ENTREPRENEURSHIP AND DIGITAL TRANSFORMATION: MANAGING DISRUPTIVE INNOVATION IN A CHANGING ENVIRONMENT

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ENTREPRENEURSHIP AND DIGITAL TRANSFORMATION: MANAGING DISRUPTIVE INNOVATION IN A CHANGING ENVIRONMENT

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EDITORIAL
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Editorial: Entrepreneurship and Digital Transformation: Managing Disruptive Innovation in a Changing Environment

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Editorial on the Research Topic

Entrepreneurship and Digital Transformation: Managing Disruptive Innovation in a Changing Environment

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The advent of digital technologies and the current environmental turbulence is fundamentally changing the way firms compete, eroding firm's boundaries and transforming value creation processes (Jonsson et al., 2018). The digital transformation invokes visions, ranging from the disruption of entire industries to the rethinking of its fundamental business model or its place in the value chain. This digital transformation encompasses the process of using digital technologies to create new business processes, new entrepreneurial activities, or modify the existing ones, culture and customer experiences to meet changing business and market requirements (Ransbotham et al., 2016).

There is no doubt that digital technologies have the potential to foster disruptive innovation and disruptive entrepreneurial activity in a wide range of sectors, both in manufacturing and services, as well as in commercial, educational and social domains (Christensen et al., 2006). In spite of the current relevance of disruptive innovation in academic and business circles, a better understanding of the phenomenon, which help firms to successfully innovate, is needed.

In this regard, the current Research Topic encompass a body of work including contributions from a total of 50 authors of different universities from 11 countries. Therefore, we can affirm it has a global character, collecting research works from three different continents: Europe (Germany, Italy, Lithuania, Romania, Slovenia, Spain, UK); Asia (China, Pakistan, Singapore) and Oceania (Australia). This collection is composed by 14 original research papers, examining three main topics: (1) *analysis of entrepreneurship and entrepreneurial education*; (2) *digital transformation and digital technologies* (including *Social Media tools*); and (3) *disruptive innovation and disruptive impact of Covid-19*. In next paragraphs, we describe briefly the different studies, grouped in the aforementioned thematic blocks.

First, different authors explored the topic of *entrepreneurship and entrepreneurial education*. In this vein, Junaid et al. examined the impact of informal institutions in promoting entrepreneurial activities. Examining data from 56 countries, results confirm how institutional antecedents combine distinctly for men's and women's entrepreneurship and this combination varies in countries with different stages of economic development. Kumpikaité-Valiunienė et al. focused its analysis in the figure of "expat-preneurs," examining the main factors that lead expatriates to develop entrepreneurial activities in foreign countries. Findings display the main demographic characteristics and motivation of expat-preneurs in a Lithuanian context. Additionally, several papers focused in the phenomenon of entrepreneurial education, provident relevant guidance and practical implications for institutions. For example, Ma et al. drawing on Fuzzy-DEMATEL and ISM methods developed a hierarchical framework for the application of big data technology in entrepreneurship education, which can be helpful for managers to organize educational activities from a macro perspective. Pérez-Fernández et al. empirically examined the role that social and psychological factors play in fostering entrepreneurial activities. Focusing on a sample of higher education students in Spain, results confirm the impact of online and face-to-face social networks, as well as positive dispositional affectivity on students' entrepreneurial intention. Finally, Martínez-Martínez and Ventura quantitatively examined the key role of entrepreneurial competences among students, providing a useful classification of entrepreneurial profiles. Findings highlight the relevance of networking and professional social skills, community engagement, or perseverance of effort, and offer interesting implications for universities, to foster entrepreneurial education.

Second, considering the current relevance of *digital transformation and digital technologies*, several papers of the Research Topic examined the issue. From a theoretical perspective, Vaska et al. conducted a structured review of the literature analyzing the development of the digital transformation field, and exploring the impact of digital technologies on business model innovation. Results describe the state of this emerging research field and provide interesting avenues for future research. From a more practical perspective, to explore the process of firms' adoption of digital strategies, Aramburu et al. empirically examined how SMEs develop digitalization processes, and the main capabilities involved. Findings confirm that digital mindset, digital mindset and empowered employees are key factors to develop a digitally enabled growth strategy. In the same vein, Roblek et al. explored the impact of digital transformation on manufacturing SMEs, and highlight key success factors to conduct disruptive innovations, offering relevant implications for practitioners.

Other articles particularly focused on the *analysis of Social Media tools*, as they are considered key techonologies enabling business transformation and digitalization (Aral et al., 2013), which have disrupted entire industries. In this vein, Popescul et al. theoretically examined the success factors of Social Media-based crowdfunding campaigns for start-up projects, and highlight the main determinants of investors decisions, providing practical implications for platforms' managers. Drawing on the current relevance of Social Media use and electronic word-of-mouth (eWOM) for firms, Sánchez-González and González-Fernández empirically examined the antecedents of eWOM in the hotel industry. Findings empirically display the variables that promote customer participation in Social Media communication processes and offer strategic recommendations for hotel managers. Additionally, Rodríguez-Gómez et al. explored the phenomenon of Social Media use as relevant learning tool, and empirically observed how the use of methods based on Web 2.0 and Social media tools are useful to teach ethics and Corporate Social Responsibility to undergraduate students.

Finally, focusing on disruptive innovations, we should highlight that, during the process of production of the current Research Topic (2020), an unexpected phenomenon, as was the irruption of Covid-19 pandemic, caused a global disruption, that affected and transformed all aspects of our daily life. Some papers of the issue addressed the phenomenon, examining the disruptive impact of Covid-19 in aspects such as university education or in the transformation of workplaces, with the emergence of teleworking. For example, García-Morales et al. examined the digital transformation of higher education after Covid-19 disruption, describing main barriers and challenges that universities found during this transformative process and highlighting also main technologies and methodologies used to evolve to online teaching in an extremely short time. Likar and Trcek applied a novel method of innovation management techniques to examine evolving challenges that arise in the transformation of higher education processes, offering interesting implications to improve distance learning processes. Considering that the arrival of Covid-19 dramatically accelerates firms' digitalization trends, Trenerry et al. identified the main categories of factors that are essential to enable an effective digital transformation of workplaces in the current scenario.

In sum, based in all the above we can affirm that this Research Topic conforms an eclectic and integrative work, empirically addressing different sectors, from education to hospitality, and examining key concepts like business model innovation, Human Resources Management, entrepreneurial education, and Social Media use. The papers included in this collection clearly contribute to extend literature in fields such as entrepreneurship; digitalization, digital transformation, and technologies and disruptive innovation. Given the fact that pandemic situation impacted on the middle of this special issue, we also included in the Research diverse studies related to the irruption of Covid-19, and its disruptive effect in different areas.

In conclusion, the current Research Topic includes 14 research papers examined the mentioned topics form different perspectives, and providing interesting theoretical and practical insights to reserarchers and practitioners working in the fields of entrepreneurship and digital transformation. Taking into account the diversity and breadth of the topics analyzed, we are aware that the current work does not embrace all the different perspective

and facets of the topics. Therefore, we suggest that more research efforts should be directed to digital environment and the dynamic and connective tools in strategy management (Ransbotham et al., 2016), so that organizations may gain valuable knowledge to drive innovation processes and firm performance. Moreover, different research approaches, such as meta-analysis, multi-case study, comparative international entrepreneurship, and mix-method research, are also recommended so as to cast light on entrepreneurship and its impacts on education and society.

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All authors equally contributed to the manuscript and approved the submitted version.

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ORIGINAL RESEARCH
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The Configurations of Informal Institutions to Promote Men's and Women's Entrepreneurial Activities

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While previous studies have examined the impact of informal institutions to determine entrepreneurial activities, this paper explores the different configurational paths of informal institutions to promote men's and women's entrepreneurial activities across factor-driven and efficiency-driven economies. We collected data from the Global Entrepreneurship Monitor for 56 countries for the years 2008–2013 and employed fuzzy-set qualitative comparative analysis to conduct the empirical analysis. The results confirm that a single antecedent condition is unable to produce an outcome while combination of different conditions can produce an outcome. We find that cultural-cognitive institutional antecedents in combination with social-normative antecedents create configurations of conditions that lead to the higher levels of men's and women's entrepreneurial activities in factor-driven and efficiency-driven economies. Moreover, this study shows that these causal conditions configure differently to promote men's and women's entrepreneurial activities in factor-driven and efficiency-driven nations. This paper may create awareness in potential entrepreneurs regarding the specific sets of institutional antecedents that can increase the emergence of entrepreneurship in different economic clusters. We show that institutional antecedents which are essential to promote entrepreneurship combine distinctly for men's and women's entrepreneurship and this combination varies in different stages of economic development.

Keywords: informal institutions, male and female entrepreneurial activities, factor-driven economies, efficiency-driven economies, fuzzy-set qualitative comparative analysis

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INTRODUCTION

Women's entrepreneurial activities have increased significantly across countries, however the proportion of women's rate of entrepreneurial activities varies considerably compared to men's entrepreneurial activities. Kelley et al. (2012) indicate that women entrepreneurs in Pakistan represent only 1% of the total entrepreneurial population while in Zambia women's engagement in entrepreneurship is 40%. The Global Entrepreneurship Monitor (2017) report states that the number of male entrepreneurs in Portugal represents 10.7% of the adult working age

population while only 6.1% are female entrepreneurs. Baughn et al. (2006) argue that informal institutions may promote or restrict women's participation in entrepreneurial activities. Since some countries associate women's roles with household activities, while others encourage women to participate in economic activities. The role and status of women are largely contradictory to entrepreneurship in traditional and patriarchal societies of many countries, as societies associate entrepreneurship with males, and depict distinct and contradictory views regarding women's rights to participate in economic activities (Roomi et al., 2018). However, women's rate of entrepreneurial activities increases if countries admire and reward them to create entrepreneurial values for society (Yousafzai et al., 2015). Thus, institutional heterogeneity demonstrates diverse impacts on men's and women's entrepreneurial activities.

Scott (1995) distinguishes informal institutions into cultural-cognitive and social-normative dimensions of institutions. Cultural-cognitive dimension of an institution appears to be a significant predictor of men's and women's entrepreneurial activity, as it forms the individuals interpretations and beliefs regarding entrepreneurship (Scott, 1995). Regarding entrepreneurship, it refers to the individuals' perception of skills, knowledge and experience as well as self-confidence and social capital to create a venture (Valdez and Richardson, 2013). Individuals use cognitive abilities to assemble previously unconnected information that helps them to determine and analyze new products or services, and collect necessary resources to create a new venture (Mitchell et al., 2000). Strong cognitive abilities assist entrepreneurs to undertake feasibility analyses successfully, develop business plans and attract financial capital to establish a new business and grow an existing business (Estrin et al., 2006). While cultural-cognitive institutions reflect the individuals' cognitive abilities, social-normative institutions are the uncodified values (what is preferable) and norms (how things to be done in line with those values) that are retained by individuals, influencing both the desirability of entrepreneurial activities and entrepreneurship as a career choice (Valdez and Richardson, 2013). In the context of entrepreneurship, social-normative institutions refer to the degree of legitimacy, respect and admiration that are associated with entrepreneurial activities (Baughn et al., 2006). Accordingly, supportive norms are linked with the perception of starting a new business, and determine entrepreneurship as a desirable career choice. Institutional environment that supports and encourages new venture creation generally considers entrepreneurial activities positively and views entrepreneurs as innovators that are essential for economic growth (Danis et al., 2011).

Previous studies have investigated the role of either culture-cognitive or social-normative institutional antecedents in determining men's and women's rates of entrepreneurial activities (De Clercq et al., 2010; Koellinger et al., 2013; de la Cruz Sánchez-Escobedo et al., 2014; Gupta and Mirchandani, 2018; Roomi et al., 2018; Santos et al., 2018a). The findings of these studies are inconsistent to promote the rate of men's and women's entrepreneurial activities. This might be attributed to the focus of researchers on either set of cultural-cognitive or social-normative institutional antecedents driving men's and women's entrepreneurial activities. However, limited attention has been paid to explore the combinatory effects of both cultural-cognitive and social-normative institutional antecedents to promote men's and women's entrepreneurial activities. The examination of former and latter institutional antecedents in isolation is unfortunate as it does not considers the integrative and interdependent effects of the institutional context that promote men's and women's rate of entrepreneurial activities. This gap in literature is leaving open need to incorporate the configurations of cultural-cognitive and social-normative institutional antecedents to explore the simultaneous interdependencies of the former and latter to start a new business. This may provide a greater understanding how cultural-cognitive and social-normative institutional antecedents combine, complement and substitute each other to promote entrepreneurial activities. It may offer deeper insight how the combinations of different institutional antecedents stimulate men's and women's entrepreneurial activities.

Drawing up on Scott (1995) institutional pillars of informal institutions and employing fuzzy-set qualitative comparative analysis (fsQCA) we investigate the combinatory effects of informal institutional antecedents to promote men's and women's rate of entrepreneurial activities in different stages of economic development. The empirical counterpart of this study is based upon the data from the Global Entrepreneurship Monitor (GEM) for 56 countries for the years 2008–2013. Economic development can be classified into three stages: (1) the factor-driven stage; (2) the efficiency-driven stage; and (3) the innovation-driven stage (Porter et al., 2002). Factor-driven and efficiency-driven economies comprise of developing countries while innovation-driven stage includes the most developed countries. The regulatory institutions in developing economies are not congruent with the norms, values and beliefs necessary for entrepreneurship, therefore the emergence of entrepreneurial activities are more likely to occur within the limits of informal institutions (Webb et al., 2014) Thus, *we seek to explore how different combinations of cultural-cognitive and social-normative institutional antecedents promote men's and women's rates of entrepreneurial activities in factor-driven and efficiency-driven economies*? *Whether these combinations differ amongst men's and women's entrepreneurial activities in factor-driven and efficiency-driven economies?*

This study is structured as follows: Section "Institutional Antecedents and Men's and Women's Entrepreneurial Activities" presents the literature review on the effects of informal institutions on entrepreneurship. Section "Materials and Methods" discusses the methodology while section "Results and Analysis" provides the results and analysis. Subsequently, discussion and conclusions are made in section "Discussion."

INSTITUTIONAL ANTECEDENTS AND MEN'S AND WOMEN'S ENTREPRENEURIAL ACTIVITIES

Institutional environment consists of rules, regulations and social norms and cognitive structures (Scott, 1995) that set

the framework to proceed transactions in the market by defining the rules of the game (North, 1990). Institutional environment is considered as structures- starting from rules and regulations to culture, custom and traditions that are operating in a society (Szyliowicz and Galvin, 2010) and largely shape the economic activities. Baumol (1990) argue that entrepreneurial activities are significantly influenced by both formal (rules and regulations) and informal (culture and social norms) institutions. Valdez and Richardson (2013) indicate that informal institutions including cultural-cognitive and social-normative are more likely to promote entrepreneurial activities in comparison to formal institutions. This suggests that cultural values, beliefs and social norms descriptive power in explaining entrepreneurship is higher than rules and regulations. Stephan et al. (2015) argue that cultural values and societal expectations are considered appropriate actions which are based upon dominant and prevalent norms in a given culture or society that foster entrepreneurship. These values and norms establish the ground rules through which members in a society behave (Muralidharan and Pathak, 2017).

Entrepreneurship occurs in a cultural context, thereby appropriate understanding of informal institutions is essential to foster entrepreneurial activities (Williams and McGuire, 2010). Informal institutions determine how societies inculcate values, encourage entrepreneurs and create a cultural milieu that foster entrepreneurship (Puffer et al., 2010). Without proper understanding of informal institutions, institutional reforms introduced by policymakers may have limited impact on overall entrepreneurial activities (Williams and Vorley, 2015). Moreover, informal institutions create individuals' perceptions, assumptions and judgment of the self, others and their environment that become institutionally embedded and transformed into a social norm of behavior which is difficult to change (Dheer, 2017). Subjective perception of individuals motivates them to identify that an entrepreneurial opportunity exists and can be exploited to gain desirable outcomes, thereby forming the basis of venture creation (Foss et al., 2008). Van Gelderen et al. (2015) argue that entrepreneurial attitudes, motivations and actions are the reflection of the extent to which individuals consider that exploiting an entrepreneurial opportunity and starting a new business are desirable and appropriate. Consequently, institutional apparatus and their effects on entrepreneurial activities widely depend on the cultural framework of the society (De Clercq et al., 2014).

Institutional heterogeneity may explain the different rate of entrepreneurial activities across developed and developing nations. It may provide help in understanding the form and structure of institutional factors that are more or less conducive to the creation of new venture for male and female entrepreneurs. Prior research examines the impact of informal institutions on venture creation (Langowitz and Minniti, 2007), however their influence varies for men's and women's entrepreneurs, as both genders socialize differently (DeTienne and Chandler, 2007). Klyver and Grant (2010) indicate that female entrepreneurs are less likely to engage in entrepreneurship compared to male entrepreneurs, as they are less familiar with other entrepreneurs and lack resource providers as well as role models. Women entrepreneurs are more likely to start a necessity-based businesses with less education, limited entrepreneurial skills and experience and are less likely to participate in professional networks than their male counterparts (Hallward-Driemeier, 2013). Moreover, women are less confident about their abilities which further amplifies the adverse impact of their limited skills on entrepreneurship. Consequently, women tend to enter in low-productivity entrepreneurial activities which occur in the informal sector of the economy and concentrate less on high-productivity sectors (Brixiová and Kangoye, 2020). These women are generally less educated and have less capital, and cultural reasons may force them toward necessity-based entrepreneurship which means that fear of failure and good career choice are less important factors in starting a business (Junaid et al., 2019).

Prior studies indicate that the likelihood of pursuing an entrepreneurial career varies between males and females, and that entrepreneurship is widely considered as a male-dominated endeavor (Hughes et al., 2012). A woman's decision to start a business is influenced by the societal attitudes of an economy (Ahl, 2006). Baughn et al. (2006) indicate that the degree of legitimacy, respect and admiration of women's engagement in entrepreneurship increase the women's participation in entrepreneurial activities. Besides normative support, women are also required to negotiate gender roles within society and households to justify their engagement in economic activities (Roomi et al., 2018). The influence of societal attitudes is external, but it exerts substantial impact on the cognitive abilities of an individual (DiMaggio, 1997), as it forms the schemas and beliefs that motivate individuals to perform specific activities and prefer certain activities over others (March and Olsen, 2010). Considering gender-based tendencies regarding entrepreneurship, Croson and Gneezy (2009) argue that, in contrast to their male counterpart, women's behavior is susceptible to the attributes of the socio-cultural environment. In spite of their importance, our knowledge of how these attributes of socio-cultural environment foster or restrict women's engagement in economic activities is far from satisfactory (Hughes et al., 2012).

A Configurational Approach to Promote Entrepreneurial Activity

This section proposes hypotheses which are related to the literature on cultural-cognitive and social-normative institutions and entrepreneurship. Subsequently, a configurational model is put forward to answer the research questions in this study.

Cultural-Cognitive Institutions

Cultural-cognitive dimension of an institution reflects the collective understanding of social reality that provides basis for the framing of meaning within a society (Valdez and Richardson, 2013), thereby it develops individuals' interpretations and beliefs (Scott, 1995; DiMaggio, 1997). Moreover, it shapes individuals attitudes, preferences, motivations and experiences (Yang et al., 2012). Consequently, cultural-cognitive institution not only illustrates significant impact on behaviors of people but also influences the emergence of economic activities in a

society (Tsui et al., 2007) including individuals' engagement in entrepreneurial activities (Liñán and Fayolle, 2015).

Cultural-cognitive dimension of an institution generally reflects the shared social knowledge and individuals' cognitive abilities that they use to understand entrepreneurship (Kostova and Roth, 2002). These cognitive abilities highlight the individuals' resources such as the entrepreneurs' social capital (Shu et al., 2018), prior knowledge and entrepreneurial experience (Frederiks et al., 2019) and fear of failure that may influence entrepreneurial activities. Individuals' perception of skills and knowledge legitimize the entrepreneurial opportunities for the creation of new venture (Busenitz et al., 2000). Likewise, Saeed et al. (2015) suggest that entrepreneurs' perception of their ability and confidence toward recognizing an entrepreneurial opportunity increase the occurrence of entrepreneurial activities. Accordingly, entrepreneurs with greater experience and knowledge are more likely to become successful in establishing a new business (Staniewski, 2016). In addition, social networking is also identified as an important determinant of recognition and exploitation of entrepreneurial opportunities (Stenholm et al., 2013). Yousafzai et al. (2015) show how individuals' social networking and role models as well as their capability to take part in entrepreneurial activity influence entrepreneurship in comparison to regulatory institutions.

Research confirms that women entrepreneurs are also required to develop entrepreneurial skills, knowledge and experience, as well as networking ties to become a successful entrepreneur. Brush et al. (2014) argue that if women develop entrepreneurial skills they can start businesses with greater confidence. Santos et al. (2018b) posit that women may associate in a network of existing entrepreneurs to enhance their level of skills, knowledge and confidence. Since networking provides access to the valuable information, confidence and skills to deal with customers as well as experiences and advice to increase the level of entrepreneurial activities (Santos et al., 2018b). Welsh et al. (2018) indicate that women entrepreneurs tend to be more determined in their entrepreneurial endeavors and risk taking, if they receive support from network ties. Shahriar (2018) postulates that women entrepreneurs are more likely to take risks in a matrilineal society, where women's propensity to start a business might be higher than men.

Hypothesis 1: The different combinations of cultural-cognitive institutional antecedents promote men's and women's entrepreneurial activities.

Social-Normative Institutions

Social-normative institutions reflect the collective "sense making" of a society, and demonstrate what is socially favorable and acceptable (Valdez and Richardson, 2013). Normative dimension of an institution deals with the extent of stabilization through the imposition and internalization of societal norms across organizations, individuals and society (Scott, 1995). Following, societal norms individuals aim to act in order to be accepted socially (Scott, 1995). Krueger et al. (2000) argue that social desirability of entrepreneurship as a career choice positively influence the entrepreneurial intentions of potential entrepreneurs, and results in the creation of new venture.

Social-normative institutions reflect values and norms that influence both the social desirability and career options of entrepreneurship. Asante and Affum-Osei (2019) suggest that entrepreneurship as a career option can only be beneficial in the presence of entrepreneurial opportunities, since without business opportunities the existence of entrepreneurship is not possible. Entrepreneurial opportunities arise from the environment in which entrepreneurs operate, and identifying these opportunities may create positive circumstances that lead to the creation of new businesses. Baughn et al. (2006) indicate that in order to seize an existing entrepreneurial opportunity, individuals must be encouraged to engage in entrepreneurial activities. In this respect, media attention tend to have a positive impact on societal norms of a country, as it provides basis to construct the individuals' understanding that starting a new business is suitable career option (Levie et al., 2010).

The social acceptability of entrepreneurship as a career option for women varies across nations; some societies facilitate or promote women to take part in economic activities while others associate women's roles with household responsibilities (Achtenhagen and Welter, 2003). Domestic obligations fall disproportionately to women, even if they work longer hours in comparison to their male spouses. Therefore, women may face added complexity to embrace entrepreneurship as a career choice. However, women who are willing to pursue entrepreneurship as a career option may distinguish themselves from others by the set of cognitive abilities. Consequently, potential female entrepreneurs could become more alert to the existing business opportunities. In this regard, previous knowledge is a major factor which influences the perception of business opportunities and exert significant influence on entrepreneurship. Individuals holding knowledge of available opportunities in the market are more likely to exploit these business opportunities in contrast to those who do not have the knowledge. Moreover, Dahal (2013) poses that media stories about successful entrepreneurs positively influence people's attitudes to business creation, since mass media is recognized as a major factor that reinforces a wide range of attitudes and peoples' behaviors. Thus, media attention is also expected to exert positive influence on the national rate of women's entrepreneurial activities.

Hypothesis 2: The different combinations of social-normative institutional antecedents promote men's and women's entrepreneurial activities.

Based on developed hypotheses, we present the following configuration model in **Figure 1**.

MATERIALS AND METHODS

Data and Sample

This study considers 6 years of data spanning through 2008–2013 from the GEM Adult population survey. GEM is one of the largest surveys on entrepreneurship and is conducted in more than 100 nations throughout the world. It performs a random national survey of at least 2000 adults of working age population between the age of 18 and 64 years in each country (Reynolds

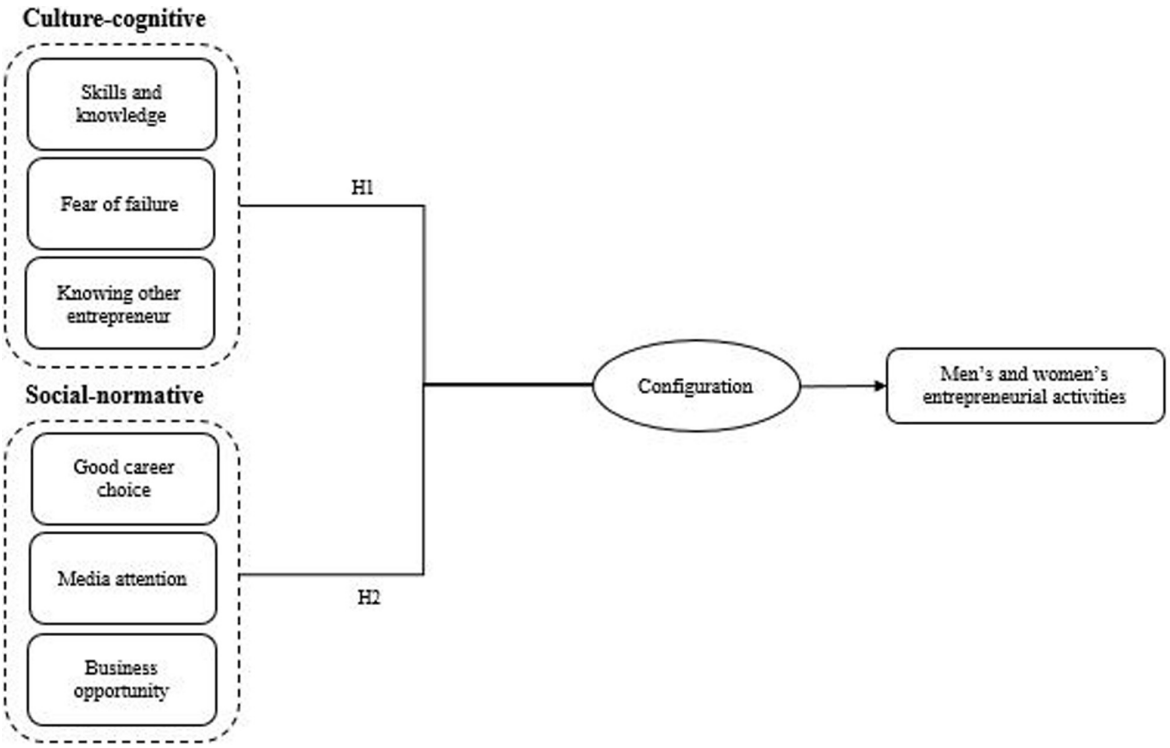

FIGURE 1 | A configurational model.

et al., 2005). Data collection is conducted by national academic teams, and the global team supervises the entire process to ensure the quality of the data. Subsequently, GEM harmonizes data to enable cross-country comparison. Our sample considers 56 countries: 25 factor-driven and 31 efficiency-driven countries which are listed in **Table 1**. Porter et al. (2002) classify countries into three stages of economic development. (1) Factor-driven; (2) efficiency-driven; and (3) innovation-driven. The first two stages of economic development include developing nations while third stage comprises of developed countries. Institutional asymmetry influences entrepreneurs to operate outside of formal institutions, but according to the restrictions of informal institutions in developing economies (London et al., 2014). These entrepreneurs are illegal according to the laws and regulations of formal institutions, however they seem legitimate as per prevailing norms, values and beliefs of society's informal institutions (Webb et al., 2009). Therefore, informal institutions provide greater explanatory power for variations in entrepreneurship in comparison to formal institutions in developing nations. Thus, we decided to explore the association of informal institutions and entrepreneurial activities in factor-driven and efficiency-driven economies.

TABLE 1 | Sampled countries.

Factor-driven (25)		Efficiency-driven (31)	
Algeria	Philippines	Argentina	Malaysia
Angola	Saudi Arabia	Barbados	Mexico
Bangladesh	Syria	Bosnia and Herzegovina	Panama
Bolivia	Uganda	Brazil	Peru
Egypt	Vanuatu	Chile	Poland
Ethiopia	Venezuela	China	Romania
Ghana	Vietnam	Colombia	Russia
India	Yemen	Costa Rica	South Africa
Iran	Zambia	Croatia	Thailand
Kingdom of Tonga		Ecuador	Trinidad and Tobago
Lebanon		Hungary	Tunisia
Libya		Latvia	Turkey
Malawi		Lithuania	Uruguay
Morocco		Macedonia	Jamaica
Nigeria		Dominican Republic	Guatemala
Pakistan		Serbia	

Global Entrepreneurship Monitor (2008–2013).

Measurement

Outcome Variable

In order to capture the impacts of informal institutions on both genders separately, we split our data to distinguish male and female response, but we use a same proxy to measure entrepreneurial activities for both genders. We consider men's and women's rates of entrepreneurial activities as the percentage of working age population (between the age of 18 and 64 years)

TABLE 2 | Description of variables.

Variables	Description	Source
Entrepreneurial activities	Percentage of adult age working population who are in the midst of creating a venture or operating an existing business that is less than 3.5 years old	GEM
Cultural-cognitive		GEM
Knowing other entrepreneurs	Whether potential entrepreneur knows other entrepreneurs before starting a business in last 2 years	GEM
Skills and knowledge	It shows the entrepreneurs skills, knowledge and experience to start a new business	GEM
Fear of failure	It presents the fear of failure the prevents the creation of new venture	GEM
Social-normative		
Good career choice	It demonstrates that individuals consider entrepreneurship is a feasible career choice in their country	GEM
Media attention	People often see stories of successful business in public media	GEM
Business opportunity	Individuals have business opportunities that are worth pursuing in the area where they live	GEM

GEM, Global Entrepreneurship Monitor.

who are in the process of starting a business i.e., a business that is less than 42 months old.

Causal Conditions of Informal Institutions

Cultural-cognitive

We distinguish male and female responses in order to ascertain the influence of cultural-cognitive dimension separately on men's and women's entrepreneurial activities. Cultural-cognitive institutions are constructed using three items from GEM. The first item shows the participants knowledge, experience and skills to start a new business. It can also be viewed as self-confidence in the entrepreneurial domain. It highlights the entrepreneurs' sense of handling the uncertainty, considering their resources and background within the national context (Valdez and Richardson, 2013). The second item demonstrates the fear of failure that prevents the creation of a new venture. It can be viewed as risk aversion. The third item illustrates whether a potential entrepreneur knows other entrepreneurs before starting a business.

Social-normative

As we mentioned earlier, we also discriminate male and female responses while measuring social-normative dimensions of institutions to estimate how these dimensions influence men's and women's entrepreneurship. Social-normative institutions are measured by the three items including good career choice, media attention and business opportunities from GEM. The first item shows that most people consider starting a new business is a desirable career option in their country. The second item shows that people often see stories about successful businesses in public media. The third item demonstrates that individuals have good business opportunities in the area where they live preceding the survey in last 6 months. The description of all variables is available in **Table 2**.

Descriptive Statistics and Correlation Matrixes

Tables 3, **4** present the descriptive statistics and describe the differences between men's and women's entrepreneurial activities as well as culture-cognitive and social-normative institutions in factor-driven and efficiency-driven economies respectively. In order to investigate the problem of multicollinearity we calculate variance of inflation factor (VIF) and find that the VIF values of all variables are well below the recommended level of 10 (Kleinbaum et al., 1988; Estrin et al., 2013). Thus, multicollinearity is not a problem in this study.

Tables 5, **6** represent the correlation matrix of factor-driven economies, we find that women's entrepreneurial activities have strong positive relationships with knowing other entrepreneurs, skills and knowledge, media attention and business opportunities while women's entrepreneurship illustrates significant and

TABLE 3 | Descriptive statistics factor-driven economies.

	Mean	SD		Mean	SD
Men's Entrepreneurial activity	0.224	0.107	Women's Entrepreneurial activity	0.171	0.122
Knowing other entrepreneur	0.575	0.127	Knowing other entrepreneurs	0.465	0.162
Skill and Knowledge	0.718	0.142	Skill and knowledge	0.623	0.149
Fear of failure	0.322	0.146	Fear of failure	0.353	0.117
Good career choice	0.773	0.102	Good career choice	0.773	0.109
Media attention	0.704	0.149	Media attention	0.715	0.137
Business opportunity	0.593	0.142	Business opportunity	0.542	0.158

TABLE 4 | Descriptive statistics efficiency-driven economies.

	Mean	SD		Mean	SD
Men's Entrepreneurial activity	0.152	0.059	Women's Entrepreneurial activity	0.105	0.663
Knowing other entrepreneur	0.466	0.096	Knowing other entrepreneurs	0.389	0.104
Skill and Knowledge	0.613	0.132	Skill and knowledge	0.507	0.145
Fear of failure	0.338	0.090	Fear of failure	0.401	0.109
Good career choice	0.700	0.110	Good career choice	0.705	0.110
Media attention	0.613	0.129	Media attention	0.630	0.121
Business opportunity	0.441	0.135	Business opportunity	0.405	0.135

TABLE 5 | Correlation among the variables factor-driven economies.

	1	2	3	4	5	6	7
Women's entrepreneurial activities	1						
Knowing other entrepreneurs	0.637***	1					
Skills and knowledge	0.724***	0.503***	1				
Fear of failure	−0.341**	−0.181	−0.388**	1			
Good career choice	0.097	−0.221	0.369**	0.023	1		
Media attention	0.263*	0.193	0.460***	−0.102	0.526***	1	
Business opportunity	0.584***	0.513***	0.612***	−0.035	0.500***	0.550***	1

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

negative relationship with fear of failure. However, men's entrepreneurial activities have a strong positive correlation with knowing other entrepreneurs, skills and knowledge and business opportunity and a significant negative relationship with fear of failure.

In **Tables 7**, **8** show correlation matrix of efficiency-driven economies, we find strong positive correlation with knowing other entrepreneurs, skills and knowledge, good career choice, media attention, and business opportunity with both men's and women's entrepreneurial activities while fear of failure is negatively associated with men's and women's entrepreneurial activities.

FsQCA

We use fsQCA to estimate the combinatory effects of different combinations of conditions on outcome (entrepreneurial activity). In entrepreneurship research, fsQCA is becoming popular (Nikou et al., 2019), as it builds on fuzzy-sets and fuzzy-logic principles with QCA (Ragin, 2000), and its robust analytical approach permits the examination of situations in which the combinations of several different conditions can predict an outcome. Ragin (2013) suggests that fsQCA establishes the association between causal conditions and outcome in terms of sets instead of variables, and its underlying theoretical assumption considers that more than one combinations of different conditions can produce same outcome (Mas-Tur et al., 2015). FsQCA follows the idea of equifinality which suggests that numerous configurational paths can lead to a desired outcome (Fiss, 2007), and also allows that different combinations or sets of causal conditions predict the same outcome. Equifinality and asymmetric causality are two key factors that reveal the complex causal structures of small, medium and even larger samples to conduct the analysis (Silva and Goncalves, 2016).

QCA presents idea that conditions are the clusters of interconnected conditions (variables) which should be simultaneously understood as a holistic integrated pattern, offering dual benefits (Fiss, 2011). Firstly, it assumes asymmetric relationship between independent and dependent variables, such as a variable can be considered necessary but not sufficient for the occurrence of an outcome. Secondly, it measures the impact of a condition on the outcome, in case the presence or absence of another condition is considered to be important (Woodside, 2013). Consequently, conditions combine differently in order to predict an outcome (Mas-Tur et al., 2015). FsQCA presents results in the form of one or multiple configurations which reflect combinations of different causal conditions that produce an outcome. Unlike regression, fsQCA allows researchers to include/exclude a condition from analysis, and explains how multiple combinations of causal conditions collectively contribute to the outcome (Fiss, 2011). We consider fsQCA is valuable for this study as it explores how cultural-cognitive and social-normative institutional antecedents collectively promote men' and women's entrepreneurial activities.

Calibration

We transform the continuous values of datasets into fuzzy set-membership scores by calibration to produce values ranging from 0 to 1 (Ragin, 2009). Following Lewellyn and Muller-Kahle (2016) we calibrate our conditions into three different threshold levels: full non-membership, crossover point and full membership. We consider the 85th and 15th percentile of original data as fully in and fully out respectively, while median is used as a crossover point. **Tables 9–12** present the calibration of the cultural-cognitive and social-normative institutional antecedents in both factor-driven and efficiency-driven economies.

Subsequently, we compressed the data into the "Truth table" to obtain all expected configurations of antecedents and causal conditions that may promote entrepreneurial activities. The truth table identifies the antecedent or causal conditions that are necessary or sufficient to produce an outcome. Accordingly, fsQCA configurational models illustrate the different combinations of antecedents or causal conditions that are likely to promote the entrepreneurial activities.

RESULTS AND ANALYSIS

The confirmation of each hypothesis is based upon the consistency and coverage values of each configurational model that falls within the recommended range. A configurational model is only informative if its consistency and coverage values are above 0.74 and less than 0.65, respectively, which show the existence of both subset relations and sufficient conditions (Tuo et al., 2019). In addition, raw coverage values determine the empirical significance of a solution and estimate the degree of each configuration model explaining the outcome. Moreover, the unique coverage determines the proportion of a membership in the outcome or the fraction of cases that are highlighted

TABLE 6 | Correlation among the variables factor-driven economies.

	1	2	3	4	5	6	7
Men's entrepreneurial activities	1						
Knowing other entrepreneurs	0.529***	1					
Skills and knowledge	0.579***	0.503***	1				
Fear of failure	−0.272*	−0.181	−0.388**	1			
Good career choice	0.036	−0.221	0.369**	0.023	1		
Media attention	0.150	0.193	0.460***	−0.102	0.526***	1	
Business opportunity	0.478***	0.513***	0.612***	−0.035	0.500***	0.550***	1

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

TABLE 7 | Correlation among the variables efficiency-driven economies.

	1	2	3	4	5	6	7
Men's entrepreneurial activities	1						
Knowing other entrepreneurs	0.229**	1					
Skills and knowledge	0.564***	0.289***	1				
Fear of failure	−0.188*	−0.134	−0.461***	1			
Good career choice	0.448***	0.048	0.482***	−0.315***	1		
Media attention	0.388***	0.314***	0.151	−0.162	0.514***	1	
Business opportunity	0.675***	0.255**	0.616***	−0.462***	0.593***	0.464***	1

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

TABLE 8 | Correlation among the variables efficiency-driven economies.

	1	2	3	4	5	6	7
Women's entrepreneurial activities	1						
Knowing other entrepreneurs	0.302***	1					
Skills and knowledge	0.521***	0.289***	1				
Fear of failure	−0.197*	−0.134	−0.461***	1			
Good career choice	0.459***	0.0484	0.482***	−0.315***	1		
Media attention	0.507***	0.314***	0.151	−0.162	0.514***	1	
Business opportunity	0.697***	0.255**	0.616***	−0.462***	0.593***	0.464***	1

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

TABLE 9 | Calibration of all variables for the factor-driven economies for male entrepreneurial activities.

Membership	Fuzzy-set value	Knowing other entrepreneurs	Skills and knowledge	Fear of failure	Good career choice	Media attention	Business opportunity	Entrepreneurial activities
Fully in	85th percentile	0.725	0.845	0.391	0.861	0.819	0.740	0.324
Cross-over	Median	0.556	0.722	0.301	0.793	0.751	0.557	0.181
Fully out	15th percentile	0.461	0.614	0.204	0.670	0.572	0.481	0.142

TABLE 10 | Calibration of all variables for the factor-driven economies for female entrepreneurial activities.

Membership	Fuzzy-set value	Knowing other entrepreneurs	Skills and knowledge	Fear of failure	Good career choice	Media attention	Business opportunity	Entrepreneurial activities
Fully in	85th percentile	0.655	0.778	0.440	0.868	0.826	0.743	0.324
Cross-over	Median	0.443	0.652	0.360	0.796	0.733	0.550	0.156
Fully out	15th percentile	0.337	0.459	0.233	0.636	0.582	0.398	0.044

TABLE 11 | Calibration of all variables for the efficiency-driven economies for male entrepreneurial activities.

Membership	Fuzzy-set value	Knowing other entrepreneurs	Skills and knowledge	Fear of failure	Good career choice	Media attention	Business opportunity	Entrepreneurial activities
Fully in	85th percentile	0.576	0.740	0.413	0.817	0.758	0.564	0.208
Cross-over	Median	0.453	0.627	0.338	0.697	0.620	0.437	0.155
Fully out	15th percentile	0.375	0.458	0.264	0.599	0.496	0.271	0.087

TABLE 12 | Calibration of all variables for the efficiency-driven economies for female entrepreneurial activities.

Membership	Fuzzy-set value	Knowing other entrepreneurs	Skills and knowledge	Fear of failure	Good career choice	Media attention	Business opportunity	Entrepreneurial activities
Fully in	85th percentile	0.513	0.633	0.512	0.809	0.761	0.525	0.157
Cross-over	Median	0.365	0.518	0.386	0.695	0.626	0.411	0.092
Fully out	15th percentile	0.289	0.357	0.306	0.612	0.517	0.247	0.044

by a single configuration. A high coverage value demonstrates that a configurational model explains the greater amount of the entrepreneurial activities (Fiss, 2011). After considering the consistency and coverage values of each variable, it might be considered as an antecedent or a causal condition of any of the configurational model that is likely to predict an outcome.

FsQCA allows exploration of whether the given condition is necessary or sufficient to promote men's and women's entrepreneurial activities. **Tables 13**, **14** present the results for necessity and sufficient conditions for factor-driven and efficiency-driven economies respectively. Necessity conditions are always present whenever an outcome occurs, however whenever the sufficient conditions occur the outcome will be generated. We consider that a causal condition or combinations of different conditions are necessary or sufficient if they demonstrate consistency and coverage values greater than 0.90 and 0.85, respectively (Ragin, 2006). Results in **Tables 13**, **14** show that neither the presence nor the absence of any causal condition is individually necessary or sufficient to promote men's and women's entrepreneurial activities. The presence and absence of each individual causal condition is well below the threshold level to consider it as necessary or sufficient to promote men's and women's entrepreneurial activities. These findings support our framework suggesting that cultural-cognitive and social-normative institutions work in combination and substitute and complement each other in promoting men's and women's entrepreneurial activities. Thus, to explain and understand how the cultural-cognitive and social-normative institutions jointly promote men's and women's entrepreneurial activities, we employ fsQCA to identify the sufficient configurations. We present **Figures 2–4** to summarize the findings of the sufficiency analysis for each causal configuration path to promote men's and women's entrepreneurial activities in factor-driven and efficiency-driven economies respectively.

In **Tables 15**, **16**, all the configuration models show that consistency values are more than 0.74, and coverage values are less than 0.65. Thus, the antecedents that are creating configurations are sufficient to promote men's and women's entrepreneurial activities (Ragin, 2009). **Table 15** demonstrates that the findings of factor-driven economies where model 1M is the combination of knowing other entrepreneurs, skills and knowledge and business opportunity with the lack of fear of failure, good career choice and media attention. On the other hand, model 1F is the combination of knowing other entrepreneurs, skills and knowledge, good career choice and media attention with the absence of business opportunity. We notice that absence of fear of failure, good career choice and media attention with the presence of business opportunity in model 1M is functionally equivalent to the presence of fear of failure, good career choice and media attention along with the absence of business opportunity in model 1F.

Model 2M is the combination of knowing other entrepreneurs, skills and knowledge, good career choice, media attention, and business opportunity and lacks fear of failure. Model 2F

TABLE 13 | Necessity and sufficiency tests in factor-driven economies.

Conditions	Factor-driven male		Factor-driven female	
	consistency	coverage	consistency	coverage
Cultural-cognitive				
Knowing other entrepreneur	0.655	0.666	0.828	0.580
∼Knowing other entrepreneur	0.539	0.546	0.612	0.382
Skills and knowledge	0.702	0.681	0.880	0.589
∼Skills and knowledge	0.438	0.466	0.544	0.358
Fear of failure	0.509	0.509	0.663	0.430
∼Fear of failure	0.646	0.664	0.720	0.484
Social-normative				
Good career choice	0.605	0.589	0.734	0.462
∼Good career choice	0.602	0.637	0.617	0.427
Media attention	0.601	0.595	0.769	0.474
∼Media attention	0.523	0.544	0.543	0.385
Business opportunity	0.743	0.676	0.801	0.540
∼Business opportunity	0.424	0.486	0.624	0.403

∼ *Indicates the negation of the condition.*

TABLE 14 | Necessity and sufficiency tests in efficiency-driven economies.

Conditions	Efficiency-driven male		Efficiency-driven female	
	consistency	coverage	consistency	coverage
Cultural-cognitive				
Knowing other entrepreneur	0.613	0.596	0.606	0.640
~Knowing other entrepreneur	0.573	0.503	0.537	0.512
Skills and knowledge	0.752	0.703	0.734	0.745
~Skills and knowledge	0.465	0.423	0.429	0.424
Fear of failure	0.534	0.489	0.488	0.663
~Fear of failure	0.666	0.619	0.656	0.663
Social-normative				
Good career choice	0.731	0.682	0.734	0.745
~Good career choice	0.477	0.434	0.435	0.431
Media attention	0.697	0.675	0.698	0.734
~Media attention	0.497	0.437	0.461	0.441
Business opportunity	0.829	0.729	0.834	0.796
~Business opportunity	0.389	0.378	0.335	0.353

~ Indicates the negation of the condition.

is a combination of knowing other entrepreneurs, skills and knowledge, media attention and business opportunity with the absence of fear of failure and a good career choice. Remarkably, the presence of good career choice in model 2M is functionally equivalent to the absence of good career choice in model 2F.

Table 16 shows the findings of efficiency-driven economies. Model 3M suggests that skills and knowledge, good career choice, and business opportunity in combination with the absence of knowing other entrepreneurs can predict men's entrepreneurship whereas model 3F requires the combination of skills and knowledge, good career choice, media attention and business opportunity without the fear of failure.

Model 4M requires the presence of skills and knowledge and business opportunity with the lack of knowing other entrepreneurs, fear of failure and media attention. On the other hand model 4F requires the combination of knowing other entrepreneurs, skills and knowledge, fear of failure, along with media attention, and business opportunity. We find that lack of knowing other entrepreneurs, fear of failure, and media attention in model 4M are functionally substitute to the presence of knowing other entrepreneur, fear of failure and media attention in model 4F.

Model 5M requires the presence of knowing other entrepreneurs, skills and knowledge, and fear of failure along with media attention and business opportunity. Model 5F requires the presence of knowing other entrepreneurs, skills and knowledge and business opportunity with the lack of fear of failure and media attention. Model's 5M presence of fear of failure and media attention act as functionally equivalent to the absence of fear of failure and media attention in model 5F.

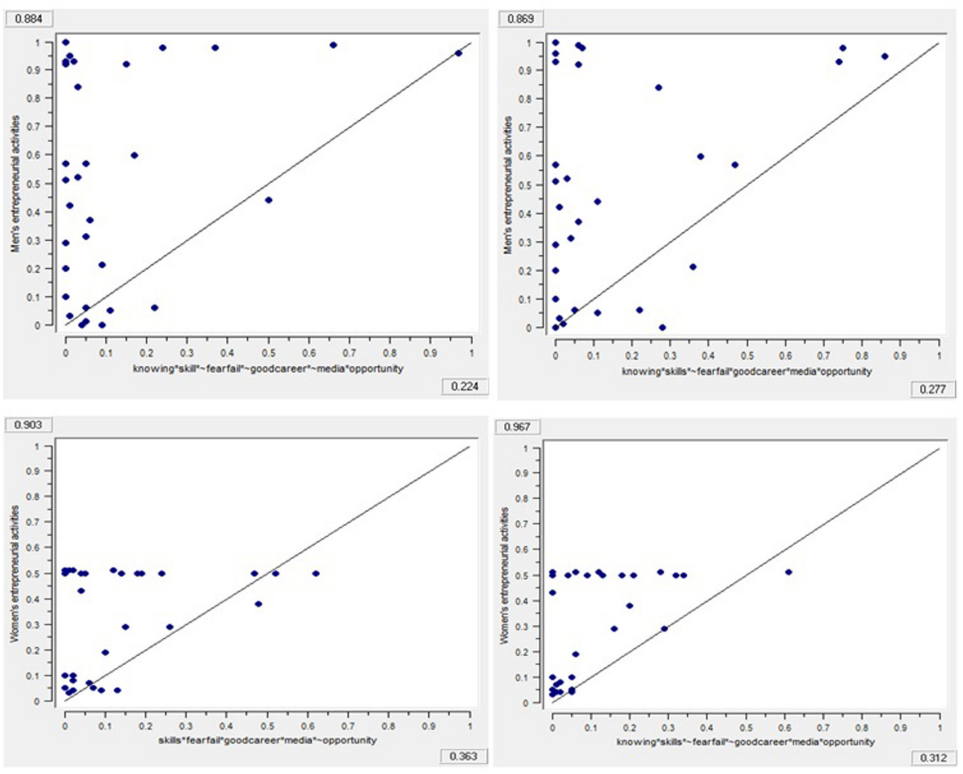

FIGURE 2 | Fuzzy outcome scatterplots associated with results in **Table 15**.

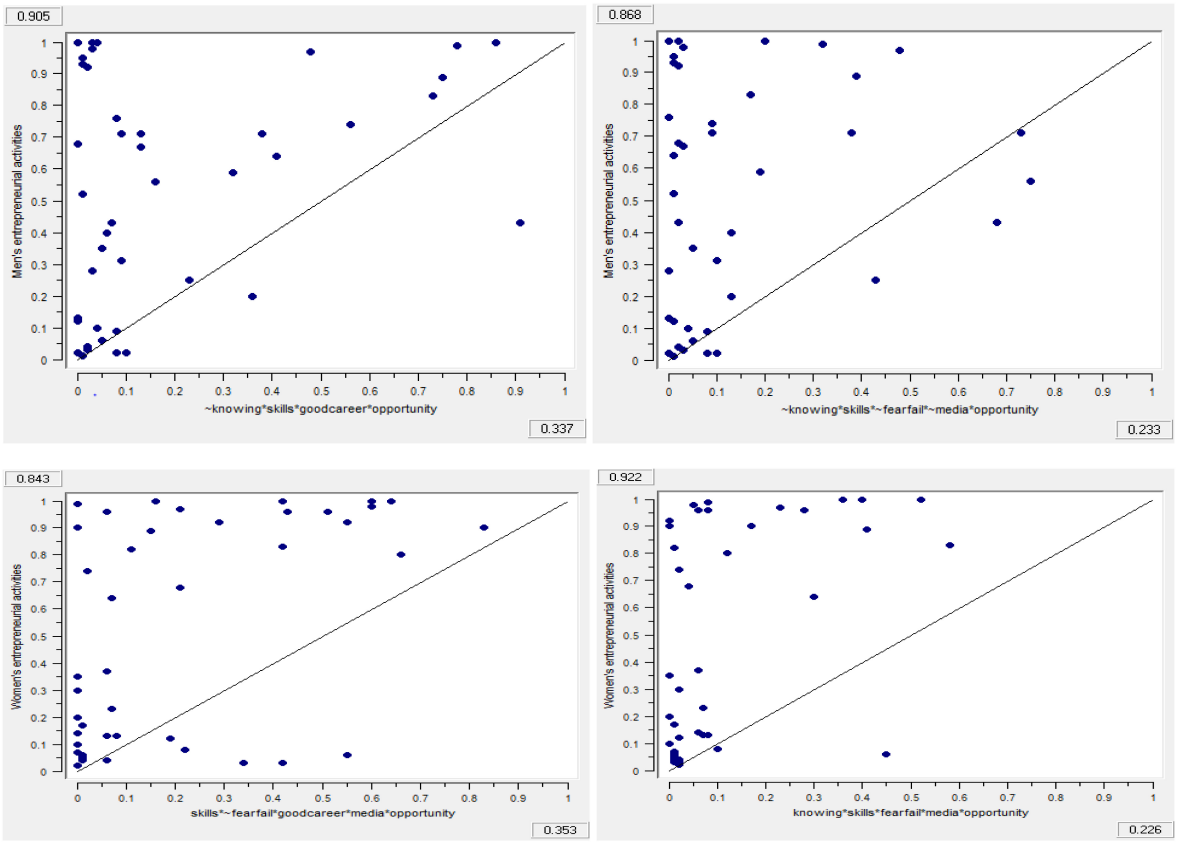

FIGURE 3 | Fuzzy outcome scatterplots associated with results in **Table 16**.

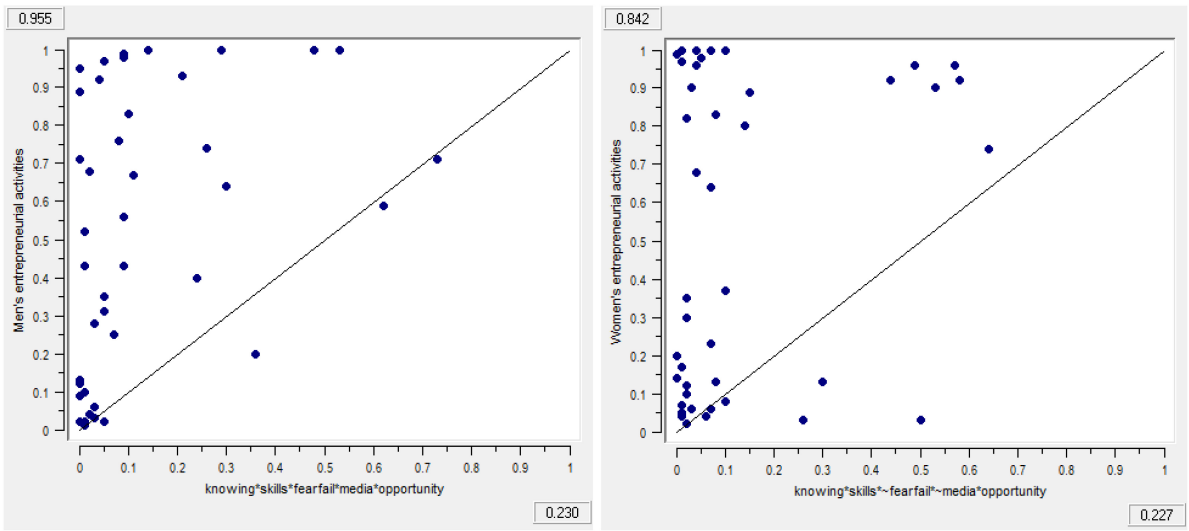

FIGURE 4 | Fuzzy outcome scatterplots associated with results in **Table 16**.

Our findings confirm the prepositions 1 and 2 asserting that cultural-cognitive and social-normative institutions may serve as an antecedent condition and jointly promote men's and women's entrepreneurial activities. The results of 1–2M and 1–2F in factor-driven economies while 3–4M and 3F and 5F in efficiency-driven economies show the different causal conditions that can

promote men's and women's entrepreneurial activities. However, models 5M and 4F in efficiency-driven economies illustrate that the same conditions can also promote men's and women's entrepreneurial activities.

DISCUSSION

In this study we explore how different combinations of both cultural-cognitive and social-normative institutions promote men's and women's entrepreneurial activities. The empirical part of this research is based upon GEM for the years of 2008–2013, and employed fsQCA to conduct the empirical analysis. The results reveal that different combinations of cultural-cognitive and social-normative institutions promote men's and women's entrepreneurial activities, and these combinations differ largely amongst male and female entrepreneurs in factor-driven and efficiency-driven economies.

Configurations of Informal Institutions in Factor-Driven Economies

Table 15 presents the results of factor-driven nations where model 1M indicates that entrepreneurs are required to develop networking as it provides novel and essential information that are likely to facilitate both the firm's risk taking behavior and problem solving as well as decision making in starting a venture (Lioukas and Voudouris, 2020). Moreover, our results suggest that it is essential for aspiring entrepreneurs to develop networking along with skills and knowledge that are substantially helpful in evaluating further business opportunities to create a venture. Experienced entrepreneurs of a business network may hold unique knowledge that may transform essential information to the nascent entrepreneurs to start a business. Makhbul and Hasun (2011) argue that being knowledgeable may support entrepreneurs to become innovative, and triggers new ideas to seize potential entrepreneurial opportunities for venture creation. Staniewski (2016) considers that individuals with a greater level of networking and entrepreneurial knowledge and skills are more likely to succeed in their entrepreneurial pursuits.

Model 2M suggests that the entrepreneurs' network improves the individuals' ability to acquire knowledge to identify and exploit new business opportunities for entrepreneurship (Song et al., 2017; Santoro et al., 2018). In addition, our findings highlight that positive societal attitudes which support entrepreneurship as a career option and present a progressive image of entrepreneurship are also required to increase the likelihood of entrepreneurial activities. In this context, the media showing successful entrepreneurs is necessary in order to motivate aspiring entrepreneurs to engage in entrepreneurship. Since potential entrepreneurs are likely to imitate the behavior of successful entrepreneurs that may reinforce entrepreneurship as a career option (Zellweger et al., 2011).

The women's entrepreneurship model 1F reveals that networking is an essential component for women entrepreneurs since it binds them in a group, and leads them to raise their voices in order to achieve their joint objectives of creating a new venture (Santos et al., 2018b). In this way they can identify and exploit business opportunities which are created by segmented communication and fit well according to the feminine taste (Santos et al., 2018b). We also find that in factor-driven economies many cultural reasons may force women to engage in necessity-based entrepreneurship. These women are less educated, lack formal financing as well as fear of failure and career choices are not relevant factors for them to pursue entrepreneurship (Junaid et al., 2019). In this respect, media representation of female entrepreneurs may positively influence the success of women entrepreneurs (Ruth Eikhof, 2013).

Model 2F suggests that women entrepreneurs should be encouraged to extend their level of networking as it may

TABLE 15 | Configurations for entrepreneurial activities in factor-driven economies.

Conditions	Factor-driven			
	Male		Female	
	1	2	1	2
Cultural-cognitive				
knowing other entrepreneur	•	•	•	•
Skills and knowledge	•	•		•
Fear of failure	⊗	⊗	•	⊗
Social-normative				
Good career choice	⊗	•	•	⊗
Media attention	⊗	•	•	•
Business opportunity	•	•	⊗	•
Consistency				
Raw coverage	0.223	0.277	0.362	0.311
Unique coverage	0.145	0.199	0.198	0.154
Overall solution consistency	0.884	0.868	0.902	0.966
Overall solution coverage:	0.472		0.562	

•*Indicates presence,* ⊗ *indicates absence.*

TABLE 16 | Configurations for entrepreneurial activities in efficiency-driven economies.

Conditions	Efficiency-driven					
	Male			Female		
	3	4	5	3	4	5
Cultural-cognitive						
knowing other entrepreneur	⊗	⊗	•		•	•
Skills and knowledge	•	•	•	•	•	•
Fear of failure		⊗	•	⊗	•	⊗
Social-normative						
Good career choice	•			•		
Media attention		⊗	•	•	•	⊗
Business opportunity	•	•	•	•	•	•
Consistency						
Raw coverage	0.337	0.232	0.229	0.352	0.225	0.226
Unique coverage	0.088	0.044	0.071	0.093	0.020	0.006
Overall solution consistency	0.904	0.868	0.954	0.842	0.922	0.841
Overall solution coverage:	0.664			0.635		

•*Indicates presence,* ⊗ *indicates absence.*

significantly help them to share knowledge, experience and contacts, which promote innovation and creativity as well as lead to the emergence of entrepreneurship (Santos et al., 2018a). In addition, network members may teach different skills to aspiring entrepreneurs to cope with a difficult situation (Soetanto, 2017), and provide resources and opportunities that would otherwise be unachievable (Gupta et al., 2014). We further augment the findings of Jung et al. (2018) that media role is essential to highlight the critical role of women's entrepreneurship to transform the socio-cultural environment and enhance the process of marketization in an economy. The former shapes the societal norms to accept entrepreneurship as a career option for females and latter facilitates the transformation of socialist economy into capitalist that may increase the emergence of entrepreneurial activities.

Configurations of Informal Institutions in Efficiency-Driven Economies

Table 16 presents the findings of efficiency-driven economies where model 3M indicates that entrepreneurs are required to acquire necessary entrepreneurial skills and knowledge to develop new business models which may create new business opportunities for venture creation (Sousa and Rocha, 2019). Hence, the ability of individuals to identify new business opportunity is the main factor of choosing entrepreneurship as a career choice (Asante and Affum-Osei, 2019). Without the existence of business opportunity, the pursuance of entrepreneurship is not possible (Shane, 2000).

Model 4M shows that skills and knowledge in combination with business opportunity are likely to facilitate entrepreneurship. Entrepreneurial skills are likely to mediate the relationship between opportunity recognition and entrepreneurial orientation (Santos et al., 2018a). In this respect, entrepreneurs' prior knowledge and skills are likely to impact the extent of an opportunity identification, as they influence the entrepreneurs' feelings and judgment in making decision to start a business (Shane, 2000). Thus, we realize that entrepreneurs' skills, knowledge and experience may facilitate the identification of an entrepreneurial opportunity to start a venture.

Model 5M shows that individuals who know existing entrepreneurs are more likely to start a new venture since networking reduces the transaction cost, enhances mobility, lowers social exclusion and makes it easier for potential entrepreneurs to access new opportunities as well as resources. In this context Dimov (2010) and Shu et al. (2018) argue that entrepreneurs' previous knowledge and skills as well as network ties facilitate the recognition of an entrepreneurial opportunity. Moreover, this model reveals if entrepreneurs' levels of aspirations are high enough or they consider that entrepreneurship may provide greater earning opportunities in comparison to the foregone employment, then fear of failure attracts more investment in the venture creation (Morgan and Sisak, 2016). Meanwhile, our result reveals that mass media coverage is required to influence the wide range of attitudes and behaviors of peoples to change the individuals' thoughts, values and sentiments that entrepreneurship is worth pursuing (Hindle and Klyver, 2007).

Model 3F indicates that starting a business is socially acceptable for women if they hold the necessary skills, knowledge and experience to engage in entrepreneurial activities (Junaid et al., 2019). Existing literature on women's entrepreneurship reports that normative support of a country's institutional environment is the most critical determinant of the emergence of women's entrepreneurial activities (Baughn et al., 2006; Yousafzai et al., 2015). We provide evidence that the combination of latter factor along with former is a better predictor for the occurrence of women's entrepreneurship. These results provide an indication that women's entrepreneurial skills and knowledge are likely to facilitate the normative support for women's entrepreneurship.

Model 4F shows women entrepreneurs are required to join a network of existing entrepreneurs which may guide and help them to discover new business opportunities as well as build their confidence to ensure that starting a business is a feasible career option. In this context, existing network members are required to enhance the sense of participation and develop the feelings of belongingness with new members which may strengthen the associational ties among network members that would be a source of satisfaction and confidence for new entrants (Sánchez-Franco et al., 2012). Accordingly, these networking ties may help women entrepreneurs to find new market niches which might be untapped by the traditional men-owned enterprises. In addition, female entrepreneur's representation in a women magazine may also positively influence the women's perception of entrepreneurship as a feasible and attainable career option, and shape the direction of their entrepreneurial aspirations (Ruth Eikhof, 2013).

Model 5F demonstrates that women entrepreneurs can create a venture by joining a network of existing entrepreneurs since networking compensates the lack of resources and provide advice and social support to exploit business opportunities as well as predicts the success of venture creation (Burt, 2019). We also find that previous knowledge and experience are critical to perceive the attractiveness of an existing business opportunity, as learning and reflecting upon past entrepreneurial experiences grant confidence to the entrepreneurs whether to exploit or ignore an available opportunity. Experienced entrepreneurs possess knowledge to evaluate the attractiveness and profitability of a business opportunity for venture creation.

CONCLUSION

This study investigates the role of cultural-cognitive and social-normative institutional antecedents to promote men's and women's entrepreneurial activities in factor-driven and efficiency-driven economies. This research introduces a fuzzy-set approach to entrepreneurship that permits comparing configurations of institutional conditions under which men's and women's entrepreneurship proliferates. The findings indicate that the configurations of both cultural-cognitive and social-normative institutional antecedents are required to promote men's and women's entrepreneurial activities in factor-driven

and efficiency-driven economies, and that these configurations differ among men's and women's entrepreneurial activities in different economic settings of factor-driven and efficiency-driven countries.

Implications

Theoretical Implications

This study makes following contributions; (1) while previous studies posit that cultural-cognitive and social-normative institutions determine men's and women's entrepreneurship (Baughn et al., 2006; Valdez and Richardson, 2013), this study makes a contribution by showing that these institutions are neither necessary nor sufficient in isolation to facilitate entrepreneurship; (2) this study indicates that cultural-cognitive and social-normative combine differently to promote entrepreneurship in different stages of economic development, and this combination varies for men's and women's entrepreneurship; (3) in contrast to previous studies which show that the impact of informal institutions differs in developing and developed countries (Danis et al., 2011), we show that the influence of informal institutions also varies in developing nations like factor-driven and efficiency-driven economies; (4) By employing fsQCA to gender based entrepreneurship research, we reveal the joint effects of institutional antecedent conditions, and extend our understanding of how distinct causal conditions combine to explore the reinforcing and substitutive patterns of relationships that promote entrepreneurship.

Practical Implications

This study has some practical implications to promote men's and women's entrepreneurial activities. The results of this study provides new insights to understand the complexity of values, beliefs and societal norms which are useful to start a venture for potential men's and women's entrepreneurs in different economic zones. By employing fsQCA we find that there are different configurational paths to promote men's and women's entrepreneurial activities, and we may have to accept that one size fits all policy would not work for both genders and for different economic clusters. Thereby, policies should be designed with respect to the prevailing economic conditions which conform to the existing cultural values and societal attitudes of a country. Further, the configurational approach may provide benefits to potential entrepreneurs in terms of providing them with useful ideas for starting a business successfully. The results of this research provide awareness to the potential entrepreneurs regarding the sets of institutional antecedents that are essential to start a venture for men's and women's entrepreneurial activities in factor-driven and efficiency-driven nations. Thus, our configurational approach may assist aspiring entrepreneurs to observe whether an optimal set of institutional antecedents are available that may lead them to engage in economic activities successfully. Finally, this study demonstrates that by employing a configurational approach we can understand the complexities associated with individuals' cognitive factors and societal attitudes in promoting men's and women's entrepreneurship in factor-driven and efficiency-driven economies.

Limitations and Future Research

This research provides deeper insight how different configurations of both cultural-cognitive and social-normative institutional antecedents promote men's and women's entrepreneurial activities. In this context, future research can compare how the presence and absence of both cultural-cognitive and social-normative institutional antecedents can restrict or promote entrepreneurial activities. Studies can also complement the institutional antecedents of regulatory institutions to examine their influence on entrepreneurial activities. This study shows the combinations of different institutions that are required to promote entrepreneurship in factor-driven and efficiency-driven economies. Future research can also add innovation-driven economies into the analysis, and examine how combinations of different institutional antecedents vary in developing and developed countries. This research used GEM data to measure the antecedents of informal institutions, future research may consider Hofstede's cultural dimensions to extend the existing study. The generalizability of the results of this study is restricted to developing economies including factor-driven and efficiency-driven as data is generated from GEM. Future research can consider World Bank or World Value Survey (WVS) to add more countries to examine the same phenomena.

DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. This data can be found here: https://www.gemconsortium.org/data.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

DJ was the main author of this study. AY was remained helpful in drafting the manuscript. FA contributed in the methodology. IS provided valuable help in final write up. Rest of the authors contributed equally to prepare the final version of the article and approved the submitted version.

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Constructing a Hierarchical Framework for Assessing the Application of Big Data Technology in Entrepreneurship Education

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The emergence of big data technology continues to innovate and change the world, bringing opportunities and challenges to all walks of life. Against the background of this era, traditional entrepreneurship education requires reform and innovation. This research attempts to explore the ways and practices of applying big data technology to entrepreneurship education so as to improve and perfect traditional entrepreneurship education and achieve its sustainable development. Based on classic theories, such as entrepreneurial theory, strategic management theory, and leadership theory, this paper develops a relatively systematic attribute system of entrepreneurship education under big data technology, comprehensively uses Fuzzy-DEMATEL and ISM methods to explore the relationship between different attributes and their importance, and finally constructs a hierarchical framework for the application of big data technology in entrepreneurship education. The results show that the attributes of entrepreneurship education under big data technology can be divided into four levels, each with different priorities and degrees of importance, and there are complex interactions and constraints among them. This study provides important guidance and suggestions for the development of entrepreneurship education and multiattribute decision-making management under the given resources, which is conducive to the sustainable development of entrepreneurs and new ventures.

Keywords: entrepreneurship education, big data, sustainable development, hierarchical framework, new venture

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INTRODUCTION

The continuous innovation of modern technology and communication systems has ushered in the era of big data, which has brought new opportunities and challenges (Wang, 2018). Naturally, big data technology poses challenges to entrepreneurs, and traditional entrepreneurship education needs transformation and innovation. Yang et al. (2014) points out that entrepreneurship education has important strategic significance and educational value. Also, an effective evaluation system is vital to guide, shape, and assess education. Further, Zheng (2019) points out that big data mining can play a very important role in establishing an entrepreneurship education system. Hence, research on entrepreneurship education with the help of big data technology is of great significance and requires a systematic evaluation framework.

Although previous studies on entrepreneurship education have been valuable, they also have limitations. First, previous studies focus more on entrepreneurship education in colleges and universities (Li, 2017; Chen Y. et al., 2018; Gianiodis and Meek, 2019). However, some facets of education in colleges and universities might not apply to entrepreneurship education in social institutions. Second, most scholars only explore traditional entrepreneurship education, and research on entrepreneurship education combined with big data technology is rare. For example, García-Rodríguez et al. (2017) explores the impact of the business model on the entrepreneurial potential of college students in entrepreneurship education. Although Zheng (2019) introduces big data into entrepreneurship education, the study focuses on logistics management and lacks applications in other functions. Furthermore, it is particularly important to emphasize that most studies on entrepreneurship education analyze issues qualitatively and propose corresponding countermeasures (Hao, 2017; Hua, 2019), and empirical research is relatively rare, which is not conducive to the long-term development of entrepreneurship education. Finally, when new technologies, such as big data, are embedded, entrepreneurship education research in the new context lacks a systematic framework. Shah et al. (2019) points out that a hierarchy contributes to improving corporate performance and plays a key role in implementing strategies. In addition, hierarchical jumps can improve management efficiency and further promote sustainable development (Sarfraz et al., 2019). Therefore, it is of great significance to explore a systematic hierarchical framework for entrepreneurship education. Because the different levels of entrepreneurship education are not isolated and are collaborative and mutually influential, the research also needs to reveal the potential influence and development paths between different levels. This work can provide a vital foundation for subsequent research on entrepreneurship education.

Based on the above, this paper carried out the following research. First, to construct a systematic attribute system of entrepreneurship education, the research focused on theories of entrepreneurship, strategic management, and leadership, extracting a total of 12 aspects, including business opportunities, monetary decisions, financial management, and legitimacy (institution, business ethics, and corporate culture) that are emphasized in entrepreneurship theory; value chain management (production management, logistics management, marketing management, and human resource management) emphasized by strategic management theory; and leadership traits and behavior (psychology, leadership) emphasized by the theories of leadership. After that, considering the application of big data technology in entrepreneurship education, 29 criteria were proposed from the 12 aspects above. Finally, we explored the development paths of entrepreneurship education under big data technology, and a hierarchical framework was built, which takes entrepreneurs as the core and focuses on sustainable development of entrepreneurs and new ventures and is not limited to entrepreneurship education in colleges or social institutions. To make complex decisions among multiple attributes, the mutual constraints and influences between attributes should be considered in this part. This study used fuzzy set theory and the decision-making trial and evaluation laboratory (DEMATEL) to identify causality interrelationships and explore the degree of importance among attributes. After that, the interpretative structural modeling (ISM) method was used to divide the levels, reveal development paths, and finally construct a hierarchical framework.

The results of this study indicate that the attributes of entrepreneurship education under big data can be divided into four levels with mutual constraints and influences between each level. Among them, business opportunities, institutions, and psychology are located on the first level of the ISM model, and these are primary and decisive aspects of entrepreneurship education. Leadership and financial management constitute the second level, stressing a focus on the leadership behavior of entrepreneurs and the assessment and improvement of a financial situation. The third level centers on the value chain, which is the development stage of formal entrepreneurial activities and has an important connection with the value-creating aspect of the enterprise. The last level includes business ethics, corporate culture, and human resource management. The realization of this level needs to undergo a complicated process, and it is affected by aspects of the first three levels.

This research complements existing studies of entrepreneurship education. Systematic and forward-looking, the hierarchical theoretical framework reflects not only the multifaceted and complex nature of the entrepreneurial process but also the embeddedness of new technologies. The results of this paper provide important guiding suggestions for entrepreneurship education, which are conducive to the transformation, innovation, and sustainable development of entrepreneurship education.

LITERATURE REVIEW

Big Data Technology

Due to the rapid development of communication and information technology, research has entered the era of big data. With the improvement in information society and enterprises, the influence of big data technology is expanding, which makes people begin to realize the huge economic benefits and social value of big data. Gartner, a big data research institution, believes that "big data" needs new processing modes to have stronger decision-making power, insight, and discovery ability as well as process optimization ability to adapt to the massive, high growth rate and diversified information assets. Specifically, big data covers a series of data generated by Internet behavior, including the preferences and intentions of producers and users as well as data related to non-traditional structures. It is characterized by great variety, huge amounts of information, and extremely fast production and update speeds. The strategic significance of big data technology lies not only in mastering huge amounts of information, but also, more importantly, the acquisition, integration, and specialized processing and analysis technology of large-scale data (Wang and Hajli, 2017). Using the new processing modes, big data technology can achieve stronger decision-making power and insight ability and create

TABLE 1 | Proposed attributes.

Aspects	Criteria	Explanation
A1 Production management	Economies of scale (C1)	Calculate the optimal scale of production to reduce production costs.
	Learning effect (C2)	Monitor and trace production processes to establish a more comprehensive learning system and move the experience curve down.
	Quality control (C3)	Trace the source of product defects to reduce product quality issues.
A2 Logistics management	Warehouse management (C4)	Realize collaborative management of inventory through the information interaction between the warehousing and sales departments.
	Transport management (C5)	Find the optimal transportation solution to reduce transportation costs.
A3 Marketing management	Distribution channel (C6)	Monitor the status of sales channels (sales volume, costs, human resources, etc.) and establish a sound distribution plan.
	Customer relationship management (C7)	Collect customer after-sales data to provide feedback and grasp the causes of problems to carry out targeted customer management.
A4 Human resource management	Recruitment management (C8)	Predict the supply and demand for human resources reasonably and match the most suitable talents for positions.
	Training and development (C9)	Provide targeted training based on the future development of employees by analyzing data.
	Performance management (C10)	Build a comprehensive performance evaluation model and provide diverse reference data.
A5 Psychology	Failure tolerance (C11)	Count the failures of entrepreneurship and analyze failure causes and countermeasures.
	Risk-taking (C12)	Collect information on entrepreneurial failure rates and guide entrepreneurs to increase their awareness of risk-taking.
	Self-efficacy (C13)	Analyze and identify factors affecting the self-confidence of entrepreneurs to cultivate the self-efficacy.
A6 Monetary decisions	Investment (C14)	Master different investment channels, assess risks and feasibility of investment projects, and optimize investment plans.
	Fundraising (C15)	Grasp different channels, risk links, and risk types of fundraising.
A7 Business opportunities	Identifying opportunities (C16)	Collect and analyze data to seize the opportunities to arbitrage or optimize products and services.
	Discovery opportunities (C17)	Use big data technology to understand and discover opportunities for which either their supply side or demand side is missing.
	Creative opportunities (C18)	Collect data to grasp the development trends of socioeconomy to seize creative opportunities.
A8 Business ethics	Explicit ethics (C19)	Understand stakeholders' concerns about business ethics and issue reports to make business ethics visible.
	Implicit ethics (C20)	Collect and analyze corporate social responsibility cases to cultivate employees' ethical responsibility.
A9 Corporate culture	Corporate culture building (C21)	Grasp the inheritance of culture and create a unique corporate culture by collecting and studying cases of successful corporate culture.
	Corporate culture feedback (C22)	Collect public feedback on corporate culture to develop a healthy corporate culture.
A10 Institution	Formal institutional entrepreneurship (C23)	Find the needs of formal systems and grasp the types of formal institutional entrepreneurship.
	Informal institutional entrepreneurship (C24)	Find institutional defects and grasp various forms of informal institutional entrepreneurship.
A11 Financial management	Financial forecast (C25)	Predict future financial status of the company to make smart financial decisions and improve the financial situation.
	Financial risk (C26)	Screen and analyze data to find harmful factors to avoid or address financial risks reasonably.
	Business integration (C27)	Strengthen data interaction between the finance department and other business departments to achieve business integration.
A12 Leadership	Transactional leadership (C28)	Record and analyze employee feedback on transactional leadership behaviors to find the best way for transactional leadership.
	Transformational leadership (C29)	Collect and study successful transformational leadership cases to better coach employees.

huge economic benefits and social value through the processing of massive and diversified information assets.

Nowadays, big data technology is applied in many fields, such as e-commerce, finance, manufacturing, transportation, social security, smart medical treatment, education, and so on, providing services and assistance in people's daily lives and the operation and management of enterprises. For enterprises, big data is a strategic asset, which can provide massive information for the operation of enterprises, improve efficiency, save costs, and enhance competitiveness and strategic decision-making ability (Ghasemaghaei et al., 2018; Rijmenam et al., 2019). At the same time, big data technology plays an important role in

TABLE 2 | Semantic transformation table.

Linguistic variables	TFN
N (No influence)	(0, 0, 0. 2)
VL (Very low influence)	(0, 0. 2, 0. 4)
L (Low influence)	(0. 2, 0. 4, 0. 6)
H (High influence)	(0. 4, 0. 6, 0. 8)
VH (Very high influence)	(0. 8, 1, 1)

the innovation and promotion of education. Klašnja-Milićević et al. (2017) point out that the application of data science and big data analysis in the field of education is of great significance and believe that a high-quality and multifunctional educational platform could be constructed through big data technology. This research shows that the application of big data technology in the field of entrepreneurship education, on the one hand, can improve the existing education mode, grasp the focus of entrepreneurship education, and carry out entrepreneurship education work in a more targeted manner; on the other hand, learning and mastering big data technology provides guidance and help for the management and development of new ventures.

Big Data Technology and Sustainable Development of Entrepreneurship Education

Entrepreneurship education is a type of education that cultivates people's entrepreneurial consciousness, thinking, skills, and other qualities, ultimately enabling the educated to have a certain entrepreneurial ability. Entrepreneurship education is of great significance to the development of entrepreneurs and enterprises, and it is essential for meeting economic and social goals (Wu et al., 2018). With the arrival of the era of big data, traditional entrepreneurship education faces major challenges and needs development and innovation urgently.

In 1987, the World Commission on Environment and Development defined sustainable development as "development that meets the needs of the present generation without jeopardizing the ability of future generations to meet their needs." Sustainable development is a new concept of development, whose main body can be economy, resources, environment, science and technology, education, and many other aspects. Among them, the sustainable development of education is an important component of the ability of sustainable development and plays a significant role in achieving the sustainable development of society (Findler et al., 2019). A sustainable education system attaches importance to educational reform, effective use of educational resources, and the strengthening of moral standards for sustainable development. This kind of education not only includes the form of school education, but also covers a wide range of subtle social education.

The sustainable development of entrepreneurship education is mainly composed of the sustainable development of entrepreneurs and of new ventures. On the one hand, the sustainable development of entrepreneurs emphasizes taking entrepreneurs as the core and improving entrepreneurial skills and the comprehensive quality required by entrepreneurs. The use of big data technology to collect and analyze massive cases and information will help to achieve the sustainable development of entrepreneurs. On the other hand, the sustainable development of new ventures means the survival, management, and long-term development of new ventures, which is also crucial for entrepreneurship and can be achieved by educating entrepreneurs to use big data technology reasonably and effectively to improve enterprise management. It can be seen that integrating big data technology into traditional entrepreneurship education can optimize and improve entrepreneurship education and promote the sustainable development of entrepreneurs and new ventures.

Proposed Attributes

This study has developed 12 aspects and 29 criteria related to entrepreneurship education with the use of big data technology. The specific criteria and explanations are shown in **Table 1**.

Production Management

Production is an important part of the daily operation of enterprises, and it is also one of the primary activities on the value chain. Reducing production costs and ensuring product quality are difficult in traditional production processes. The use of

TABLE 3 | The direct relation matrix of the aspects.

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
A1	0.0000	0.3790	0.1567	0.5694	0.2361	0.2044	0.3472	0.1250	0.2044	0.3948	0.2202	0.1726
A2	0.2679	0.0000	0.4266	0.5694	0.0139	0.2679	0.3472	0.0456	0.0774	0.2679	0.3313	0.3472
A3	0.2361	0.2996	0.0000	0.1567	0.2361	0.1567	0.3790	0.5694	0.5377	0.1250	0.1567	0.2361
A4	0.1726	0.0139	0.1250	0.0000	0.3472	0.0139	0.1091	0.2361	0.5694	0.2361	0.0139	0.2361
A5	0.1409	0.1409	0.3313	0.3948	0.0000	0.3472	0.5377	0.5060	0.3472	0.3472	0.3472	0.5694
A6	0.2044	0.2361	0.2679	0.1567	0.1885	0.0000	0.1726	0.4425	0.5694	0.1409	0.2520	0.2520
A7	0.5377	0.3472	0.5377	0.2520	0.3472	0.3472	0.0000	0.3472	0.2520	0.3313	0.5694	0.5694
A8	0.0139	0.2361	0.2996	0.0933	0.2361	0.1567	0.2044	0.0000	0.1250	0.2361	0.1250	0.1250
A9	0.1567	0.0139	0.0774	0.2520	0.2520	0.0456	0.0456	0.2044	0.0000	0.0139	0.1250	0.1250
A10	0.2361	0.2361	0.3472	0.3313	0.2361	0.5694	0.5694	0.2361	0.3472	0.0000	0.5694	0.5218
A11	0.5377	0.5377	0.5377	0.4107	0.2361	0.5694	0.2361	0.2679	0.0456	0.2520	0.0000	0.0298
A12	0.5694	0.2044	0.2361	0.4107	0.2520	0.2202	0.1409	0.5060	0.5694	0.3472	0.2361	0.0000

TABLE 4 | The total relation matrix of the aspects.

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
A1	0.1316	0.1871	0.1718	0.2681	0.1631	0.1623	0.2001	0.1701	0.1996	0.1967	0.1695	0.1725
A2	0.1888	0.1131	0.2241	0.2644	0.1174	0.1720	0.1954	0.1567	0.1768	0.1688	0.1870	0.2008
A3	0.1698	0.1671	0.1338	0.1732	0.1579	0.1428	0.1972	0.2564	0.2538	0.1344	0.1481	0.1740
A4	0.1156	0.0687	0.1102	0.0972	0.1483	0.0767	0.1049	0.1462	0.2199	0.1215	0.0807	0.1361
A5	0.2015	0.1744	0.2495	0.2693	0.1516	0.2263	0.2719	0.3001	0.2766	0.2198	0.2303	0.2882
A6	0.1531	0.1453	0.1750	0.1617	0.1389	0.1024	0.1444	0.2201	0.2507	0.1266	0.1553	0.1633
A7	0.3019	0.2393	0.3119	0.2720	0.2345	0.2473	0.1883	0.2873	0.2768	0.2359	0.2919	0.3037
A8	0.0869	0.1219	0.1546	0.1144	0.1215	0.1121	0.1285	0.0999	0.1272	0.1222	0.1080	0.1153
A9	0.0854	0.0486	0.0732	0.1160	0.1029	0.0580	0.0636	0.1068	0.0692	0.0531	0.0746	0.0817
A10	0.2358	0.2071	0.2662	0.2722	0.2063	0.2838	0.2878	0.2566	0.2881	0.1584	0.2858	0.2870
A11	0.2589	0.2455	0.2743	0.2618	0.1797	0.2562	0.2036	0.2275	0.1953	0.1873	0.1441	0.1631
A12	0.2553	0.1646	0.1981	0.2524	0.1809	0.1749	0.1713	0.2645	0.2891	0.1990	0.1808	0.1452

big data technology can enable enterprises to achieve economies of scale (C1) in production. Entrepreneurs can use big data technology to calculate the optimal scale of enterprise production to reduce production costs. In addition, using big data technology can monitor production links, trace production processes, and establish a more comprehensive learning system to shift the experience curve down and achieve the learning effect (C2). Finally, using big data technology to find the source of product defects can ensure that the product is under quality control (C3) while in the production processes, thereby reducing product quality problems and optimizing the production processes of the enterprise.

Logistics Management

In traditional logistics management, companies lack a comprehensive understanding of logistics costs, which may lead to misallocation of resources and a large amount of capital consumption (Yan, 2019). Big data technology provides more information support for enterprise logistics cost management. Applying information technology to enterprise logistics cost management is conducive to realizing the information management and structural optimization of the logistics function (Li and Zhao, 2019).

TABLE 5 | Total relation matrix analysis of the aspects.

Aspects	D	R	(D+R)	(D−R)
A1	2.1924	2.1845	4.3769	0.0079
A2	2.1655	1.8828	4.0483	0.2826
A3	2.1084	2.3427	4.4512	−0.2343
A4	1.4261	2.5226	3.9487	−1.0966
A5	2.8595	1.9030	4.7625	0.9566
A6	1.9368	2.0150	3.9518	−0.0781
A7	3.1907	2.1570	5.3477	1.0337
A8	1.4126	2.4922	3.9048	−1.0796
A9	0.9330	2.6231	3.5561	−1.6901
A10	3.0352	1.9238	4.9589	1.1114
A11	2.5973	2.0561	4.6534	0.5412
A12	2.4762	2.2310	4.7072	0.2452

Through the establishment of a real-time feedback system between the warehousing and sales departments and the interaction of data and information, a network of upstream and downstream links can be formed to achieve collaborative management of inventory (C4). Apart from this, entrepreneurs can build a logistics information platform, extract more valuable information from massive data, and find the optimal transportation solution (C5) to reduce transportation costs (Li and Zhao, 2019).

Marketing Management

As a daily operational management capability, marketing is part of the entrepreneurial capabilities that entrepreneurs must cultivate (Yang et al., 2014). Nowadays, traditional marketing activities of enterprises struggle to grasp the increasingly complex customer demand and customer psychology, creating an urgent need for change. Big data technology can help companies build an innovative road for marketing management and improve marketing effectiveness (Han, 2019).

Channel selection has become an important part of consumers' complex decision-making processes (Han, 2019). Using big data technology to monitor the status of distribution channels (sales volume, costs, human resources, etc.) can establish a reasonable and sound sales plan (C6). Through the big data integration system, enterprises can obtain business-related data sources to understand customers' behavior and provide feedback, which will help improve products and services and get them closer to the target market in order to meet the needs of consumers and enable more effective customer relationship management (C7) (Kubina et al., 2015; Anshari et al., 2019).

Human Resource Management

With the rapid development of the Internet and associated technologies, traditional human resource management strategies struggle to satisfy enterprises' practical needs (Shen, 2015). Relying on the convenience brought by big data, enterprises can speed up the innovation of human resource management and change management thinking to achieve better development (Zhang, 2019).

Traditional recruitment has low effectiveness. With the help of big data technology, information on employees and jobs can

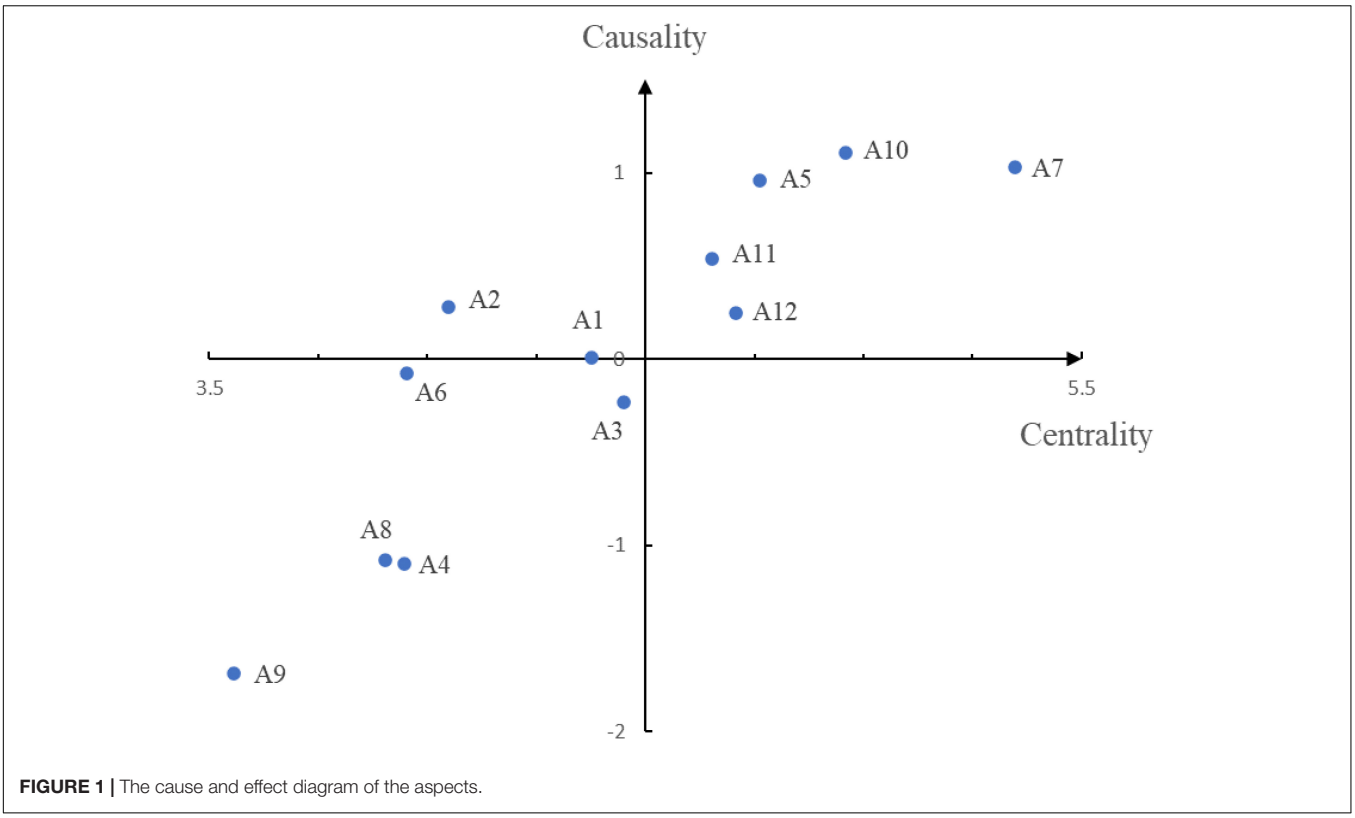

FIGURE 1 | The cause and effect diagram of the aspects.

be integrated, and a "personnel database" can be established to predict the supply and demand for human resources. Through processing and analyzing the data, the most suitable talents can be found to improve the degree of matching for positions and employees, which can achieve effective recruitment (C8) (Zhang and Xu, 2018). Furthermore, the use of big data can measure the comprehensive ability of employees, predict their future development, and conduct targeted training (C9) to unlock their potential and improve their motivation. Finally, big data technology also provides diverse reference data and more effective evaluation models for performance evaluation (C10) (Li, 2018).

Psychology

The success of entrepreneurship depends on the characteristics and abilities of entrepreneurs. Therefore, entrepreneurship education needs to focus on cultivating the psychological qualities of entrepreneurs. However, the relevant content in this area is relatively defective in entrepreneurship education, and the entrepreneurship education course has not yet included scientific planning (Hao, 2017).

Big data technology can be used to deeply analyze the complex psychology of entrepreneurs and guide entrepreneurs to cultivate specific psychological qualities. Entrepreneurship is not a smooth process. Entrepreneurs must have the ability to endure setbacks (Hao, 2017). Using big data technology to analyze and study the causes and countermeasures of entrepreneurial failures can help to improve the failure tolerance of entrepreneurs (C11). In addition, entrepreneurs must develop a risk-taking capability to survive the competition (Cui et al., 2016). Therefore, increasing the risk-taking awareness of entrepreneurs (C12) is also part of psychological education, which can be achieved by collecting information on entrepreneurial failures and providing guidance to entrepreneurs. Finally, self-efficacy (C13) reflects the confidence that an individual has in their abilities. Successful entrepreneurs are usually convinced that they can bring any activity to a successful ending. Also, they feel that they can control their success, which does not depend on others (Ismail and Zain, 2015). Using big data technology to understand the self-confidence of entrepreneurs and analyze its influencing factors can help to cultivate the self-efficacy of entrepreneurs.

Monetary Decisions

With increasing economic globalization and development and innovation in information systems, the monetary decision-making environment of enterprises is changing rapidly. On the one hand, the continuous emergence of new business and products has made the decision making of enterprises more and more complicated. On the other hand, the application of big data technology has revolutionized the business model in the monetary field, challenging the traditional monetary model and gradually developing in the direction of Internet finance (Yu, 2015; Zhang et al., 2015). All of these have affected the monetary decisions of enterprises accordingly.

Ensuring scientific quality and predictability is difficult given the traditional monetary decision making of enterprises. With big data technology, companies could discover value from the data and apply it directly to major business decisions,

TABLE 6 | The direct relation matrix of the criteria.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26	C27	C28	C29
C1	0.00	0.01	0.01	0.08	0.11	0.09	0.10	0.06	0.06	0.07	0.05	0.04	0.08	0.08	0.07	0.14	0.22	0.22	0.01	0.01	0.05	0.04	0.12	0.05	0.15	0.22	0.24	0.22	0.24
C2	0.03	0.00	0.05	0.10	0.14	0.09	0.16	0.06	0.07	0.14	0.08	0.05	0.16	0.15	0.06	0.20	0.22	0.24	0.03	0.03	0.09	0.08	0.16	0.09	0.21	0.22	0.24	0.24	0.24
C3	0.01	0.01	0.00	0.10	0.10	0.06	0.09	0.04	0.05	0.07	0.05	0.03	0.08	0.08	0.06	0.14	0.22	0.22	0.01	0.01	0.04	0.04	0.11	0.05	0.15	0.22	0.22	0.20	0.20
C4	0.18	0.13	0.21	0.00	0.04	0.12	0.16	0.01	0.01	0.05	0.07	0.03	0.10	0.12	0.09	0.10	0.20	0.20	0.11	0.10	0.03	0.01	0.15	0.08	0.20	0.24	0.24	0.09	0.10
C5	0.16	0.10	0.16	0.01	0.00	0.10	0.14	0.01	0.01	0.02	0.06	0.04	0.06	0.09	0.05	0.08	0.16	0.16	0.08	0.08	0.01	0.01	0.12	0.06	0.16	0.24	0.24	0.06	0.06
C6	0.07	0.04	0.06	0.19	0.20	0.00	0.04	0.04	0.05	0.11	0.13	0.14	0.21	0.16	0.10	0.21	0.22	0.24	0.13	0.12	0.05	0.02	0.21	0.13	0.18	0.22	0.22	0.12	0.11
C7	0.05	0.03	0.05	0.12	0.19	0.01	0.00	0.01	0.03	0.07	0.12	0.10	0.14	0.10	0.06	0.14	0.22	0.22	0.12	0.09	0.02	0.01	0.17	0.09	0.15	0.19	0.22	0.08	0.08
C8	0.24	0.17	0.24	0.21	0.24	0.06	0.10	0.00	0.01	0.05	0.16	0.15	0.20	0.10	0.04	0.08	0.12	0.13	0.07	0.04	0.11	0.09	0.17	0.13	0.16	0.18	0.18	0.16	0.18
C9	0.24	0.24	0.24	0.24	0.24	0.06	0.11	0.01	0.00	0.05	0.16	0.16	0.21	0.10	0.05	0.07	0.13	0.13	0.04	0.07	0.12	0.11	0.18	0.12	0.15	0.20	0.21	0.17	0.17
C10	0.24	0.15	0.24	0.17	0.22	0.03	0.05	0.01	0.01	0.00	0.11	0.10	0.16	0.06	0.05	0.05	0.10	0.10	0.04	0.03	0.08	0.08	0.14	0.08	0.14	0.18	0.18	0.16	0.15
C11	0.10	0.08	0.10	0.01	0.01	0.09	0.11	0.14	0.14	0.18	0.00	0.01	0.03	0.10	0.05	0.11	0.17	0.17	0.10	0.10	0.10	0.10	0.12	0.06	0.06	0.11	0.10	0.08	0.10
C12	0.13	0.11	0.13	0.02	0.04	0.10	0.14	0.13	0.14	0.24	0.01	0.00	0.05	0.12	0.06	0.12	0.24	0.22	0.13	0.12	0.15	0.15	0.14	0.10	0.11	0.14	0.12	0.14	0.14
C13	0.08	0.08	0.08	0.01	0.01	0.05	0.10	0.10	0.12	0.14	0.01	0.01	0.00	0.05	0.05	0.09	0.14	0.15	0.06	0.07	0.06	0.06	0.13	0.05	0.07	0.08	0.08	0.07	0.08
C14	0.08	0.05	0.08	0.08	0.12	0.05	0.06	0.01	0.01	0.03	0.14	0.12	0.16	0.00	0.01	0.09	0.15	0.14	0.06	0.05	0.01	0.01	0.24	0.16	0.17	0.22	0.22	0.07	0.07
C15	0.11	0.06	0.10	0.10	0.14	0.06	0.10	0.01	0.01	0.05	0.13	0.15	0.24	0.05	0.00	0.13	0.20	0.22	0.06	0.06	0.05	0.02	0.24	0.24	0.22	0.24	0.24	0.13	0.10
C16	0.21	0.16	0.21	0.15	0.16	0.16	0.18	0.04	0.04	0.12	0.22	0.21	0.24	0.11	0.05	0.00	0.03	0.05	0.13	0.11	0.05	0.03	0.24	0.24	0.10	0.12	0.13	0.09	0.08
C17	0.14	0.10	0.13	0.09	0.15	0.12	0.16	0.04	0.04	0.05	0.20	0.16	0.24	0.06	0.04	0.01	0.00	0.01	0.06	0.07	0.01	0.01	0.24	0.16	0.05	0.10	0.09	0.05	0.06
C18	0.15	0.12	0.14	0.10	0.14	0.11	0.16	0.04	0.04	0.05	0.21	0.17	0.24	0.06	0.05	0.01	0.01	0.00	0.08	0.06	0.01	0.01	0.24	0.16	0.06	0.10	0.10	0.05	0.06
C19	0.06	0.05	0.05	0.02	0.03	0.22	0.24	0.07	0.08	0.15	0.20	0.16	0.24	0.20	0.17	0.10	0.18	0.18	0.00	0.01	0.10	0.08	0.12	0.07	0.06	0.12	0.12	0.21	0.20
C20	0.05	0.06	0.05	0.02	0.03	0.17	0.24	0.08	0.08	0.13	0.18	0.17	0.24	0.18	0.13	0.08	0.18	0.20	0.01	0.00	0.08	0.10	0.12	0.06	0.06	0.12	0.14	0.18	0.21
C21	0.10	0.06	0.08	0.03	0.06	0.22	0.24	0.21	0.22	0.24	0.14	0.10	0.24	0.24	0.20	0.07	0.14	0.14	0.06	0.05	0.00	0.01	0.20	0.12	0.01	0.03	0.05	0.22	0.24
C22	0.09	0.04	0.08	0.02	0.04	0.15	0.22	0.18	0.22	0.24	0.15	0.10	0.24	0.24	0.16	0.05	0.12	0.12	0.05	0.05	0.01	0.00	0.20	0.10	0.01	0.03	0.03	0.21	0.21
C23	0.14	0.10	0.12	0.08	0.10	0.05	0.05	0.08	0.08	0.09	0.13	0.12	0.17	0.06	0.05	0.10	0.16	0.17	0.08	0.07	0.01	0.01	0.00	0.01	0.06	0.10	0.10	0.10	0.11
C24	0.21	0.16	0.20	0.11	0.15	0.05	0.09	0.09	0.09	0.14	0.14	0.12	0.24	0.09	0.03	0.12	0.18	0.21	0.12	0.12	0.03	0.01	0.02	0.00	0.10	0.12	0.15	0.20	0.20
C25	0.12	0.06	0.12	0.14	0.18	0.08	0.12	0.01	0.01	0.04	0.14	0.14	0.21	0.16	0.10	0.22	0.24	0.24	0.09	0.08	0.09	0.05	0.24	0.24	0.00	0.04	0.03	0.13	0.12
C26	0.07	0.05	0.07	0.11	0.14	0.05	0.08	0.01	0.01	0.01	0.14	0.12	0.17	0.12	0.06	0.14	0.24	0.24	0.05	0.05	0.05	0.05	0.24	0.16	0.01	0.00	0.01	0.08	0.09
C27	0.08	0.05	0.07	0.12	0.15	0.05	0.09	0.01	0.01	0.01	0.14	0.10	0.17	0.11	0.05	0.14	0.24	0.24	0.03	0.04	0.05	0.04	0.24	0.16	0.01	0.01	0.00	0.09	0.10
C28	0.06	0.04	0.07	0.11	0.18	0.07	0.12	0.07	0.10	0.11	0.24	0.14	0.24	0.14	0.06	0.14	0.24	0.24	0.05	0.05	0.05	0.05	0.22	0.16	0.01	0.03	0.02	0.00	0.01
C29	0.07	0.05	0.07	0.12	0.20	0.07	0.12	0.08	0.09	0.12	0.24	0.16	0.24	0.15	0.08	0.16	0.24	0.24	0.05	0.05	0.05	0.05	0.22	0.16	0.01	0.02	0.04	0.01	0.00

making monetary decisions more scientific. By using big data technology, entrepreneurs can see channels of investment (C14) and fundraising (C15) more comprehensively, and through more accurate assessments of risks and feasibility, smart investment and fundraising can be realized to optimize monetary decisions (Xia and Zhou, 2015).

Business Opportunities

Research on opportunity identification and development occupies an important position in the field of entrepreneurship research. Entrepreneurship is a process of chasing and realizing business opportunities. The real entrepreneurial process begins with the discovery of opportunities by entrepreneurs (Shane and Venkataraman, 2000). The identification, acquisition, and integration of entrepreneurial opportunities are the prerequisites and necessary conditions for starting a new business. Furthermore, the ability to identify opportunities is an important dimension of entrepreneurial abilities. Obtaining a strong opportunity recognition ability gives the enterprise a first-mover development to create opportunities for the realization of corporate goals (Zhou and Gao, 2019).

Relying on big data technology, the risks and types of business opportunities can be evaluated systematically. Here are three types of opportunities that can be developed by entrepreneurs: identifying opportunities, discovery opportunities, and creative opportunities. The development of identifying opportunities (C16) can be achieved by collecting huge amounts of data to find opportunities for arbitrage or optimizing and improving products and services to better meet people's needs. Discovery opportunities (C17) emphasize situations in which either supply or demand is missing. Massive cases could help entrepreneurs grasp the existence and differences of supply and demand-oriented opportunities. Finally, relevant data and information on changes in the social environment could predict the development trends of socioeconomy and related industries effectively, which will help to capture creative opportunities (C18).

Business Ethics

In today's society, corporate social responsibility (CSR) has seeped into every aspect of the enterprise. CSR has not only changed the social participation and social life of the enterprise but also the relationship between enterprises and their stakeholders. The success of an enterprise depends on the help and support of a series of stakeholders. To achieve sustainable development, enterprises must be economically responsible to shareholders and socially responsible to other stakeholders

TABLE 7 | The total relation matrix of the criteria.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26	C27	C28	C29
C1	0.03	0.02	0.03	0.04	0.06	0.04	0.05	0.03	0.03	0.04	0.05	0.04	0.06	0.05	0.03	0.06	0.09	0.09	0.02	0.02	0.02	0.02	0.07	0.04	0.05	0.08	0.08	0.07	0.08
C2	0.05	0.03	0.05	0.05	0.07	0.05	0.07	0.03	0.03	0.06	0.06	0.05	0.09	0.07	0.03	0.08	0.10	0.11	0.03	0.03	0.04	0.03	0.09	0.06	0.07	0.09	0.09	0.08	0.09
C3	0.03	0.02	0.03	0.04	0.05	0.03	0.05	0.02	0.02	0.04	0.05	0.03	0.06	0.04	0.03	0.05	0.09	0.09	0.02	0.02	0.02	0.02	0.07	0.04	0.05	0.07	0.07	0.07	0.07
C4	0.07	0.05	0.07	0.03	0.05	0.05	0.07	0.02	0.02	0.03	0.05	0.04	0.07	0.06	0.04	0.05	0.09	0.09	0.04	0.04	0.02	0.01	0.08	0.05	0.07	0.08	0.09	0.05	0.05
C5	0.06	0.04	0.06	0.02	0.03	0.04	0.06	0.01	0.01	0.02	0.04	0.03	0.05	0.04	0.03	0.04	0.07	0.07	0.03	0.03	0.01	0.01	0.07	0.04	0.05	0.08	0.08	0.04	0.04
C6	0.06	0.04	0.05	0.07	0.08	0.03	0.05	0.03	0.03	0.05	0.07	0.07	0.10	0.07	0.04	0.08	0.10	0.11	0.05	0.05	0.03	0.02	0.10	0.07	0.07	0.09	0.09	0.06	0.06
C7	0.04	0.03	0.04	0.05	0.07	0.02	0.03	0.02	0.02	0.04	0.06	0.05	0.07	0.05	0.03	0.06	0.09	0.09	0.04	0.04	0.02	0.01	0.08	0.05	0.05	0.07	0.08	0.05	0.05
C8	0.09	0.06	0.09	0.07	0.09	0.04	0.06	0.02	0.02	0.04	0.08	0.07	0.10	0.06	0.03	0.06	0.09	0.09	0.04	0.03	0.04	0.03	0.09	0.07	0.06	0.08	0.08	0.07	0.08
C9	0.09	0.08	0.09	0.08	0.09	0.04	0.07	0.02	0.02	0.05	0.08	0.07	0.10	0.06	0.03	0.06	0.09	0.09	0.03	0.04	0.04	0.04	0.10	0.07	0.07	0.09	0.09	0.08	0.08
C10	0.08	0.05	0.08	0.06	0.08	0.03	0.05	0.02	0.02	0.03	0.06	0.05	0.08	0.04	0.03	0.04	0.07	0.07	0.03	0.03	0.03	0.03	0.08	0.05	0.05	0.07	0.08	0.07	0.07
C11	0.05	0.04	0.05	0.03	0.04	0.04	0.05	0.04	0.04	0.06	0.04	0.03	0.05	0.05	0.03	0.05	0.08	0.08	0.04	0.04	0.03	0.03	0.07	0.04	0.04	0.06	0.06	0.05	0.05
C12	0.06	0.05	0.06	0.04	0.05	0.05	0.07	0.04	0.05	0.08	0.05	0.04	0.07	0.06	0.04	0.06	0.10	0.10	0.05	0.05	0.05	0.04	0.09	0.06	0.05	0.07	0.07	0.07	0.07
C13	0.04	0.03	0.04	0.02	0.03	0.03	0.05	0.03	0.04	0.05	0.03	0.02	0.04	0.03	0.02	0.04	0.06	0.06	0.03	0.03	0.02	0.02	0.06	0.03	0.03	0.04	0.04	0.04	0.04
C14	0.04	0.03	0.04	0.04	0.05	0.03	0.04	0.01	0.02	0.03	0.06	0.05	0.07	0.03	0.02	0.05	0.07	0.07	0.03	0.03	0.02	0.01	0.09	0.06	0.06	0.07	0.08	0.04	0.04
C15	0.06	0.04	0.06	0.05	0.07	0.04	0.06	0.02	0.02	0.04	0.07	0.06	0.10	0.04	0.02	0.06	0.09	0.10	0.04	0.03	0.03	0.02	0.10	0.08	0.07	0.09	0.09	0.06	0.06
C16	0.08	0.06	0.08	0.06	0.07	0.06	0.08	0.03	0.03	0.06	0.09	0.08	0.10	0.06	0.03	0.04	0.07	0.07	0.05	0.05	0.03	0.02	0.10	0.08	0.06	0.07	0.07	0.06	0.06
C17	0.06	0.04	0.05	0.04	0.06	0.04	0.06	0.02	0.02	0.03	0.07	0.06	0.09	0.04	0.02	0.03	0.05	0.05	0.03	0.03	0.02	0.01	0.09	0.06	0.03	0.05	0.05	0.04	0.04
C18	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.02	0.02	0.03	0.07	0.06	0.09	0.04	0.03	0.03	0.05	0.05	0.03	0.03	0.02	0.01	0.09	0.06	0.04	0.05	0.06	0.04	0.04
C19	0.05	0.04	0.05	0.04	0.05	0.07	0.09	0.03	0.04	0.06	0.08	0.07	0.10	0.08	0.05	0.06	0.09	0.09	0.03	0.02	0.04	0.03	0.08	0.05	0.04	0.07	0.07	0.08	0.08
C20	0.05	0.04	0.05	0.03	0.05	0.06	0.08	0.03	0.04	0.06	0.08	0.07	0.10	0.07	0.05	0.05	0.09	0.09	0.02	0.02	0.03	0.03	0.08	0.05	0.04	0.07	0.07	0.07	0.08
C21	0.06	0.04	0.06	0.04	0.06	0.07	0.09	0.06	0.07	0.08	0.07	0.06	0.11	0.08	0.06	0.05	0.09	0.09	0.04	0.03	0.02	0.02	0.10	0.06	0.04	0.05	0.06	0.08	0.09
C22	0.06	0.04	0.05	0.04	0.05	0.05	0.08	0.05	0.06	0.08	0.07	0.05	0.10	0.08	0.05	0.04	0.08	0.08	0.03	0.03	0.02	0.02	0.09	0.06	0.03	0.05	0.05	0.08	0.08
C23	0.06	0.04	0.05	0.04	0.05	0.03	0.04	0.03	0.03	0.04	0.06	0.05	0.07	0.04	0.02	0.04	0.07	0.07	0.03	0.03	0.02	0.01	0.04	0.03	0.04	0.05	0.05	0.05	0.05
C24	0.08	0.06	0.08	0.05	0.07	0.04	0.06	0.04	0.04	0.06	0.07	0.06	0.10	0.05	0.03	0.06	0.09	0.10	0.05	0.04	0.02	0.02	0.06	0.04	0.05	0.07	0.07	0.08	0.08
C25	0.06	0.04	0.06	0.06	0.08	0.04	0.06	0.02	0.02	0.04	0.07	0.06	0.10	0.07	0.04	0.08	0.10	0.10	0.04	0.04	0.03	0.02	0.10	0.08	0.03	0.05	0.05	0.06	0.06
C26	0.04	0.03	0.04	0.04	0.06	0.03	0.05	0.02	0.02	0.03	0.06	0.05	0.07	0.05	0.03	0.05	0.09	0.09	0.03	0.03	0.02	0.02	0.09	0.06	0.02	0.03	0.03	0.04	0.05
C27	0.04	0.03	0.04	0.04	0.06	0.03	0.05	0.02	0.02	0.03	0.06	0.05	0.07	0.05	0.03	0.05	0.09	0.09	0.02	0.02	0.02	0.02	0.09	0.06	0.02	0.03	0.03	0.05	0.05
C28	0.05	0.03	0.05	0.05	0.07	0.04	0.06	0.03	0.04	0.05	0.08	0.06	0.09	0.06	0.03	0.06	0.09	0.09	0.03	0.03	0.02	0.02	0.09	0.06	0.03	0.04	0.04	0.03	0.04
C29	0.05	0.04	0.05	0.05	0.07	0.04	0.06	0.03	0.04	0.05	0.08	0.06	0.10	0.06	0.03	0.06	0.09	0.10	0.03	0.03	0.03	0.02	0.09	0.07	0.03	0.04	0.05	0.04	0.04

(such as customers, employees, community members, etc.), which is a reflection of their business ethics. Therefore, it is necessary to educate entrepreneurs to make them aware of the importance of CSR and business ethics. Traditionally, it is difficult for companies to achieve real ethical externalization and internalization. Big data technology makes the explicit and implicit ethics of companies visible and helps them to better realize those ethics. Externally, entrepreneurs can use big data technology to grasp the concerns of different stakeholders on business ethics and issue targeted reports to make corporate ethics visible (C19) (Li et al., 2018). Internally, collecting and studying cases related to corporate social responsibility could develop employees' sense of ethical responsibility and internalize corporate ethics (C20).

Corporate Culture

Corporate culture is the soul of corporate survival and development and a powerful driving force for sustainable development of enterprises (Shen, 2018). In the context of economic globalization and rapid development of science and technology, optimizing and upgrading corporate culture constantly, creating the innovative corporate culture with core values, ensuring long-term development, and enhancing core competencies of enterprises are necessary for the survival and development of enterprises in domestic and international markets (Chen, 2017). Also, enterprises need to seize the opportunities brought by big data and accelerate the improvement and adjustment of the aspects of corporate culture (Chen G. et al., 2018).

Using big data technology to collect cases of corporate culture can enable entrepreneurs to learn outstanding cultures of different industries and fields and to grasp the inheritance of culture, thereby creating a unique corporate culture (C21). In addition, traditional corporate culture-building lacks close connection with the public, and big data technology can help entrepreneurs collect public attitudes and evaluations of corporate culture and establish a cultural feedback mechanism (C22), which can help improve and develop corporate culture.

Institution

There is a close relationship between the institution and entrepreneurship. A reasonable institution can encourage entrepreneurs to devote themselves to entrepreneurial activities and promote the increase of social wealth and economic development. Ahlstrom and Bruton (2002) indicate that entrepreneurial enterprises could not only adapt to existing

TABLE 8 | Total relation matrix analysis of the criteria.

Criteria	D	R	(D+R)	(D−R)
C1	1.6322	1.3934	3.0256	0.2388
C2	1.1701	1.7798	2.9499	−0.6097
C3	1.5922	1.2952	2.8874	0.2970
C4	1.3073	1.5360	2.8434	−0.2287
C5	1.7666	1.2164	2.9831	0.5502
C6	1.2254	1.8165	3.0420	−0.5911
C7	1.7398	1.3949	3.1347	0.3448
C8	0.7946	1.8417	2.6363	−1.0471
C9	0.8860	1.9336	2.8197	−1.0476
C10	1.3364	1.5101	2.8465	−0.1738
C11	1.8660	1.3320	3.1980	0.5340
C12	1.5268	1.7263	3.2530	−0.1995
C13	2.4180	1.0683	3.4863	1.3497
C14	1.5727	1.2808	2.8536	0.2919
C15	0.9440	1.6690	2.6130	−0.7249
C16	1.5388	1.8006	3.3394	−0.2618
C17	2.4235	1.2782	3.7017	1.1453
C18	2.4844	1.3225	3.8069	1.1619
C19	0.9793	1.7217	2.7010	−0.7424
C20	0.9245	1.6590	2.5835	−0.7345
C21	0.7515	1.8315	2.5830	−1.0801
C22	0.6304	1.6577	2.2882	−1.0273
C23	2.4476	1.2345	3.6821	1.2130
C24	1.6370	1.7079	3.3449	−0.0710
C25	1.3746	1.6772	3.0518	−0.3027
C26	1.8752	1.2631	3.1383	0.6120
C27	1.9272	1.2549	3.1822	0.6723
C28	1.6980	1.4775	3.1755	0.2205
C29	1.7449	1.5343	3.2792	0.2106

institutional environments, but also create a relatively favorable institutional environment for themselves by changing certain conditions. Institutional entrepreneurship is a new topic in strategic management in recent years, and it refers to entrepreneurial behavior processes in which entrepreneurs mobilize resources to change existing institutions or create new institutions under the institutional framework; establish and promote the rules, values, beliefs, and behavior models that organizations need to gain recognition; and create, develop, and utilize profitable opportunities (Maguire et al., 2004; Greenwood and Suddaby, 2006). Institutional entrepreneurship is not a one-time act, but a development process that is dynamic and facilitates the complete transformation of the institutional framework. Given the dynamics and complexity of institutional entrepreneurship, we can use big data technology to help entrepreneurs grasp the characteristics and forms of institutional entrepreneurship conveniently. Using big data technology to find the demand for formal systems helps entrepreneurs grasp the types of formal institutional entrepreneurship (C23) and start a business that meets the demand of the systems. Furthermore, big data technology can help entrepreneurs understand institutional defects and various forms of informal institutional entrepreneurship (C24), which provides them with more entrepreneurial options.

Financial Management

Big data technology has brought opportunities for the innovation and development of financial management in order to further develop enterprises. Introducing big data technology into financial management can greatly improve the efficiency of financial management and gradually enhance the competitive advantage of enterprises (Wang, 2019). Using big data technology to predict future financial status, operating results, and cash flow prospects of the company (C25) can help entrepreneurs make financial decisions that are more conducive to the development of the company and improve the financial situation in a targeted manner. By screening and analyzing data to find harmful factors, entrepreneurs can avoid or address financial risks rationally (C26). In addition, big data can promote information interaction between different departments, which helps to integrate the financial department with other business departments, such as production, sales, human resources, etc. (C27) (Cheng and Dong, 2015).

Leadership

Among key factors affecting corporate operation and development, leadership is considered to be critical. The leadership behavior of entrepreneurs plays a decisive role in entrepreneurial and innovative capabilities. Zhu et al. (2005) point out that scientific leadership could promote the organizational construction and cultural atmosphere, thus exploring the creativity of the organization and improving the innovation efficiency. Hassan et al. (2018) believe that leadership effectiveness is crucial to the development of educational institutions and is mainly influenced by leadership practice and style.

Longshore and Bass (1987) first put forward the theory of transactional and transformational leadership. They divided leadership into two dimensions: transactional and transformational leadership. Transactional leadership behavior (C28) refers to the interaction between leaders and subordinates through a large number of exchanges and implicit contracts. Leaders guide subordinates mainly through rewards and fulfill promised rewards after they complete their tasks. The whole relationship process is like a transaction. Using big data technology to record and analyze employees' feedback on transactional leadership behaviors will help entrepreneurs find the best way and improve their transactional leadership.

Transformational leadership behavior (C29) adopts visionary and creative leadership behavior and focuses on the establishment of emotional ties with followers, thus creating higher value (García-Morales et al., 2012). Transformational leaders convey their ideas and values to subordinates, transmit organizational goals and common missions to subordinates, and motivate them to stimulate inspiration and potential so that they can make the greatest efforts to achieve the organizational goals. Collecting and studying successful transformational leadership cases helps entrepreneurs to guide and support employees so that they can make their best efforts to achieve the overall goals of the organization.

Starting from classic management theories, such as entrepreneurship, leadership, and strategic management theory

and combing the existing literature, the research has sorted out the attribute system of big data entrepreneurship education, which includes 12 aspects and 29 criteria. Next, fuzzy-DEMATEL and ISM methods are used to evaluate the complex relationship between attributes and construct a hierarchical framework.

MATERIALS AND METHODS

Selection of Research Methods

The purpose of this study is to explore how to apply big data technology in the field of entrepreneurship education to improve and perfect traditional entrepreneurship education. Based on the theories of leadership, entrepreneurship, and strategic management and a review of the existing literature, 12 aspects and 29 criteria for entrepreneurship education under big data technology have been developed as the attribute system, and the specific practices of applying big data technology to entrepreneurship education have been systematically expounded, which is of guiding significance for the development of entrepreneurship education. However, the study also needs to further clarify the complex interrelations and importance of various aspects and criteria so as to ensure that more reasonable and effective multiattribute decision making can be carried out under the condition of limited resources, and the key aspects of entrepreneurship education can be better grasped. A fuzzy-DEMATEL hybrid method is adopted to analyze and evaluate attributes, which can clearly reveal the causal relationship between attributes and their importance through the values of centrality, causality, and the cause-and-effect diagram and clarify the important driving aspects of entrepreneurship education. In addition, the research needs to construct a more explicit hierarchical framework to simplify and clarify the complex interrelations among the attributes of entrepreneurship education to facilitate the overall control and rational decision making of entrepreneurship education by managers.

Fuzzy-DEMATEL

Fuzzy mathematics based on fuzzy set theory is used to analyze the fuzzy degree of feature relevance. It is a method of simulating the human brain to process fuzzy information. The triangular fuzzy number (TFN) provides an effective means to quantify human linguistic preferences into computable form (Opricovic and Tzeng, 2004). Fuzzy set theory transforms qualitative language into quantitative data and overcomes the problem of expert linguistic preferences (the uncertainty caused by expert judgment), thus reducing the error and improving the credibility of the analysis results, which can provide a more valuable reference for managers' decision making (Du et al., 2020).

The DEMATEL method is a decision-making tool based on graph theory and matrix calculation. It is used to analyze the importance of system factors and help to plan and solve problems (Lin and Tzeng, 2009). DEMATEL can be used to explore the relationship and influence degree of various factors affecting the evaluation object and reveal the causal relationship and importance of attributes so as to better evaluate problems and management decisions (Büyüközkan and Çifçi, 2012).

In this paper, a fuzzy-DEMATEL hybrid method is adopted to analyze and evaluate the relationship and importance between 12 aspects and 29 criteria for entrepreneurship education under big data technology, which not only solves the uncertainty of expert linguistic preferences, but also retains the practical and effective advantages of traditional DEMATEL method in factor identification. Specific steps are as follows:

Step 1: For the problem under study, build a system of factors, set to F1, F2,. . . , Fn.

Step 2: Determine the influence relationship between two factors by the expert scoring method and express it in matrix form. Invite experts to use the language operators "no influence (N)," "very low influence (VL)," "low influence (L)," "high influence (H)," and "very high influence (VH)" to evaluate the relationship between factors. Through the semantic transformation table shown in **Table 2**, the original expert evaluation is converted into TFNs $w_{ij}^k = (a_{1ij}^k, a_{2ij}^k, a_{3ij}^k)$ to represent the fuzzy weight of the ith factor that affects the jth factor evaluated by the kth expert.

Step 3: Converting the fuzzy data into crisp scores (CFCS) method is used to defuzzify the initial value of the expert score and obtain the direct relation matrix Z that reflects the direct effect between the factors, including the following four steps:

(1) Normalization:

$$xa_{1ij}^k = \left(a_{1ij}^k - \min a_{1ij}^k\right) / \Delta_{\min}^{\max} \tag{1}$$

$$xa_{2ij}^k = \left(a_{2ij}^k - \min a_{1ij}^k\right) / \Delta_{\min}^{\max} \tag{2}$$

$$xa_{3ij}^k = \left(a_{3ij}^k - \min a_{1ij}^k\right) / \Delta_{\min}^{\max} \tag{3}$$

(2) Compute left-side (ls) and right-side (rs) normalized values:

$$x\ ls_{ij}^k = xa_{2ij}^k / \left(1 + xa_{2ij}^k - xa_{1ij}^k\right) \tag{4}$$

$$x\ rs_{ij}^k = xa_{3ij}^k / \left(1 + xa_{3ij}^k - xa_{2ij}^k\right) \tag{5}$$

(3) Calculate the crisp values:

$$x_{ij}^k = \left[x\ ls_{ij}^k \left(1 - x\ ls_{ij}^k\right) + x\ rs_{ij}^k x\ rs_{ij}^k\right] / \left[1 - x\ ls_{ij}^k + x\ rs_{ij}^k\right] \tag{6}$$

$$z_{ij}^k = \min a_{1ij}^k + x_{ij}^k \times \Delta_{\min}^{\max} \tag{7}$$

(4) Calculate the average crisp values:

$$z_{ij}^k = \left(z_{ij}^1 + z_{ij}^2 + \ \cdots \ + z_{ij}^k\right) / n \tag{8}$$

Step 4: Normalize the direct relation matrix Z to obtain the normalized direct relation matrix G:

$$\lambda = 1 / \max_{1 \le i \le n} \sum_{j=1}^{n} z_{ij},\ G = \lambda Z \tag{9}$$

Step 5: According to Equation (10) below, the total relation matrix T is obtained. (E is the identity matrix):

$$T{=}G\,(E - G)^{-1} \tag{10}$$

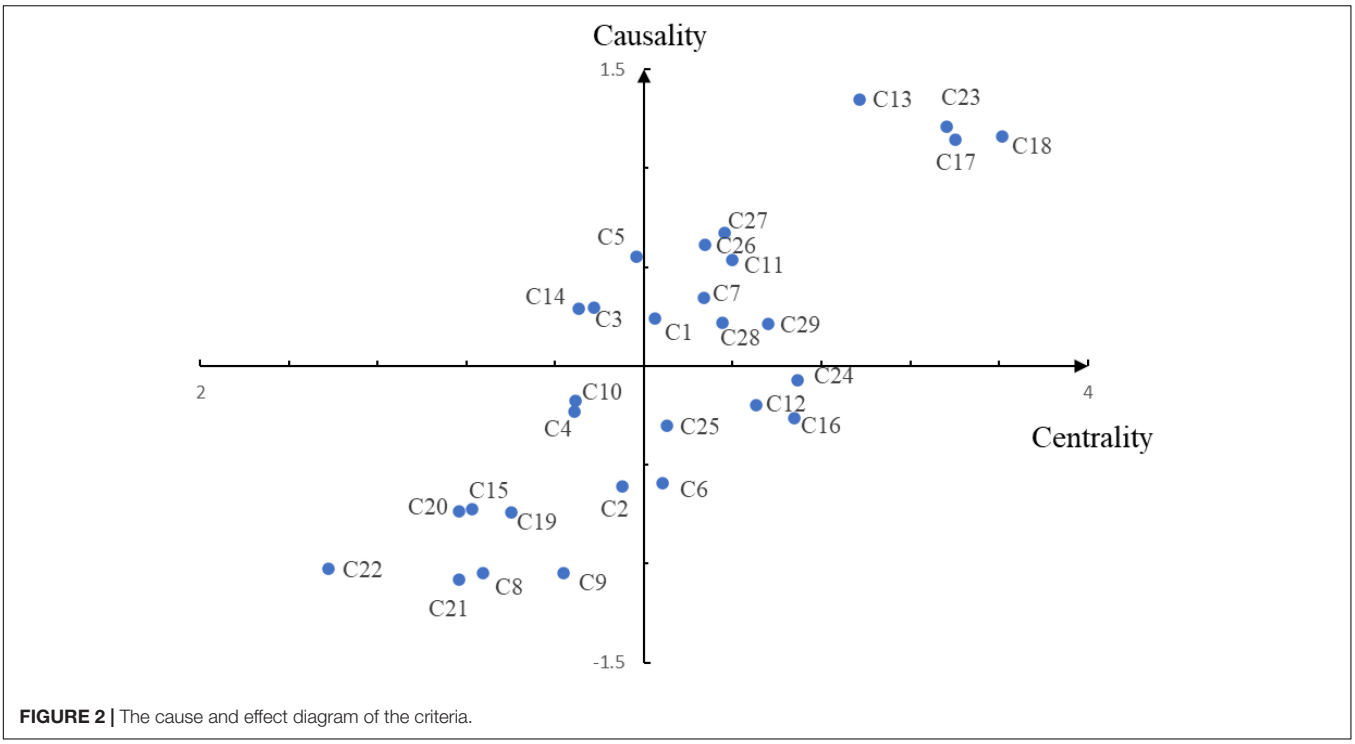

FIGURE 2 | The cause and effect diagram of the criteria.

TABLE 9 | The reachability matrix.

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
A1	1	0	0	1	0	0	0	0	0	0	0	0
A2	0	1	0	1	0	0	0	0	0	0	0	0
A3	0	0	1	0	0	0	0	1	1	0	0	0
A4	0	0	0	1	0	0	0	0	0	0	0	0
A5	0	0	1	1	1	0	1	1	1	0	0	1
A6	0	0	0	0	0	1	0	0	1	0	0	0
A7	1	0	1	1	0	0	1	1	1	0	1	1
A8	0	0	0	0	0	0	0	1	0	0	0	0
A9	0	0	0	0	0	0	0	0	1	0	0	0
A10	0	0	1	1	0	1	1	1	1	1	1	1
A11	1	0	1	1	0	1	0	0	0	0	1	0
A12	1	0	0	1	0	0	0	1	1	0	0	1

Step 6: Based on the total relation matrix, the driving power (D) and dependence power (R) can be obtained. The elements in the matrix T are added by rows to obtain driving power Di, which represents the comprehensive influence of the factor in this row on all other factors. The elements in the matrix T are added by columns to obtain dependence power Ri, which represents the comprehensive influence of all other factors on the factor in this column. The equations are as follows:

$$Di = \sum_{j=1}^{n} t_{ij} \ (i = 1, 2, \ldots, n) \tag{11}$$

$$Ri = \sum_{i=1}^{n} t_{ij} \ (i = 1, 2, \ldots, n) \tag{12}$$

(D+R) represents the magnitude of the effect of the factor, which is called centrality (m). (D−R) reflects the causal relationship between the factors, which is called causality (n). If the causality is positive, it means that the factor has more effect on other factors and belongs to the cause group; conversely, if it is negative, it means that the factor is more affected by other factors and belongs to the effect group. The equations are as follows:

$$m_i = D_i + R_i (i = 1, 2, \cdots, n) \tag{13}$$

$$n_i = D_i - R_i (i = 1, 2, \cdots, n) \tag{14}$$

ISM

The ISM method is used to classify the system structure to transform the ambiguous ideas and views into an intuitive

model with structural relationships (Beikkhakhian et al., 2015). The fuzzy-DEMATEL method is usually used to evaluate the complex interrelation between factors at the micro level, and the ISM method focuses more on the macro level, which can decompose the complex system into subsystems and reveal the relationship between attributes more clearly and intuitively. This paper uses the ISM method to divide the attribute system of entrepreneurship education under big data technology into 4 levels, illustrates the influence paths between different levels, and finally, constructs a hierarchical theoretical framework. In the above fuzzy-DEMATEL analysis process, the total relation matrix is obtained. However, the total relation matrix T only reflects the mutual influence relationship between different factors, and the influence of the factors on itself has not been taken into account. Therefore, it is necessary to calculate the overall relation matrix that reflects the overall influence relationship of system factors. The calculation equation is

$$H = T + E = h_{ij} \tag{15}$$

Next, the threshold λ is introduced to eliminate redundant information and obtain the most simplified matrix. Based on the trial calculation, the threshold calculation models that best fits the research is obtained. The equation is:

$$\lambda = \alpha + \beta \tag{16}$$

where α and β are the mean and standard deviation of all elements in the total relation matrix T, respectively.

The threshold is used to remove the redundant factors, and the reachability matrix M is obtained. The equations are as follows:

$$M = [m_{ijn*n}, (i = 1, 2....n; j = 1, 2....n) \tag{17}$$

$$m_{ij} = \begin{cases} 1, h_{i,j} \geq \lambda \\ 0, h_{i,j} < \lambda \end{cases} (i = 1, 2 \ldots, n; j = 1, 2, \ldots, n) \tag{18}$$

In Equation (18), 1 means there is a direct effect between the two factors, and 0 means there is no direct effect between the two factors.

TABLE 10 | Primary decomposition structure.

i (Aspects)	$L(f_i)$	$P(f_i)$	$C(f_i) = L(f_i) \cap P(f_i)$
(1) (A1)	1,4	1,7,11,12	1
(2) (A2)	2,4	2	2
(3) (A3)	3,8,9	3,5,7,10,11	3
(4) (A4)	4	1,2,4,5,7,10,11,12	4
(5) (A5)	3,4,5,7,8,9,12	5	5
(6) (A6)	6,9	6,10,11	6
(7) (A7)	1,3,4,7,8,9,11,12	5,7,10	7
(8) (A8)	8	3,5,7,8,10,12	8
(9) (A9)	9	3,5,6,7,9,10,12	9
(10) (A10)	3,4,6,7,8,9,10,11,12	10	10
(11) (A11)	1,3,4,6,11	7,10,11	11
(12) (A12)	1,4,8,9,12	5,7,10,12	12

Next, the reachability set L(fi), antecedent set P(fi), and intersection set C(fi) are obtained by hierarchical processing. The equation is:

$$C(f_i) = L(f_i) \cap P(f_i) \tag{19}$$

Finally, the ISM model is determined by the reachability set and intersection set.

RESULTS

Based on a review and analysis of the literature, 12 aspects and 29 criteria are summarized in this paper. Seven experts were interviewed, and their opinions on the impact relationship between these aspects and criteria were obtained by scoring.

All the experts have been engaged in the field of entrepreneurship education for more than 10 years and have rich practical experience. We introduced the purpose of the study to the experts and explained the connotation of attributes. Seven experts discussed the proposed attributes over and over again to ensure the reliability of the study. Then, the experts evaluated the degree of influence between attributes and filled in the questionnaires. This process takes the form of individual face-to-face interviews to ensure that the experts' judgments are not affected. Finally, the original data in the questionnaires are processed to get the research results.

According to the CFCS method, the original data of 12 aspects are processed to obtain the direct relation matrix of the aspects as shown in **Table 3**.

Normalize the direct relation matrix to get a normalized direct relation matrix. Then, Equation (10) is used to obtain the total relation matrix as shown in **Table 4**.

According to Equations (11)–(14), the driving power (D), dependence power (R), centrality (D+R), and causality (D−R) are calculated as shown in **Table 5**. The cause and effect diagram of the aspects is made as shown in **Figure 1**.

The driving power reflects the influence degree of the aspect on other aspects, and the dependence power indicates the influence degree of the aspect by other aspects. The causality clarifies the causal relationship between the aspects. The aspect with a positive causality has a greater influence on other aspects, and the aspect with a negative causality means that it is more affected by other aspects. The centrality reflects the position and importance of each aspect in the system. The greater the value, the more important the aspect is. The aspects with large values of both causality and centrality are located in the first quadrant of the cause-and-effect diagram (**Figure 1**). They are the aspects that can drive the achievement of other aspects and have a high degree of importance and need to be given priority in the case of limited resources.

According to the size of causality (D−R), 12 aspects are divided into the cause group and the effect group. As can be seen from **Figure 1** and **Table 5**, seven aspects belong to the cause group, including production management (A1), logistics management (A2), psychology (A5), business opportunities (A7), institution (A10), financial management (A11), and leadership (A12). Among them, A5, A7, and A10

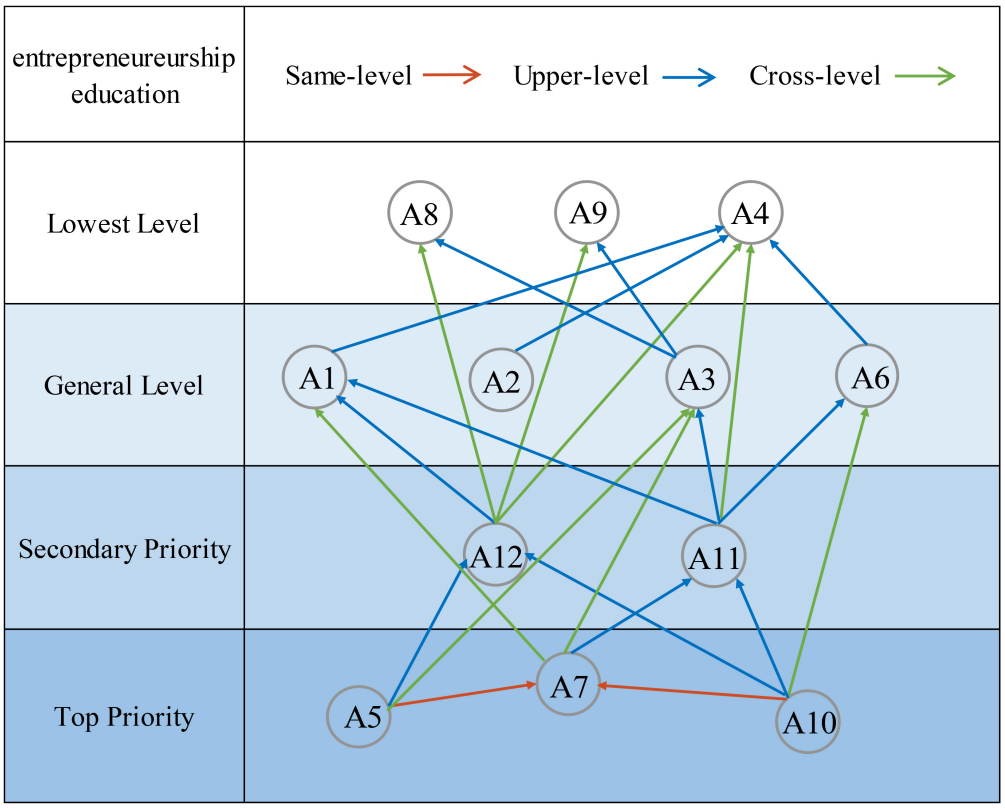

FIGURE 3 | ISM model.

are the main driving aspects and have a great impact on other aspects. This is because entrepreneurship is inseparable from opportunities and institutions. The development of opportunities and the recognition from the system are the prerequisites for entrepreneurship. In addition, a strong psychological quality is the key to entrepreneurial success, and instilling entrepreneurial traits in the educated should be valued. In addition, there are five aspects in the effect group, including marketing management (A3), human resource management (A4), monetary decisions (A6), business ethics (A8), and corporate culture (A9). These aspects have a weak impact on entrepreneurship education and are more susceptible to other aspects. Therefore, these aspects should be given proper attention and control to help to improve the effect of entrepreneurship education. In terms of centrality, the priority of aspects is in the order of A7, A10, A5, A12, A11, A3, A1, A2, A6, A4, A8, and A9. Based on the above, it can be seen that A5, A7, and A10 are the crucial aspects, and the relevant measures should be taken into account.

Again, the CFCS method is used to process the original data of 29 criteria, and the direct relation matrix of the criteria is generated as shown in **Table 6**.

Next, Equations (9) and (10) are used to get the total relation matrix of the criteria as shown in **Table 7**.

Finally, Equations (11)–(14) are used to calculate the driving power (D), dependence power (R), centrality (D+R), and causality (D−R), and the results are shown in **Table 8**.

The cause-and-effect diagram of the criteria is made as shown in **Figure 2**.

As can be seen from **Figure 2** and **Table 8**, there are 14 criteria that belong to the cause group, including C1, C3, C5, C7, C11, C13, C14, C17, C18, C23, C26, C27, C28, and C29, and C2, C4, C6, C8, C9, C10, C12, C15, C16, C19, C20, C21, C22, C24, and C25 are in the effect group. In addition, the cultivation of self-efficacy (C13) under A5, the identification of discovery opportunities (C17) and creative opportunities (C18) under A7, and formal institutional entrepreneurship (C23) under A10 are four important driving criteria of entrepreneurship education with the application of big data technology.

After that, the ISM method is used to get the hierarchical framework. Based on Equations (15)–(18) and the total relation matrix of the aspects, the reachability matrix is generated as shown in **Table 9**.

Then the reachability set L(fi), antecedent set P(fi), and intersection set C(fi) are obtained from the reachability matrix and Equation (19) as shown in **Table 10**.

As can be seen from **Table 10**, the reachability set and the antecedent set intersect in three aspects of A4, A8, and A9, which constitute a level of the hierarchical framework. The rows and columns mapped by A4, A8, and A9 in the reachability matrix are deleted to obtain a higher-level decomposition structure, and the above processes are performed repeatedly. After several hierarchical divisions, the factor set Nq (q = 1, 2,…, 5) of each

layer is finally obtained: N1 = {A4, A8, A9}; N2 = {A1, A2, A3, A6}; N3 = {A11, A12}; N4 = {A7}; N5 = {A5, A10}. Based on the above analysis, the ISM model is established and shown in **Figure 3**. It can be seen that A5, A7, and A10 are the rooted aspects of entrepreneurship education affecting other aspects and should be given priority consideration.

In summary, the attributes that affect entrepreneurship education are complex, and there are interactions between each level. Different attributes have different influencing modes and mechanisms, thus forming a systematic integration framework of entrepreneurship education under big data.

DISCUSSION AND CONCLUSION

Discussion

There are few studies on the application of big data technology to the field of entrepreneurship education. This study systematically proposes a set of criteria for the development of entrepreneurship education and offers a new hierarchical theoretical framework. The results reveal that the hierarchical theoretical framework can be divided into four levels.

Throughout the framework, business opportunities (A7), psychology (A5), and institution (A10) are at the first level. Although these are three different aspects of entrepreneurship education, they are not isolated from each other and reflect the characteristics of entrepreneurship indirectly. First, the identification of business opportunities is at the first level, which is in line with core entrepreneurship theory. Entrepreneurship itself is a process of chasing and realizing business opportunities (Shane and Venkataraman, 2000). As the external environmental factor of entrepreneurship, the aspect of the institution is at the first level, which is consistent with the theory of legitimacy (Zimmerman and Zeitz, 2002). The theory of legitimacy emphasizes that the success of institutional entrepreneurship depends on the acquisition of legitimacy, and new ventures must surmount the obstacle of legitimacy and be recognized by the system. There is a certain correlation between the aspects of institution and business opportunities in this paper. The results show that institutional education has an impact on the identification and acquisition of business opportunities. Finally, the aspect of psychology is at the first level, which is consistent with existing research on entrepreneurial psychology (Ismail and Zain, 2015). Psychological education is related to the personal characteristics of entrepreneurs, which influences the identification of opportunities and is the key to the success of entrepreneurship education. It can be seen that, at the first level, the results not only validate the theory of institutional entrepreneurship (Maguire et al., 2004; Greenwood and Suddaby, 2006), but also verify the importance of developing opportunities and instilling entrepreneurial traits in entrepreneurship education.

As a new aspect, leadership (A12) has been developed in this paper, which is relatively rare in the field of entrepreneurship education. This aspect has a deep relationship with behavioral theories of leadership, emphasizing that the leadership behavior of entrepreneurs has an important impact on corporate performance (Chandler and Hanks, 1994). The development of this aspect needs to use big data technology to study successful leadership cases and explore the best ways to achieve leadership effectiveness to enhance transactional leadership and transformational leadership. The two aspects of leadership and psychology are closely related, and they are, respectively, associated with the behaviors and traits of leaders. The results show that they are at a relatively high level, which is consistent with the upper echelons theory. The upper echelons theory claims that the organization is the reflection of its top managers, whose values, characteristics, and behaviors play a decisive role in the strategic choice and organizational performance of the enterprise (Hambrick and Mason, 1984; Tecle and Ayako, 2016; Georgakakis et al., 2017). The results of this paper not only reflect the combination of behavioral theories and trait theory of leadership, but also prove the importance of upper managers' traits and entrepreneurs' leadership behaviors in organizations (Marshall et al., 1995). Apart from the aspect of leadership discussed above, financial management (A11) is also located on the second level and is identified as a significant aspect. It precedes processes of value creating in entrepreneurship and is valued by entrepreneurship education. Financial management stresses the integration of the financial department with other departments, the forecast of financial conditions, and the assessment and avoidance of financial risks, which reflects the importance that entrepreneurs place on cash flow and the need for risk defense (Forlani and Mullins, 2000).

The third level is the development stage of formal entrepreneurial activities, which is a process of developing opportunities and creating value. Hence, this level is mainly based on the theory of the value chain, involving the four aspects of production management (A1), logistics management (A2), marketing management (A3), and monetary decisions (A6). All links complement each other and have vital connections. For example, feedback from customers reveals new demand, which is part of the identification of business opportunities and can provide corresponding information for the adjustment of corporate production plans so that the products can meet customer demand. In addition, in the operation process of value creating, the role of big data technology is mainly related to reducing costs, ensuring quality, interacting and sharing information, and optimizing decisions, which maximizes the value created by the enterprise. In addition, the results reveal that the activities of value creating are affected by aspects located on the first two levels. Entrepreneurship theory emphasizes that the success of entrepreneurial activities depends on entrepreneurs (McGrath and MacMillan, 2000), and the realization of value creating is influenced by the behavior of leaders. Apart from this, there is an important correlation between value-creating activities of enterprises and the external institutional environment, which may explain why uncertain institutional factors are significant factors in economic development. Finally, the results indicate that the value-creating processes are affected by the types of business opportunities and the identification and evaluation of business opportunities. The realization of corporate value-creating activities depends on the identification of different

types of opportunities and the acquisition and integration of resources (Sirmon et al., 2007).

Human resource management (A4), business ethics (A8), and corporate culture (A9) are at the last level. The construction of these three aspects requires the participation and cooperation of all employees, which needs to go through a long and complex process and is affected by aspects on the first three levels. Human resource management is at this level, reflecting the long-term nature of human resource development. Additionally, the construction of business ethics and corporate culture is mostly related to awareness of corporate social responsibility and environmental protection, which is an important way for companies to gain social benefits. Business ethics and corporate culture are at the last level, which also shows that the shaping of ethics and values is still behind economic construction. It is related to the nature of entrepreneurship. Entrepreneurship itself is different from operating large mature enterprises. For start-ups, the main goals of the early stage are still to create economic benefits to maintain the survival and development of the enterprise (Gao et al., 2018). However, if we expand our vision to mature enterprises, social and economic benefits may be equally important, which reflects the pursuit of long-term interests and is in line with the theory of corporate social responsibility.

Implications

The research of this paper has some implications. First of all, this paper has certain theoretical implications. The study considers the theories of entrepreneurship (development of business opportunities, acquisition of legitimacy, etc.), leadership (traits and behaviors), and strategic management (value chain model). By sorting out the existing literature, the attribute system is constructed, covering 12 aspects and 29 criteria related to entrepreneurship education, which is innovative and forward-looking. Second, in terms of methodological implications, the fuzzy-DEMATEL hybrid method is used to evaluate the complex relationship among 12 aspects and 29 criteria, and the key driving aspects and criteria in entrepreneurship education are revealed, which helps to manage the multiattribute decision making of entrepreneurship education. At the same time, the use of fuzzy set theory overcomes the problem of linguistic preferences, and the credibility of the results is enhanced. In addition, the research divides 12 aspects of entrepreneurship education into four levels by using the ISM method, clarifies the influence paths among the levels, and finally constructs a systematic and clear hierarchical framework, which is helpful for managers to conduct overall management and control of entrepreneurship education from a macro perspective. Finally, the results show that the attributes of entrepreneurship education under big data technology can be divided into four levels, which can also clearly and systematically reveal the priority of the different levels. The results of this paper are not only the verification of classic theories, but also the innovative guidance of entrepreneurship education, which is of great significance to the sustainable development of entrepreneurs and new ventures.

Limitations and Future Research

Previous research on entrepreneurship education focuses on entrepreneurship education in college at the traditional level, lacking quantitative research and a systematic framework. Compared with previous studies, this paper considers the upgrading and challenges to entrepreneurship education brought by big data technology. In addition, the object of entrepreneurship education in this article becomes more extensive, and the research plays a guiding role for all entrepreneurs. This research is based on the integration of multiple theories and takes the embeddedness of new technologies into account, which can promote the integration and systematic development of entrepreneurship education theories and provide viable suggestions for the practical application of entrepreneurship education.

However, this study still has several limitations. First, although a systematic framework has been constructed in this article, there is still a possibility of missing attributes, which needs to be further explored in future research. Second, the research is based on the questionnaire data from experts. Although fuzzy set theory is used to address linguistic preferences of experts, there are still some errors that are difficult to eliminate, which may have a certain impact on the results. Finally, the results of this paper have yet to be verified and supplemented in practice. Future research should focus on solving the above problems and constantly improve the thinking of entrepreneurship education.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

HM and CL provided the idea. YL and YG wrote the manuscript. HM and YL carried out the data analysis. All authors contributed to the article and approved the submitted version.

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Online and Face-to-Face Social Networks and Dispositional Affectivity. How to Promote Entrepreneurial Intention in Higher Education Environments to Achieve Disruptive Innovations?

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Although entrepreneurial intention has been widely studied using cognitive models, we still lack entrepreneurial vocation and, therefore, lack disruptive innovations. Entrepreneurship scholars have some understanding of the reasons underlying this weakness, although there is much room for improvement in our learning concerning how to promote entrepreneurship among university students, especially in the transformed context of digital technologies. This paper focuses on the early stages of start-up, and in particular seeks to evaluate what role social and psychological factors play in the development of entrepreneurial intentions. Drawing on network theory, we consider the impact of social networks on entrepreneurial intention. Specifically, we analyze the influence of two types of social networks: face-to-face and online social networks, with the latter proving especially important in digital transformations. In addition, based on affective congruency theory, we relate affect with entrepreneurial intention. Particularly, we evaluate the influence of positive and negative dispositional affectivity on the formation of entrepreneurial intentions. Finally, since affect and emotions can also be related with social relationships, we analyze whether dispositional affectivities influence entrepreneurial intention through the mediation effect of social networks. Using structural equation modeling, we confirm the impact of both online and face-to-face social networks, as well as positive dispositional affectivity on entrepreneurial intention for 589 higher education students in Spain. However, negative dispositional affectivity is not seen to influence entrepreneurial intention. Furthermore, both face-to-face and online social networks are influenced by positive dispositional affectivity. Moreover, these two types of networks can even partially mediate the relationship between positive dispositional affectivity and entrepreneurial intention. Positive dispositional affectivity can thus influence entrepreneurial intention in two different ways: directly and indirectly through both face-to-face and online social networks. This study provides further insights and adds to the literature on affect, social networks, and

entrepreneurial intention. From a broader perspective, we also contribute to the literature on disruptive innovations by explaining how the development of entrepreneurial intentions would have positive consequences for university students vis-à-vis achieving these disruptive innovations.

Keywords: disruptive innovation, entrepreneurial intention, social networks, dispositional affectivity, digital transformation

INTRODUCTION

Disruptive innovation is irremediably linked to entrepreneurship (Schumpeter, 1934), being considered as the underlying driver of the disruptive phenomenon (Chandra and Yang, 2011). In fact, disruptive innovations and entrepreneurship are key factors for the economic and social development (Si et al., 2020). However, entrepreneurial intentions, which are the intentions to start a new company (Krueger et al., 2000), are low, especially in the countries where the income is high. For instance, according to Global Entrepreneurship Monitor (2018), the average percentage of individuals among 18 and 64 years that manifest their intentions to start up is 20.4%. These low entrepreneurial intentions hinder disruptive innovations. This is particularly important in universities, where entrepreneurial intentions are even lower since only the 9.0% of all students intend to be an entrepreneur after finishing their studies (Global University Entrepreneurial Spirit Student's Survey, 2018). Therefore, there is a need to boost the entrepreneurial intention of university students because they have specialized knowledge and competences (Galloway and Brown, 2002). More specifically, they have knowledge and competences in terms of new technologies and Internet (Venkatesh and Morris, 2000), which are particularly valuable vis-à-vis creating disruptive innovations. Entrepreneurial intentions are crucial to understanding entrepreneurship, involving careful planning and thinking by the individual in a cognitive way (Bird, 1988). Traditionally, entrepreneurial intention has been studied with different cognitive models derived from psychology, such as the entrepreneurial event model (Shapero and Sokol, 1982) or theory of planned behavior (Ajzen, 1991).

However, these cognitive models fail to fully take account of the fact that individuals are influenced by their environment. As argued by Bandura (1986), cognition is not isolated in internal processes of individuals because it is interdependent with their physical and social environment. In this sense, previous research has considered that social environment interacts with individuals to boost the discovery, exploration and exploitation of opportunities (De Carolis and Saparito, 2006; Corbett, 2007). One key element of a person's social environment is their social networks (face-to-face and online) since individuals maintain social relationships with a large number of other people (Hoang and Antoncic, 2003). Face-to-face networks are based on physical relationships that individuals maintain in their daily lives over long periods (Gedajlovic et al., 2013). Network theory has explained the key role played by face-to-face social networks in entrepreneurship (e.g., Hoang and Antoncic, 2003; Jack, 2010). Nevertheless, the Internet, and particularly social network sites (SNSs) such as Facebook or Twitter, have changed physical relationships, especially for university students since the latter use online social networks extensively to connect with other people (Subrahmanyam et al., 2008). Moreover, these online social networks can promote business innovations through information and knowledge sharing (Pérez-González et al., 2017), thereby supporting entrepreneurial activities (Smith et al., 2017). Since literature suggests that face-to-face and online social networks may be different constructs with different consequences (Gil de Zúñiga et al., 2017), we address the influence of both face-to-face and online social networks in entrepreneurial intention.

Furthermore, over the last decade interest has arisen vis-à-vis the role of affect and emotions in entrepreneurship. Traditional psychological studies consider the association of affect and cognition (Zajonc, 1980; Lazarus, 1982), suggesting that any analysis of an individual's cognition requires a careful understanding of their emotions (Forgas, 1995). Drawing on this argument, entrepreneurship research has considered the relevance of affect on entrepreneurial processes (Baron, 2008; Delgado-García et al., 2015), such as opportunity evaluation (Foo, 2011), opportunity exploitation (Grichnik et al., 2010) and self-employment transitions (Nikolaev et al., 2019). Despite these studies, the earlier stages of entrepreneurial process have received less attention by previous literature (Delgado-García et al., 2015). Therefore, we address this gap by building on affective congruency theory (Rusting, 1998) in order to explore the role of affect of potential entrepreneurs. This theory explains that individuals process more efficiently the information which is in line with their affect (Rusting, 1998). Among the different concepts associated with affect, we focus on dispositional affectivities defined as stable tendencies to experience positive or negative affect in the long-term (Baron, 2008) because these stable tendencies are relevant for entrepreneurial decisions (Nikolaev et al., 2019). Additionally, given the inherent characteristics of entrepreneurship, an individual's intention to become an entrepreneur does not develop over a short period, particularly with regard to the uncertainty and personal risk involved in entrepreneurship (Baron, 2008).

Therefore, we hypothesize that dispositional affectivities influence entrepreneurial intention in the same direction as affective valence (positive or negative).

Finally, individual differences in affect can have important consequences in social relationships (Keltner, 1996). Indeed, previous entrepreneurship literature suggests that affect could be one antecedent of individuals' social networks, which may have different consequences on entrepreneurship (Baron, 2008; Hayton and Cholakova, 2012). Therefore, we address this by conjecturing that dispositional affectivities may influence

entrepreneurial intention, not only because of the role they pay in individuals' cognition, but also by influencing the development of their social networks. Our research explores whether affect and emotions provide the first step toward developing face-to-face and online social networks which, in turn, might influence entrepreneurial intentions; i.e., the relationship between affect and entrepreneurial intention and whether this relation is mediated by social networks. We test these hypotheses in a sample of 589 university students from two universities in Spain.

This research makes various contributions to entrepreneurship research. First, we advance research by considering how social networks influence entrepreneurial intention. In particular, we analyze what influence social network size (both online and face-to-face) has on entrepreneurial intentions. Therefore, we simultaneously consider both the social environment and entrepreneurial cognition, and provide a fuller explanation than those which simply examine either one or the other (De Carolis and Saparito, 2006; De Carolis et al., 2009). Second, we extend prior research on the role of affect in entrepreneurship by considering the influence of dispositional affectivities on entrepreneurial intention, beyond traditional cognitive intention models (Shapero and Sokol, 1982; Ajzen, 1991). In this sense, our study follows the recommendation of Baron (2008) with regard to exploring the interaction of affect and cognition in an effort to enhance research on entrepreneurial cognition. Third, we also contribute to the research on entrepreneurial intention by analyzing the dual role of dispositional affectivities in entrepreneurial cognition and by revealing the cognitive and social mechanisms that underlie this influence. We thus respond to Fayolle and Liñán's (2014) suggestion to expand the antecedents, moderators, and mediators of entrepreneurial intention in order to increase our knowledge thereof. Finally, from a broader perspective, we contribute to the literature on disruptive innovations, which has found that SNSs promote disruptive innovations in established companies (Scuotto et al., 2017). We extend this to previous stages of the start-up process by explaining how SNSs, in conjunction with dispositional affectivities, encourage disruptive innovations through the development of individuals' entrepreneurial intention. In this sense, entrepreneurship theories may be a unique source of insights for advancing in the study of disruptive innovations since the objective of study would be evaluated differently (Christensen et al., 2016).

THEORETICAL BACKGROUND

Social networks consist on "a set of actors and some set of relationships that link them" (Hoang and Antoncic, 2003). These social relations are a fundamental element of everyone's life (Kim and Aldrich, 2005). Individuals currently have two types of social networks: face-to-face and online. Face-to-face are the physical networks that people have in their daily lives over long periods (Gedajlovic et al., 2013). Nevertheless, SNSs are key to supplementing these physical networks. SNSs such as Facebook or Twitter are web-based services where individuals construct a public profile within a system, articulate a list of other individuals that share a connection with them and view their list of connections and the lists of others (Boyd and Ellison, 2007). Therefore, SNSs create a context that favors meaningful communicative exchanges and potential benefits (Ellison et al., 2014).

Previous research on entrepreneurship has found that face-to-face social networks influence the different entrepreneurial processes and outcomes (Hoang and Antoncic, 2003; Jack, 2010). These studies have usually employed network theory arguments that social networks have a significant impact on the type and extent of resources acquired by entrepreneurs (Jack, 2005). Therefore, these social networks may contribute earlier, developing a willingness to create a new company, which has not been widely studied in entrepreneurship (Bonesso et al., 2018). Furthermore, online social networks have scarcely been considered in entrepreneurship research (Smith et al., 2017), even though entrepreneurs increasingly use these SNSs (Sigfusson and Chetty, 2013; Fischer and Reuber, 2014). SNSs offer an unprecedented opportunity for entrepreneurs to participate in interactions on a scale and in a manner not previously possible and to access new information (Reuber and Fischer, 2011). In this sense, SNSs provide an efficient and effective means to grow a business (Edosomwan et al., 2011). For instance, entrepreneurs obtain knowledge in SNSs that helps to foster innovations in small and medium-sized enterprises (Candi et al., 2018; Papa et al., 2018). Affect refers to the general phenomenon of subjective feelings (Barsade, 2002). The general phenomenon of subjective feelings includes different types of experiences such as dispositional affectivity, specific emotion, and mood. As previously commented, dispositional affectivities are stable tendencies to experience positive or negative affect in the long-term (Baron, 2008). Specific emotions are the consequence of specific events. They disappear quickly and are characterized by being highly intense. Conversely, moods are not associated to specific events, are stable and involve low intensity (Frijda, 1986). Both specific emotions and moods are affective states. Traditional research on affect has considered the impact of affect on cognition by examining the impact of affective valence (positive or negative) (Forgas, 1995; Rusting, 1998). In particular, previous research on affect has explored affective congruence arguments, which predicts that individuals process more efficiently the information that is in line with their affects. In other words, when an individual has positive or negative affect, it will be easier for him or her to perceive, attend to, learn and interpret information of the same emotional valence (Rusting, 1998). Regarding this theory, dispositional affectivities and affective states produce similar effects across situations (Rusting, 1998; Lyubomirsky et al., 2005).

Previous research on entrepreneurship has evidenced the important impact of affect and emotions on entrepreneurial cognition and decision-making (Baron, 2008; Delgado-García et al., 2015). Baron (2008) was the first to propose the role of affect in different key aspects of entrepreneurship. After this work, some authors have explored the influence of affect on different entrepreneurial processes. These authors have mainly focused in the more advanced steps of entrepreneurship (Delgado-García et al., 2015). For instance, Foo (2011) have found how

emotions influence opportunity risk perception and preferences in opportunity evaluation. In addition, Grichnik et al. (2010) have found that both positive and negative affect condition the allocation of time and resources to exploit an entrepreneurial opportunity. Finally, Nikolaev et al. (2019) have examined how positive and negative dispositional affectivities influence entry into entrepreneurship.

HYPOTHESES DEVELOPMENT

Dispositional Affectivities and Entrepreneurial Intention

Based on affective congruency (Rusting, 1998), positive affect can influence the interpretation of situations more positively (Isen et al., 1978; Isen and Shalker, 1982), leading individuals to overestimate the chances of positive outcomes (Wright and Bower, 1992; Zelenski and Larsen, 2002). In the entrepreneurial context, positive affect would encourage individuals to expect better outcomes if they decide to start up (Simon et al., 2000). In addition, when evaluating the possible outcomes of entrepreneurship, individuals take into account the inherent risks involved in entrepreneurship. Positive affect decreases how individuals consider the possibility of risks (Wright and Bower, 1992), such that they would see entrepreneurship as being less risky than it really is because they would consider the positive information about entrepreneurship from their memory (Isen et al., 1985). Finally, positive affect makes individuals trust on their knowledge (Bless et al., 1996; Foo et al., 2015) and skills (Baron, 2007), including their entrepreneurship-related knowledge and skills. Therefore, we propose:

H1: Individuals' positive dispositional affectivity is related to greater entrepreneurial intention.

Based on affective congruency (Rusting, 1998), negative affect can promote negativity bias, which is a propensity to overestimate the relevance of negative information regarding any situation (Kunda, 1999), thus triggering pessimistic evaluations (Direnfeld and Roberts, 2006). Hence, negative affect leads individuals to overestimate the possibility of negative results (Wright and Bower, 1992; Zelenski and Larsen, 2002), including the possible negative outcomes of entrepreneurship. Furthermore, negative affect leads individuals to perceive situations as threatening, such that they seek to avoid potential losses (Jorgensen, 1996). Thus, negative affect can lead individuals to consider entrepreneurship as a future high-risk option because this affect lead to the activation of negative associations and memories, influencing the judgment of the risk of entrepreneurship (Baron, 2008). Finally, negative affect influences individuals' consideration of their capabilities in a deficient manner, leading them to evaluate their knowledge (Ambady and Gray, 2002). Individuals' negative affect is therefore associated with a reduced sense of control regarding task management (Bosma et al., 1998), including the tasks required to engage in entrepreneurial behavior. Taking into account these arguments, we propose that:

H2: Individuals' negative dispositional affectivity is related to less entrepreneurial intention.

Dispositional Affectivities and Social Networks

Previous literature has considered that positive affect promotes the appearance of social relationships (Lyubomirsky et al., 2005). First, positive perspectives in individuals allow them to be more attractive in an interpersonal way (Staw et al., 1994) such that other individuals want to be with them (Srivastava et al., 2006). In fact, individuals seek communication with others who display positive affect (Watson et al., 1992; Berry and Hansen, 1996) since they believe that these social interactions will allow them to obtain greater rewards (Harker and Keltner, 2001).

Additionally, positive affect increases individuals' tendency to seek new and more varied social ties (Lucas and Diener, 2003; Andersson, 2012). In this sense, previous research has associated positive affect (Baron, 2008) and happiness (Requena, 1995) with differences in individuals' social networks, for example in the size of these social networks. Therefore, we propose:

H3a: Individuals' positive dispositional affectivity is related to them having larger face-to-face social networks.
H3b: Individuals' positive dispositional affectivity is related to them having larger online social networks.

Previous research has found that negative affect decreases social abilities (Mor and Winquist, 2002). Additionally, negative affect reduces how many social interactions an entrepreneur has (Baron, 2008) since other individuals prefer to interact less in social relationships with high negative affect individuals (Staw et al., 1994). This is because individuals' social relationships that involve negative affect typically tend to be unpleasant (Berry and Hansen, 1996). Furthermore, these individuals are less likely than others to initiate a conversation (Cunningham, 1988). They therefore interact less in social terms and, when they do socially interact, these interactions are more negative (Räikkönen et al., 1999) and shorter (Geers et al., 1998). Following this, previous literature has suggested that higher negative affect individuals tend to have smaller social networks (Lucas and Diener, 2003). Hence, we propose:

H4a: Individuals' negative dispositional affectivity is related to them having smaller face-to-face social networks.
H4b: Individuals' negative dispositional affectivity is related to them having smaller online social networks.

The Mediating Role of Social Networks

Previous research considers that the effects of personal dispositions are often related to their interaction with environmental factors (Wood and Bandura, 1989). In this sense, previous literature on entrepreneurship considers that the relationships between affect (for example, dispositional affectivities) and cognitive processes (for example, entrepreneurial intention) occur in a context of moderating and mediating environmental variables (Hmieleski and Baron, 2009). In addition, Baron (2008) proposes that affect can influence the frequency or quality of social contacts, which may

have consequences on entrepreneurship through the access to essential resources for entrepreneurs that these social networks provide. Hayton and Cholakova (2012) develop propositions regarding the influence of human capital, time invested, idea complexity or relevance to core self in the relationship between affect and the intention to develop an entrepreneurial idea. Beyond these propositions, they also suggest that affect may not only influence entrepreneurship directly through individual cognitive processes, but also more indirectly due to its influence in terms of developing the social networks through which individuals can obtain relevant information and resources. Therefore, the impact of dispositional affectivities on entrepreneurial intention may not only be the result of an individual cognitive process, but also a consequence of the mediation effect of social networks.

Drawing on the network theory, previous research has shown how prior contacts, especially friends or family, may provide resources in the start-up (Johannisson, 1988), which proves relevant in the early stages of creating a new business (Greve and Salaff, 2003). The most intuitive network component is size, i.e., the number of links between a central individual and others (Hoang and Antoncic, 2003). Entrepreneurs try to extend social networks so as to acquire important information and resources (Greve and Salaff, 2003). In fact, individuals with a larger network are well positioned to acquire the resources required for their entrepreneurial activities (Dubini and Aldrich, 1991), allowing them to have greater control over entrepreneurship (De Carolis et al., 2009). Finally, De Carolis and Saparito (2006) find that networks consisting of many contacts reduce uncertainty in exchanges, which increases an individual's belief that they will achieve the expected outcomes, making the pursuit of a new entrepreneurial opportunity more attractive. We thus propose:

H5a: The greater the size of the face-to-face social networks, the greater the entrepreneurial intention.

SNSs allow individuals to create larger and more disperse social networks (Wellman et al., 2001; Donath and Boyd, 2004) since they can interact with more individuals than they were formerly able to (Ellison et al., 2011). Indeed, as SNSs admit a broader range of individuals, each individual's networks become larger (Ellison et al., 2014), thereby providing access to different perspectives (Ellison et al., 2014). SNSs offer an infinite number of opportunities to bridge structural holes (Rainie and Wellman, 2012), which in turn increases the possibility of valuable exchanges because these structural holes provide more diverse information (Burt, 2000). Therefore, individuals with more contacts in SNSs view their chances of success in entrepreneurial opportunities positively (Fischer and Reuber, 2011). Therefore, we propose:

H5b: The greater the size of online social networks, the greater the entrepreneurial intention.

We have just explained the direct effect of social network size on entrepreneurial intention, which, together with the explained influence of dispositional affectivities on social networks and the previously mentioned arguments of Baron (2008) and Hayton and Cholakova (2012), allows us to consider the mediating role of these social networks:

H6a: The size of face-to-face networks mediates the relationship between positive dispositional affectivity and entrepreneurial intention.
H6b: The size of online networks mediates the relationship between positive dispositional affectivity and entrepreneurial intention.
H6c: The size of face-to-face networks mediates the relationship between negative dispositional affectivity and entrepreneurial intention.
H6d: The size of online networks mediates the relationship between negative dispositional affectivity and entrepreneurial intention.

The model of this study appears in **Figure 1**.

RESEARCH METHOD

Sample and Data Collection

We collected information from October to December 2017 from two public universities in Spain through a cross-sectional design[1]. We obtained 608 responses from students in their final 2 years of university, who answered questionnaires voluntarily after being informed about the objective of the study. The students were taking degrees in business or related disciplines such as finance, accounting, marketing, trade, or economics. **Table 1** shows the main characteristics of the final 589 university students in terms of gender, age, experience as self-employed and as an employee, family entrepreneur, and close friend entrepreneur, since 19 responses were removed due to missing data.

Students in our sample have, on average, roughly 1 year to make a decision regarding their professional career (Fitzsimmons and Douglas, 2011). In this sense, we follow Krueger (1993), who indicates that in order to analyze entrepreneurial intention, researchers must use samples of individuals who are now facing important career decisions. Given this relatively short period of time, students' entrepreneurial intention is likely to be the same after graduation (Audet, 2004). Additionally, this segment of the population has specific knowledge and competences that could be exploited through new ventures (Galloway and Brown, 2002), favoring disruptive innovations (Chandra and Yang, 2011). For these reasons, student samples are appropriate in studies on nascent entry into entrepreneurship (Hsu et al., 2017), and are highly prevalent in entrepreneurial intention research (Kolvereid, 1996; Krueger et al., 2000; Fitzsimmons and Douglas, 2011).

[1]Due to the cross-sectional nature of our study and although there are possible two-way causal relationships between constructs, our theoretical arguments suggest us a direction for causality. In addition, we consider dispositional affectivities as starting point because these dispositions are relatively stable and allow individuals to exhibit a certain kind of response across various situations (Watson and Clark, 1984).

Measurement Scales

We measure entrepreneurial intention with five Entrepreneurial Intent Questionnaire items (Liñán and Chen, 2009), based on prior research (Kolvereid, 1996; Krueger et al., 2000). This questionnaire has been widely used in the literature (e.g., Liñán et al., 2011; Ilouga et al., 2014; Karimi et al., 2016).

Online and face-to-face network size are measured through two items: the total number of friends that individuals connect with online or in face-to-face social networks and how many of these friends are contacted frequently, since both aspects are important in terms of these networks (Ellison et al., 2011).

Finally, we measure individuals' dispositional affectivities with the PANAS scale (Watson et al., 1988), which is a widely used scale in research on affect. We follow the adaptation in Spanish of Sandín et al. (1999). Twenty items make up this scale, with ten items being related to positive dispositional affectivity and ten to negative dispositional affectivity.

Control Variables and Common Method Bias

We use different control variables to analyze entrepreneurial intention. First, we include age since the literature has shown that age is negatively associated with the propensity for entrepreneurship (Curran and Blackburn, 2001). Additionally, previous findings have reported that women display less inclination toward entrepreneurial activities than men (Mathews and Moser, 1995). We therefore incorporate a gender dummy (1 = female; 0 = male). Furthermore, previous literature has found that both job experience (Mathews and Moser, 1995) and previous experience in entrepreneurship

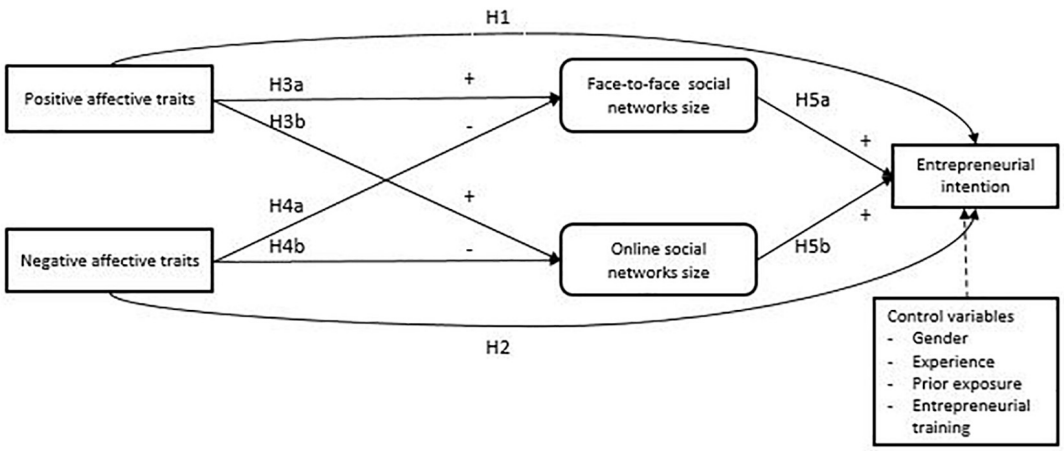

FIGURE 1 | Model of entrepreneurial intention based on social networks and dispositional affectivities.

TABLE 1 | Sample characteristics.

Gender	***N***	**% of total**	**Age**	***N***	**% of total**
Male	245	41.6	19	9	1.5
Female	344	58.4	20	90	15.2
			21	200	34.1
			22	125	21.3
			23	69	11.8
			24	28	4.8
			25	25	4.2
			>25	43	7.1
TOTAL	589	100.00	TOTAL	589	100.00
Experience as self-employed	***N***	**% of total**	**Experience as employee**		**% of total**
Yes	29	4.9	Yes	300	50.9
No	560	95.1	No	289	49.1
TOTAL	589	100.00	TOTAL	589	100.00
Family member entrepreneur	***N***	**% of total**	**Close friend entrepreneur**	***N***	**% of total**
Yes	349	59.3	Yes	293	49.7
No	240	40.7	No	296	50.3
TOTAL	589	100.00	TOTAL	589	100.00

(Shepherd, 2003) are positively associated to the likelihood of starting up. We thus create two different dummy variables (1 = respondent has previous experience as an employee or self-employee, 0 = otherwise). Finally, previous research has found the relationship between entrepreneurial training and entrepreneurial intention (Bae et al., 2014). We therefore incorporate a dummy variable regarding if the university student has received previous entrepreneurial training (1 = yes; 0 = no).

Common method bias can be a severe issue when the dependent and independent variables are measured through the perception and response of the same individual (Podsakoff et al., 2003). In order to assess the severity of this bias, we conducted a Harman one-factor test (Podsakoff and Organ, 1986) with our four main variables in order to ascertain whether variance is largely attributed to any single factor. We adopt the criterion of an eigenvalue greater than 1, and find four factors. The highest covariance explained by one factor is 19.2%. We therefore confirm that said bias is not a concern.

ANALYSIS AND RESULTS

Prior to evaluating the psychometric properties of our scales, we identify the categories of affect using principal component analysis with the varimax rotation (IBM SPSS Statistics 24). Using eigenvalue criteria, we find six categories that are higher or very close to 1: three categories of positive dispositional affectivity and another three of negative dispositional affectivity. These six categories are able to explain the 59.075% of the total variance of positive and negative affect. **Table 2** shows the different components of affect that form these six categories as well as the eigenvalues and the percentage of explained variance of each of these categories. This finding is not surprising since there are differences among affects of the same valence (Lerner and Keltner, 2000). Indeed, Watson and Clark (1999) have elaborated the PANAS-X in order to justify that affect is made up of two broad dimensions (positive and negative affect), each of which may consist of various correlated, but ultimately distinguishable specific affects.

Therefore, individuals can exhibit distinctions on the affect scales regarding a one-dimensional approach for positive and negative affect (Gaudreau et al., 2006). Following this, we consider positive dispositional and negative dispositional affectivities to be second-order constructs, decreasing the number of relationships in this complex structural model, thus making the estimation more parsimonious and easier to understand (Hair et al., 2016).

We employ structural equation modeling for statistical analysis. In particular, we use partial least squares (PLS). This is because PLS has no indeterminacy problems associated with other techniques, does not require data normality (Wittmann et al., 2009), and deal with both first-order and second-order constructs.

Measurement Model

Since PLS can handle both reflective and formative constructs (Chin and Newsted, 1999), we evaluate the measurement quality of these two different types of constructs. All the first-order constructs are reflective. The second-order constructs of positive and negative dispositional affectivities are formative. **Table 3** shows how we measured the first-order constructs. In this **Table 3**, we also assess the reflective constructs by examining item reliability, internal consistency, as well as convergent and discriminant validity (Roldán and Leal, 2003). Firstly, all items loadings of the first-order constructs are significant at $p < 0.01$ Additionally, all constructs exceed the thresholds for a Cronbach's alpha of 0.6 and a composite reliability of 0.7. Finally, the average variance extracted also exceeds the threshold of 0.5 (Fornell and Larcker, 1981).

Beyond the reflective constructs, we evaluate whether each factor contributes significantly to the second-order construct in order to statistically validate their formative character. **Table 4** shows the six factors of dispositional affectivities. The outer weights confirm that all the factors are important for the second-order construct. We also verify multicollinearity through the variance inflation factor. There are no collinearity concerns because the values of the factors are below the cut-off value of 5 (Kleinbaum et al., 2013).

Finally, in **Table 5** we evaluate the discriminant validity of the reflective measures by evaluating whether the root square of the average variance extracted is larger than the interconstruct correlations. We support this discriminant validity of our constructs. Summing up, we can affirm that all the constructs display good psychometric properties.

Structural Model

We use bootstrapping (2000) in SmartPLS 3.0 to randomly generate subsamples that determine whether the Beta coefficients (β) are significant. Results are shown in **Table 6**.

First, positive dispositional affectivity positively and significantly influences entrepreneurial intention ($\beta = 0.234$, $p = 0.000$), thereby supporting H1. However, we do not find support for H2 because negative dispositional affectivity has no significant influence on entrepreneurial intention ($\beta = -0.030$, $p = 0.200$). Furthermore, positive dispositional affectivity positively influences both face-to-face social network size ($\beta = 0.188$, $p = 0.000$) and online social network size ($\beta = 0.210$, $p = 0.000$), such that we find support for H3a and H3b respectively. However, we do not obtain support for H4a and H4b because negative dispositional affectivity has no significant impact on either face-to-face social network size ($\beta = -0.046$, $p = 0.112$) or online social network size ($\beta = -0.030$, $p = 0.225$). As regards the latter direct effects, entrepreneurial intention is also positively and significantly influenced by both face-to-face social network size ($\beta = 0.061$, $p = 0.048$) and online social network size ($\beta = 0.098$, $p = 0.009$). Therefore, we find support for H5a and H5b, respectively.

Regarding control variables, results show that men have significantly higher entrepreneurial intention than women ($\beta = -0.149$, $p < 0.001$). In addition, previous experience as employee ($\beta = 0.144$, $p < 0.001$), having an entrepreneur in their family ($\beta = 0.131$, $p < 0.001$) and having previous entrepreneurial training ($\beta = 0.118$, $p < 0.001$) are also significant

TABLE 2 | Results of PANAS factorial analysis.

PA1	PA2	PA3	NA1	NA2	NA3
λ = 4.112	**λ = 0.989**	**λ = 0.949**	**λ = 3.312**	**λ = 1.355**	**λ = 1.104**
% EV = 20.560	**% EV = 4.946**	**% EV = 4.712**	**% EV = 16.561**	**% EV = 6.777**	**% EV = 5.519**
Active	Alert	Interested	Afraid	Hostile	Distressed
Enthusiastic	Attentive		Ashamed	Irritable	Jittery
Excited	Determined		Guilty	Upset	Nervous
Proud	Inspired		Scared		
Strong					

λ*, eigenfactor; EV, explained variance of each factor.*

TABLE 3 | Reliability and convergent validity.

Construct/indicator	Factor loading
Entrepreneurial intention (α = 0.941, AVE = 0.833, CR = 0.961) Rate the following statements:	
I am ready to do whatever it takes to become an entrepreneur	0.849**
My professional goal is to become an entrepreneur	0.923**
I will make every effort to create and run my own company	0.924**
I am determined to set up a firm in the future	0.932**
I have seriously thought about starting a business in the future	0.870**
Online network size (α = 0.607, AVE = 0.716, CR = 0.835)	
With how many different people, approximately, are you connected through SNSs?	0.855**
With how many of these people do you maintain frequent contact through SNSs?	0.829**
Face-to-face network size (α = 0.899, AVE = 0.668, CR = 0.923)	
With how many different people, approximately, are you connected in a personal way?	0.910**
With how many of these people do you maintain frequent contact in a personal way?	0.952**
Positive affect 1 (α = 0.762, AVE = 0.520, CR = 0.844)	
Active	0.733**
Enthusiastic	0.694**
Excited	0.729**
Proud	0.658**
Strong	0.763**
Positive affect 2 (α = 0.627, AVE = 0.510, CR = 0.786)	0.678**
Alert	0.649**
Attentive	0.775**
Determined	0.635**
Inspired Positive affect 3 (n.a.) Interested	1.000**
Negative affect 1 (α = 0.685, AVE = 0.524, CR = 0.814)	
Afraid	0.682**
Ashamed	0.704**
Guilty	0.710**
Scared	0.763**
Negative affect 2 (α = 0.694, AVE = 0.633, CR = 0.837)	0.807**
Hostile	0.824**
Irritable	0.726**
Upset	0.737**
Negative affect 3 (α = 0.696, AVE = 0.632, CR = 0.837)	0.801**
Distressed Jittery Nervous	0.825**

***$p < 0.01$.*

for entrepreneurial intention. However, to have experience as self-employed (β = 0.037, $p > 0.05$) or a close friend entrepreneur (β = 0.030, $p > 0.05$) are not significantly related to entrepreneurial intention. In sum, the control variables have significant effects on entrepreneurial intention.

Finally, to clarify the implications of the previous findings, we obtain in PLS the β of each specific indirect effect of dispositional affectivities on entrepreneurial intention through the size of face-to-face and face-to-face social networks. Thus, we also calculate the total effect of dispositional affectivities on entrepreneurial

TABLE 4 | Quality criteria of second-order measurement.

Formative second-order construct facets/components	Outer weights	VIF
Positive affect		
PA1: excited, strong, enthusiastic, proud, active	0.662**	1.545
PA2: alert, inspired determined, attentive	0.424**	1.557
PA3: interested	0.091**	1.061
Negative affect		
NA1: guilty, scared, ashamed, afraid	0.444**	1.337
NA2: hostile, irritable, upset	0.391**	1.393
NA3: distressed, nervous, jittery	0.419**	1.512

*Bias-corrected bootstrap significance levels: **p < 0.01 (one-tailed test). VIF, variance inflation factor.*

intention. As **Table 5** shows, we obtain four specific indirect effects. First, face-to-face social network size significantly and positively mediates (β = 0.012, $p = 0.089$) the relationship between positive dispositional affectivities and entrepreneurial intention, thus supporting H6a. We also obtain support for H6b because this same relationship is mediated significantly and positively by online social network size (β = 0.021, $p = 0.028$). These mediating effects are partial because, as mentioned, the direct effect of positive dispositional affectivity on entrepreneurial intention is also significantly positive. Adding the two indirect effects and the direct effect, we obtain the total effect of positive dispositional affectivity on entrepreneurial intention (0.266). In contrast, in the relationship between negative dispositional affectivity and entrepreneurial intention, we find no significant mediating role of either face-to-face social network size (β = −0.003, $p = 0.291$) or online social network size (β = −0.003, $p = 0.345$), such that H6c and H6d are not supported. The total effect of negative dispositional affectivity on entrepreneurial intention is −0.036.

DISCUSSION

This study expands previous research by evaluating the combined influence of affect and social networks on entrepreneurial intention for students in higher education institutions in order to promote new ventures and disruptive innovations among them. First, prior research has found that social networks are a key element when establishing a new firm (Greve and Salaff, 2003; Jack, 2010). Based on networks theory, our findings suggest that both face-to-face and online social networks are also important in the early cognitive steps of entrepreneurship. In this sense, this study responds to De Carolis et al.'s (2009) suggestion that entrepreneurship research can examine how the environment impacts cognition and ultimately affects entrepreneurship.

Second, drawing on affective congruency theory (Rusting, 1998), this research contributes to the research on affect and entrepreneurship by evaluating the importance of dispositional affectivities on entrepreneurial intention. Previous studies have explored the role of affect on several entrepreneurial processes (Baron, 2008; Grichnik et al., 2010; Foo, 2011; Nikolaev et al., 2019), although current understanding of how affect and emotion might impact entrepreneurial cognition, particularly in the early stages of entrepreneurship, remains in its infancy (Delgado-García et al., 2015). We therefore expand previous research into the influence of affect on the first cognitive steps of entrepreneurship. Additionally, we confirm that individuals' positive affect usually relates to having more extensive social networks than individuals' negative affect (Lucas and Diener, 2003; Baron, 2008). Thus, these face-to-face and online social networks are a partial mediator of the influence of dispositional affectivities on entrepreneurship, which is line with previous suggestions of literature (Baron, 2008; Hayton and Cholakova, 2012).

From a broader perspective, we contribute to the literature on disruptive innovations by explaining how social networks and dispositional affectivities promote entrepreneurial intentions. Over the past years, disruptive innovation has been widely linked to the study of entrepreneurship (Si et al., 2020). Taking into account that entrepreneurial activity is associated with disruptive innovation (Schumpeter, 1934), the development of entrepreneurial intentions would have positive consequences for university students vis-à-vis achieving these disruptive innovations. In particular, in the current context of digital transformation, individuals can use online social networks to promote disruptive innovations, not only in established companies (Scuotto et al., 2017), but also when creating new companies, as a way of taking advantage of these innovations (Si et al., 2020). In this research, we follow the suggestion of Christensen et al. (2016) regarding the use of entrepreneurship literature in order to advance in the study of disruptive innovations from a different point of view. First, our results show that positive dispositional affectivity positively influences entrepreneurial intention. These results are consistent with Hayton and Cholakova's (2012) proposition concerning the influence of positive affect on the intention to develop an entrepreneurial idea. In a more general view, these findings are in line with previous literature regarding the importance of positive affect as an element for the cognitive processes of entrepreneurship (Baron, 2008). However, negative dispositional affectivity is seen to have no influence on entrepreneurial intention. Although this finding might at first seem surprising, this is not fully the case. Positive and negative valence of affect do not always produce opposite effects (Lerner and Keltner, 2000). In a recent meta-analysis, Fodor and Pintea (2017) have found a significant positive relation between positive affect and entrepreneurial performance, but the influence of negative affect on entrepreneurial performance is no significant. Our finding could be explained because negative affect encourages individuals to make a greater effort and to engage in a deeper search to identify opportunities (Foo et al., 2015). Individuals' negative dispositional affectivity would not influence entrepreneurial intention, but might impact subsequent steps of entrepreneurship, given that those who display high negative dispositional affectivity would exhibit entrepreneurial intention (or not), yet might be more cautious than individuals who evidence positive dispositional affectivity.

TABLE 5 | Zero-order correlations and discriminant validity.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Entrepreneurial intention	0.913														
2. Online network size	0.204	**0.846**													
3. Face-to-face network size	0.178	0.402	**0.938**												
4. Positive affect 1	0.259	0.224	0.173	**0.721**											
5. Positive affect 2	0.270	0.131	0.158	0.589	**0.693**										
6. Positive affect 3	0.211	0.069	0.096	0.221	0.204	—									
7. Negative affect 1	−0.002	−0.074	−0.053	−0.087	−0.093	−0.033	**0.723**								
8. Negative affect 2	−0.082	−0.043	−0.018	−0.153	−0.060	−0.035	0.391	**0.795**							
9. Negative affect 3	−0.066	−0.005	−0.086	−0.049	−0.011	−0.081	0.468	0.501	**0.795**						
10. Gender	−0.168	−0.021	−0.193	−0.036	−0.062	0.079	−0.007	0.011	0.072	—					
11. Experience as self-employed	0.135	0.092	0.061	0.136	0.144	0.051	−0.022	−0.013	−0.011	−0.094	—				
12. Experience as employee	0.195	0.091	−0.003	0.140	0.097	0.086	−0.013	−0.039	−0.004	−0.056	0.209	—			
13. Entrepreneur in family	0.150	0.029	−0.009	0.039	0.056	0.080	0.069	0.000	0.037	0.018	0.063	0.078	—		
14. Close friend entrepreneur	0.086	0.161	0.111	0.121	0.142	−0.020	−0.087	−0.040	−0.091	−0.084	0.086	0.166	0.060	—	
15. Entrepreneurial training	0.178	0.119	0.084	0.036	0.097	0.077	0.017	0.002	0.034	−0.109	0.117	0.103	0.005	0.116	—

The diagonal corresponds to the root square of average variance extracted.

Furthermore, our results show that both online and face-to-face social networks are positively influenced by positive dispositional affectivity. These results are consistent with previous literature, which has related face-to-face social networks with positive affect (Baron, 2008) and happiness (Requena, 1995). In the case of online networks, we confirm previous research linking psychological well-being, which is related to positive affect, with online network size (Steinfield et al., 2008). Therefore, the ability to be positive within social networks forms a key part of them (Leyden et al., 2014). However, negative dispositional affectivity was found to have no impact on either face-to-face or online networks. As for entrepreneurial intention, positive and negative valence of affect do not always produce opposite effects (Lerner and Keltner, 2000). Indeed, some previous studies have failed to find any relationship between negative affect and social activity (Watson et al., 1992) or have even found a positive relationship between negative affect and social interaction because individuals with negative affect can try to engage in social interactions in order to regulate their negative affect (Berry and Hansen, 1996). Although these studies are based on face-to-face networks, in online networks this situation should be even more pronounced. In these networks, repeated exchanges are more likely because time is compressed, interactions are accelerated, and individuals are more accessible (Baym, 2010). Therefore, individuals with negative affect can interact continuously in order to address their negative affect.

Finally, we discuss the mediating effects of social network size on the relationship between dispositional affectivities and entrepreneurial intention. As regards direct effects, face-to-face social networks positively influence entrepreneurial intention. This result is in line with previous literature concerning the importance of social networks for obtaining resources in the early stages of entrepreneurship (Greve and Salaff, 2003; De Carolis et al., 2009). Our results also show the positive significance of online social networks on entrepreneurial intention. So far, most of the literature on social networks in entrepreneurship has focused on the face-to-face context (Jack, 2010; Gedajlovic et al., 2013). However, the way in which social networks are developed has changed in recent years and the use of online social networks by entrepreneurs forms an important part of their networking activities (Fischer and Reuber, 2011; Sigfusson and Chetty, 2013; Smith et al., 2017), such that our study provides further insights into entrepreneurial intention research by considering the digital transformation context. Although we do not compare online and face-to-face networks, our results suggest a greater importance of online networks than face-to-face networks for entrepreneurial intention. This could be explained by the fact that individuals have many more contacts in online networks than in face-to-face ones (Ellison et al., 2014), and obtain more knowledge and information for promoting innovation (Pérez-González et al., 2017). Furthermore, our results confirm a partially mediating effect of social network size (both online and face-to-face) on the relationship between positive dispositional affectivity and entrepreneurial intention. However, this mediating effect is not important in the case of negative dispositional affectivity. As explained, negative dispositional affectivity influences neither intention nor social network size, such that its mediating effect

TABLE 6 | Standardized parameter estimates.

Hypotheses	Direct effect	Outcome	
Direct effects			
Positive dispositional affectivity → Entrepreneurial intention	0.234***	H1 supported	
Negative dispositional affectivity → Entrepreneurial intention	−0.030	H2 not supported	
Positive dispositional affectivity → Face-to-face social network size	0.188***	H3a supported	
Positive dispositional affectivity → Online social network size	0.210***	H3b supported	
Negative dispositional affectivity → Face-to-face social network size	−0.046	H4a not supported	
Negative dispositional affectivity → Online social network size	−0.030	H4b not supported	
Face-to-face social network size → Entrepreneurial intention	0.061**	H5a supported	
Online social network size → Entrepreneurial intention	0.098***	H5b supported	
Mediating effects	**Indirect effect**	**Total effect**	**Outcome**
Positive dispositional affectivity → Face-to-face social network size → Entrepreneurial intention	0.012**	0.266***	H6a partially supported
Positive dispositional affectivity → Online social network size→ Entrepreneurial intention	0.021*	0.266***	H6b partially supported
Negative dispositional affectivity → Face-to-face social network size → Entrepreneurial intention	−0.003	−0.036	H6c not supported
Negative dispositional affectivity → Online social network size → Entrepreneurial intention	−0.003	−0.036	H6d not supported
Control relationships			
Gender → Entrepreneurial intention	−0.120***		
Experience as employee → Entrepreneurial intention	0.121***		
Experience as self-employed → Entrepreneurial intention	0.029		
Family member entrepreneur → Entrepreneurial intention	0.126***		
Close friend entrepreneur → Entrepreneurial intention	−0.026		
Entrepreneurial training → Entrepreneurial intention	0.118***		
R^2 of entrepreneurial intention	**0.190**		
R^2 of face-to-face social network size	**0.039**		
R^2 of online social network size	**0.046**		

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. The bold values are referred to the R square in order to show the importance of it.

cannot be significant. Therefore, we go one step further than previous literature's suggestion regarding the possible indirect impact of affect on entrepreneurship when developing social networks (Baron, 2008; Hayton and Cholakova, 2012), and confirm that only positive affect (and not negative affect) influence entrepreneurship both directly and indirectly (through social networks). This result is in line with Baron (2007), who considers that positive affect is a more important trait for entrepreneurship than negative affect. Anyway, we cannot forget that the direct effect of positive dispositional affectivity is much greater than the indirect effect. This suggests that, in terms of entrepreneurial intention, individuals at first use the interaction of affect and cognition as an internal and even unconscious process. They then consider how this affect is shaped by the social environment, as a more external process, in order to influence cognition. It also suggests that the impact of affect on entrepreneurial intention is partly based on an objective/measurable variable, social network size, and on a more direct path through the influence of affect on individuals' perceptions and expectations, which may be biased.

Practical Implications

Beyond its theoretical contribution, our study has practical implications. First, we show that both dispositional affectivities and social networks (face-to-face and online) are important as drivers of entrepreneurial intention and, thus, for the design of specific training programs by institutions that promote entrepreneurial action and disruptive innovations (Fayolle et al., 2006). For example, universities should promote the development of social and psychological abilities among business students, by studying topics related to social psychology. By developing such social skills, students could understand the complementary nature of face-to-face and online networks and the importance of positive dispositional affectivity in order to further these networks and promote entrepreneurial intention and disruptive innovation. Additionally, our finding that positive dispositional affectivity (and not negative dispositional affectivity) has two different paths for influencing entrepreneurial intention, either directly in a subjective way or through social networks in a more objective manner, can be used by different institutions that support entrepreneurship. When individuals apply for funding to start up, these institutions can analyze their dispositional affectivities, and to what extent these individuals use them to develop their entrepreneurial intentions directly or through social networks. This will help choose which individuals are best suited to undertaking entrepreneurial projects that will lead to disruptive innovations.

Limitations

Our research has several limitations. First, the relationship among dispositional affectivities, networks and cognition is likely to be complex and multidirectional. Despite evidencing certain

benefits, our cross-sectional analysis only allows us to study one causal direction of the suggested relations. Although these relations are based on theoretical arguments, future research could evaluate them through longitudinal research. Second, our study focuses on a sample of university students because they have specialized knowledge and competences (Galloway and Brown, 2002), especially in terms of new technologies and Internet (Venkatesh and Morris, 2000), which can favor disruptive innovations. Furthermore, university student samples have the advantage of evaluating individuals who are the same age and who display the same skills, thus endowing the sample with homogeneity. However, precisely because they are all students means that we are unable to know whether the results would also apply to broader samples of individuals. Future research may analyze our model in other samples, particularly of individuals who have already finished their university degrees or vocational education. Eventually, the factors of positive and negative dispositional affectivities are not completely equal to previous scales such as PANAS or PANAS-X. However, second-order modeling allows us to test our hypotheses correctly.

Future Research

Our research points to several future lines of enquiry. First, we could expand this study by evaluating the resources obtained in social networks, given that the literature suggests that these networks allow individuals to acquire different resources (Jack, 2010). For instance, social networks can provide social support (Renzulli and Aldrich, 2005). Indeed, as previously mentioned, our results suggest a greater importance of online networks than face-to-face networks for entrepreneurial intention. Future studies could try to ascertain if there are specific differences between online and face-to-face social networks in terms of the resources obtained in these two types of social networks that might explain the former's greater importance. For example, online social networks may offer advantages such as lower uncertainty and higher perceived differentiation (Fischer and Reuber, 2014), which would make it easier for individuals to achieve disruptive innovations than in face-to-face social networks. In addition, although positive affect has several positive consequences, previous research has considered that too much positive affect may also have disadvantages (Baron et al., 2012). Scholars might consider exploring whether social networks developed by high positive affect entrepreneurs really do contribute (or not) to the success (or failure) of a new company in terms of growth or innovations. Furthermore, previous research has proposed that entrepreneurial passion, an intense positive feeling related with entrepreneurship (Cardon et al., 2009), influences entrepreneurial intention (Biraglia and Kadile, 2017). Entrepreneurial passion and dispositional affectivities are likely to work together to also influence social networks. Since entrepreneurial passion is contagious (Cardon et al., 2009), if individuals display entrepreneurial passion in social networks, they could increase the size of these social networks. Future research might integrate dispositional affectivities, entrepreneurial passion, social networks, and entrepreneurial intention in order to obtain more disruptive innovations. Additionally, the field of entrepreneurial intention would benefit from a more dynamic study perspective. For example, the socially situated cognition approach advocates analyzing the interactive psychological processes that link individuals to their environments and vice versa (Smith and Semin, 2006), which is an approach that has previously been used in entrepreneurship research (Cacciotti et al., 2016). Finally, from a broader perspective, existing research has asked for studying how disruptive innovations are transformed to entrepreneurship (Si et al., 2020). Therefore, future research could study if individuals with higher entrepreneurial intentions are better able to take that step from disruptive innovation to entrepreneurship.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors contributed to the article and approved the submitted version.

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Entrepreneurial Profiles at the University: A Competence Approach

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The Entrepreneurial University plays a central role in entrepreneurial ecosystems and actively influences the development of entrepreneurial human capital, which is a critical asset for many economies. There is thus a requirement for the identification and strengthening of entrepreneurial competences, but no previous studies have included any analysis of these competences in the university context using an approach based on profiles. The present study fills this gap by investigating the existence of different entrepreneurial profiles among students, based on their competences. It also defines key competences that are critical for differentiating between these profiles and improving entrepreneurial competence levels more generally. To meet these objectives, a field research campaign was developed. Data on 1104 students from various degrees and faculties were collected and analyzed using a quantitative methodological approach. The results reveal the existence of four entrepreneurial competence profiles, namely *low profile*, *top profile*, *social profile*, and *grit profile*. Among as many as 12 possible entrepreneurial competences, the most prominent can explain to a large extent the entrepreneurial profiles of students; these are networking and professional social skills, community engagement, perseverance of effort, and consistency of interest. The results provide evidence of the importance of social capital and *grit*. In addition to their contribution to the theory in this area and the development of the Entrepreneurial University paradigm, the results are also useful for the design of training strategies aimed at strengthening the levels of competence of students, thereby providing universities with tools to foster the creation of entrepreneurial human capital.

Keywords: entrepreneurship, Entrepreneurial University, entrepreneurial competences, competence profiles, grit, social capital

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INTRODUCTION

Business and entrepreneurship ecosystems, defined by the collaborative creation of new value and a critical participation in entrepreneurial initiatives, have increasingly been noted to be of service in integrating approaches used to achieve disruptive innovation and improve performance. In this sense, universities can be considered as ecosystems, and they too require a disruptive innovative perspective in order to face the challenges placed on them by society. In this context, the concept of the "Entrepreneurial University" has emerged, referring to a university's evolution toward an ecosystem that combines teaching, research, and knowledge transfer to favor the development of entrepreneurial initiatives with social and economic value (Gibb and Hannon, 2006; Guerrero et al., 2014; Ventura and Quero, 2017). The Entrepreneurial University involves the implementation of

radical innovation to change the traditional conception of the institution (Ventura et al., 2019). Audretsch (2009) highlights the importance of knowledge-based entrepreneurship, stating that "entrepreneurial activity is the missing link between investments in new knowledge and economic growth" (p.27).

For a university to be truly entrepreneurial, the promotion of entrepreneurship must be carried out from a systemic point of view, with a clear orientation toward innovation and the dissemination of an entrepreneurial culture (Kirby, 2002). Isenberg (2011) points to the importance of policy strategies regarding the setup of the ecosystem, and places special emphasis on the value of the inherent human capital. Specifically, human capital with the capacity to be entrepreneurial has a key and determining role regarding the outcomes of a disruptive innovation system. Training in entrepreneurial activity, especially at higher levels throughout the university system, is thus considered an essential ingredient when increasing the entrepreneurial capital resource of an economy. The entrepreneurial university must therefore place special emphasis on fomenting entrepreneurial human capital, by developing competences that enable the setting up of new projects (Audretsch, 2014).

According to Chiru et al. (2012), the term "competence" refers to a combination of knowledge, tools, values, and attitudes that allow effective and efficient personal or professional performance. Based on this concept, entrepreneurial competences are those that enable the creation and discovery of opportunities in the environment and their use in a company's establishment and successful management (Hunjet et al., 2015). Numerous investigations have been carried out to define the term and establish different categorizations of competence. However, entrepreneurial competence has received scant attention regarding the university environment, and no previous work is known to have addressed the entrepreneurial competence profile of university students. In order to fill this perceived gap in our understanding, we conducted empirical research based on the following research questions:

Q1: Is the university population heterogeneous in terms of entrepreneurial competences, and is it possible to identify different entrepreneurial profiles among university students based on their competences?

Q2: Are there key competences that are critical to differentiating between competence profiles and improving the competence levels of students?

To answer these questions, we present the results of a bibliographic review of previous research on the definition and nature of the competences needed for entrepreneurial activity. The study adopts the classification proposed by Morris et al. (2013), who identify 13 competences and developed a questionnaire geared to their measurement. Based on 1104 student responses, we use a quantitative methodology to analyze the entrepreneurial competences and the profiles that permit differentiation between groups of students by referring to the most developed skills or core competences. The measurement of competence allows us to reach a conclusion on the entrepreneurial competences of the university population, which provides new knowledge to improve teaching and learning. This will lead to the better acquisition and development of entrepreneurial competences in the university ecosystem, which will in turn foster entrepreneurial human capital, thus enhancing disruptive innovation and the Entrepreneurial University.

The structure of the remainder of this article is as follows. First, we stress the importance of Entrepreneurial Universities, as well as their potential to generate well qualified human capital through the development of entrepreneurial competences. Then, we discuss the definition of competences, presenting different views and categorizations. We present the empirical methods and results of our work, and finally we discuss the theoretical contributions together with the educational and entrepreneurial implications.

THEORETICAL FRAMEWORK

The Entrepreneurial University as a Provider of Entrepreneurial Human Capital

Universities can play a crucial role in the outcomes of innovation ecosystems, given the importance of knowledge-based entrepreneurship as a catalyst for economic development and job creation (Audretsch, 2009). In this respect, universities provide a liaison between industry and government, laying the foundations for the proliferation of relationships based on innovation (Etzkowitz and Leydesdorff, 2000). The relevance of the university is based mainly on its potential to generate new knowledge, as well as providing entrepreneurial and well-qualified human capital (Zahra and Wright, 2011; Castellacci and Natera, 2013; Guerrero et al., 2016). As Audretsch (2014) indicates, universities must condition the supply of an economy's entrepreneurial capital, directly affecting business creation and entrepreneurial dynamics. In this context, the paradigm "Entrepreneurial University" acquires special relevance, and constitutes the theoretical framework of this study. This conception of university, first introduced by Etzkowitz (1983), focuses on the influence of the university on the environment and on the related interactions involved in encouraging progress and development. Specifically, in the knowledge society universities have a challenging role in becoming organizations that are more socially and economically relevant (Nelles and Vorley, 2011).

When the concept was first posited, it referred mainly to universities with a clear focus on innovation, entrepreneurial culture, and a proactive tendency to facilitate knowledge transfer to society through the creation of businesses (Clark, 1998; Kirby, 2002). Knowledge transfer is thus seen as a "third leg" of income generation, distinct from teaching and research. The level of implementation of this third leg conditions the contribution of universities to socio-economic development. Entrepreneurial Universities promote the commercialization of the research results they generate (Jacob et al., 2003; Williams, 2003), seeking new sources of funding in order to encourage investment in university entrepreneurship (Yokohama, 2006). Moreover, the Entrepreneurial University is also characterized by the design of new spaces and services that facilitate the creation of companies

based on technology and knowledge (Chrisman et al., 1995; Etzkowitz, 2003).

That said, the purpose of the Entrepreneurial University has evolved over time to transcend this third-leg, knowledge-transfer mission, both by developing entrepreneurial activity and by fostering the entrepreneurial behavior of the institution as a whole. In this respect, the Entrepreneurial University adds to the entrepreneurial culture in the management of the institution, involving all agents in the creation of an entrepreneurial ecosystem, one that is interconnected with its environment and where new relationships are generated between university community agents and between the institution and companies (Friedman and Silberman, 2003; Etzkowitz, 2004; Rizzo, 2015). Through its mediating role, entrepreneurial universities catalyze creativity and knowledge and favor exchange of information between the actors in the ecosystem (Mele and Russo-Spena, 2015). In the words of Sam and Van der Sijde (2014) "an Entrepreneurial University actively identifies and exploits opportunities to improve itself (with regard to education and research) and its surroundings (knowledge transfer) and is capable of managing (governing) the mutual dependency and impact of the three university tasks" (p. 902). The Entrepreneurial University implies a constant interchange between the educational institution and the rest of society, involving and engaging different actors.

In words of Fantauzzi et al. (2019), there are three key aspects of the university paradigm: strategic and operational decision-making to create connections with the environment, connections with the agents of the environment, (e.g., with other institutions or companies), and the entrepreneurial attitudes and actions of those who make up the university (teachers, researchers, and students). This last aspect is closely linked with the development of the entrepreneurial competences of these actors. Following a bibliometric review, Skute (2019) highlights the existence of four different approaches in the study of the Entrepreneurial University, namely partner complementary, ecosystem, interaction channel, and academic entrepreneurship. The present research is framed within this last theoretical approach, which focuses on the characteristics of academic entrepreneurs and their engagement in business creation (D'Este et al., 2012). It highlights the relevance of entrepreneurial competences, experiences, perceived norms, and intentions to undertake entrepreneurial initiatives, as well as the mechanisms that promote this entrepreneurial human capital.

The fostering of entrepreneurial human capital in the university, through the generation, attraction, and retention of entrepreneurs, is one of the main objectives of the Entrepreneurial University (Bramwell and Wolfe, 2008). The education and development of entrepreneurial students encompasses both tangible and intangible aspects, such as the acceptance and image of the entrepreneur in society, the existence of sufficient economic resources to meet the financial needs of the initiatives, and above all, a strong training in entrepreneurship (Ventura and Quero, 2017). Human Capital is defined by Becker (1993) to be a set of competences, knowledge, abilities, and skills acquired through education and training, such that the design of a high-quality entrepreneurial education based on the development of competences is key to achieving this primary objective of the Entrepreneurial University. In this respect, the identification and definition of the entrepreneurial competences of the students are crucial for generating an increasingly entrepreneurial form of human capital. The following section is a theoretical review of the concept and existing classifications, which frames the study of competence as developed here.

Entrepreneurial Competences

In recent decades, the development of competence has been studied extensively in numerous disciplines, including psychology (Sternberg and Kolligian, 1990), education (Burke, 1989), human resources (Burgoyne, 1993), and business organization (Boyatzis, 1982). Competences are complementary and independent aspects of these subjects and can be used in different fields (Rey, 1996). The diversity of disciplines that address the study of competence and the plurality of contexts in which they are applied makes the definition of the term particularly complex.

Several terms are used in the scientific literature to refer to the concept of competence: "skills," "expertise," "acumen," and "competency" (Mitchelmore and Rowley, 2010; Arafeh, 2016). These terms make reference to abilities, capabilities, capacities, qualifications, and other related attributes (Baartman et al., 2007). Such terminological diversity makes international consensus on the subject difficult, in both academic and applied fields, hindering the development of common knowledge and expressions that could lead to a connection between the research initiatives and their practical applications (Mitchelmore and Rowley, 2010). Jubb and Robotham (1997) state that it remains a challenge to develop a widely accepted definition of competences to foster common ground between researchers and trainers. Likewise, Boon and Van der Klink (2003) hold that competence remains a "fuzzy concept." Although several decades have passed since its first conceptualization, there is still a great terminological diversity in this area of knowledge. Even so, the existence of shared characteristics in the different conceptual approaches is evident.

The most common factors referred to as "competence" are personal ability, knowledge, and having the tools necessary to achieve personal or professional goals. The European Parliament and Council (2006) explains competence as a combination of skills, knowledge and attitudes. Chiru et al. (2012, p. 4011) define it as the proven ability to "select, combine and use the appropriate knowledge, skills and other acquisitions (values and attitudes) in order to successfully solve a particular category of work or learning situations and for professional or personal development in terms of effectiveness and efficiency." The definition of Morris et al. (2013, p.353) follows the same logic, indicating that a competence "refers to the knowledge, skills, attitudes, values, and behaviors that people need to successfully perform a particular activity or task." According to Wynne and Stringer (1997), competences are what people need to develop to achieve the outputs required for their job, referring to what they know, do, and think. Along the same lines, Mertens (1996) relates

competence to an individual's capacity to achieve a particular goal in a given context.

It is also important to highlight that the term "competence" influences both the personal and the professional sphere. In this sense, the European Qualification Framework has established that competence is a "proven ability to use knowledge, skills and personal, social and/or methodological abilities in work or study situations and in professional and personal development" (European Parliament and Council, 2008, p. 4). In this sense, numerous efforts have been made by various institutions and in academia to define models of competence that help to explain professional behaviors, performances, and outcomes (Schippmann et al., 2000; Kurz and Bartram, 2002; Sanchez and Levine, 2009). An example of theoretical and practical development in this area is the metamodel created by Bellini et al. (2019) on the objectives proposed by the European Qualification Framework (European Commission, 2005). However, such models do not focus on the competences needed for self-employment and entrepreneurship, but rather on competences for employment and professional success within a company from the perspective of human resources. Therefore, in order to contribute to the paradigm of the Entrepreneurial University, a complementary approach is considered necessary, to focus specifically on the entrepreneurial competences.

Competences, especially those that foster entrepreneurial capacities, are crucial for the development of entrepreneurial human capital. Cubico et al. (2010) indicate that there are certain personal qualities that distinguish between non-entrepreneurs and entrepreneurs, and condition the business success of the latter. The competences are not only understood as key to the professional development of individuals, but also to their personal growth. In this sense, numerous studies explain entrepreneurial competences as transversal aspects that influence various spheres of life and foster active participation in society (Bacigalupo et al., 2016). In 2006, the published "Recommendation on key competences for lifelong learning" highlighted that the "sense of initiative and entrepreneurship," understood as the capacity to turn ideas into action, is a key competence for all citizens (European Parliament and Council, 2006). Therefore, based on the importance of entrepreneurial education for the progress of society, the European Commission developed an "Entrepreneurship Competence Framework or EntreComp" to promote a common understanding of the entrepreneurial competences.

Entrepreneurial competences also have strong implications for business creation and activities related to the entrepreneurial process. The development of an entrepreneurial project is strongly influenced by the levels of competence and profiles of those who participate in it. The self-awareness of these levels is also relevant, because this facilitates communication and increases the professional autonomy of the entrepreneurs (Bellini et al., 2019). The personal characteristics of entrepreneurs, and their knowledge, skills, and experiences are key strategic resources for organizations and have a positive impact on business success (Lewis and Churchill, 1983; McClelland, 1987; Barney, 1991; Kiggundu, 2002; Onstenk, 2003). It is therefore important to extend both the study of entrepreneurial competences and the analysis of entrepreneurial competence profiles in order to understand the degree to which entrepreneurial competences are the result of individual or contextual factors (Gümüsay and Bohné, 2018), and to detect the key competences needed to develop entrepreneurial human capital. The aim, in other words, is to identify critical primary competences that stand out for their relevance or for their need for reinforcement. These should be at the core of the design and implementation of training programs, given their importance for the success of such programs (Burke, 1989; Voorhees, 2001; Onstenk, 2003).

Al-Mamun et al. (2016) define entrepreneurial competences as the skills needed to use resources to improve the performance of a micro-company. For Boyatzis (1982), competence is a person's capacity to meet the job demands of a certain business environment to reach desired results. Mitchelmore and Rowley (2010) refer to the set of competences that operationalize a venture in a company, both technical and non-technical (Huck and McEwen, 1991). Similarly, Hunjet et al. (2015) define entrepreneurial competence as:

A combination of knowledge, skills, attitudes and capabilities to create and discover opportunities in the environment, to introduce changes, and to direct one's behavior toward successful creation and management of an organization, whose purpose it is to take advantage of these opportunities and to deal with a high level of uncertainty and complexity in a challenging environment (p. 623).

From the various definitions of entrepreneurial competences reviewed here, it is possible to identify certain common characteristics. In this sense, the entrepreneurial competences are considered to be individual capacities, in terms of a set of knowledge, expertise, skills, tools, attitudes, and values oriented to reach professional development and to achieve entrepreneurial goals. They are also treated as important aspects in the successful performance of entrepreneurial activities in terms of effectiveness and efficiency, meeting the entrepreneurial demands of society. Based on these shared characteristics, the present study considers entrepreneurial competences as knowledge, experiences, skills, and attitudes, which enable and favor the success of entrepreneurial activities.

The structuring of entrepreneurial competences into coherent groups "has proven to be challenging, due to the interconnected and multifaceted character of entrepreneurship as a competence" (Komarkova et al., 2015, p. 71). Nevertheless, many attempts have been made by public institutions and in academia to determine some classifications of entrepreneurial competences. EntreComp, developed by the European Commission (Bacigalupo et al., 2016), builds a competence model in which 3 areas and 15 specific interrelated and interconnected entrepreneurial competences are identified. In particular, "'Ideas and opportunities,' 'Resources,' and "Into Action" are the 3 areas of the conceptual model and they have been labeled to stress entrepreneurship competence as the ability to transform ideas and opportunities into action by mobilizing resources" (p.10). This European benchmark is used to distinguish the following entrepreneurial competences: spotting opportunities, creativity, vision, valuing ideas, ethical and sustainable thinking, self-awareness and self-efficacy,

TABLE 1 | Classifications of entrepreneurial competences according to different authors.

Authors	N°	Entrepreneurial competences
Hayton and Kelley, 2006	4	Innovation, intermediation, defense, sponsorship
Chandler and Jansen, 1992	2	Ability to recognize and seize opportunities, willingness and capacity for intense effort.
Di Zhang and Bruning, 2011	5	Market orientation, entrepreneurial orientation, need for achievement, internal locus of control, need for cognition
Abdullah et al., 2009	8	Progress, achievement orientation, commitment, decision-making capacity, risk management, tenacity, networking, optimism
Man et al., 2002; Kaur and Bains, 2013	6	Opportunity competence, relationship competence, conceptual competence, organizing competence, strategic competence, commitment competence
Onstenk, 2003	3	Ability to recognize and analyze market opportunities, ability to communicate and detect attitudes, to persuade and discuss with stakeholders, capacity for networking and learning effectively from business interactions.
Wu, 2009	23	Analytical thinking, business acumen, customer orientation, commitment to learning, communication, conceptual thinking, order and quality, developing others, empathy, expertise, flexibility, influence, information seeking, initiative, innovation, organizational awareness, personal motivation, relationship building, results orientation, self-confidence, self-control, team leadership, verbal and written communication.
Morris et al., 2013	13	Opportunity recognition, opportunity assessment, risk management, conveying a complete vision/vision of the future, tenacity/perseverance, creative problem solving/creativity, resource leveraging, guerrilla skills value creation. New products, services and models, ability to maintain focus and adapt, resilience, self-efficacy, networking and social skills

motivation and perseverance, mobilizing resources, financial and economic literacy, mobilizing others, taking the initiative, planning and management, coping with uncertainty, ambiguity and risk, working with others, learning through experience.

In the same vein, several authors have offered classifications that serve to identify the competences related to entrepreneurial activity. **Table 1** presents different categorizations of competence according to the author concerned, together with the number of competences and their characteristics. It can be seen that while the number of identified competences varies, there are similarities in their characteristics.

MATERIALS AND METHODS

In order to achieve the stated objectives and answer the research questions raised, a quantitative methodology is developed to analyze the entrepreneurial competences of a population of university students. We then outline the data collection and methodology used for the analysis.

Data Collection

The classification of competence used here as the key reference is that developed and validated by Morris et al. (2013). These authors identified 13 entrepreneurial competences using a two-sample, three-round Delphi approach method, through which industry experts, consisting of entrepreneurs and entrepreneurship training professionals, worked together to compile a list of entrepreneurial skills. Instrumental reliability was corroborated using pre-/post-testing. The effectiveness of this methodology for reaching consensus has been demonstrated when panels of experts are used (Chan et al., 2001). The instrument used to measure the 13 competences is a questionnaire of 111 items on a five-point Likert scale. **Table A1** (additional material) shows the classification of entrepreneurial competences and the student assessment questionnaire used, as developed by Morris et al. (2013).

The sample was composed of 1104 students from 52 Bachelor's and Master's degrees in 16 different faculties of the University of Malaga, Spain; 36.1% (n = 399) of the sample were male and 63.9% were female (n = 705). The questionnaire was completed online between October 2019 and April 2020 within the framework of the student's registration on the university employment platform Talentank. There is some diversity in the sample regarding the origins of the qualifications and the number of academic years completed. According to Liñán and Chen (2009), studies based on a population of university students offer the advantages of homogeneity and similarity in terms of age and qualifications.

Analyses

Using Stata version 14.0, a twofold multivariate approach was chosen to determine the existence of entrepreneurial profiles among the university students in the sample. First, we employed an exploratory factor analysis (EFA) with a rotation procedure to identify the underlying dimensions of the entrepreneurial competences of the population (Bachhaus et al., 2011) and to reduce the number of variables. After testing different methods of EFA and rotation procedures with similar results, the principal factors were selected with an orthogonal varimax rotation. The number of retained factors with this method is consistent with previous literature on the subject using the same measurement instrument (Morris et al., 2013) and the different factors are clearly defined through the item scores. Following the recommendations of Hair et al. (1998), we included only factor loadings greater than 0.3, and the variables clearly loaded in the different factors. In the present study, the sample size is greater than 1000, a condition considered excellent by MacCallum et al. (1999). The Kaiser–Meyer–Olkin (KMO) was used to validate the adequacy of the sample for factorial analysis, and having obtained the factors, we measured internal consistency using Cronbach's alpha.

Second, we performed a cluster analysis. After testing various methods of hierarchical and non-hierarchical clustering with similar results, we determined that the clearest grouping was provided by Ward's Hierarchical agglomerative method with a squared Euclidean measure of distance. We used the generated factors as variables, to divide the sample into homogenous

groups, and to determine the entrepreneurial competence profiles of the university students and the possible differences between them. Two stopping rules, recommended for hierarchical clustering, were applied to determine the optimal number of groups, namely the Caliński and Harabasz (1974) and the Duda et al. (2001). For the former, larger values of pseudo-F indicate more of a distinction between clusters, while in the latter, larger values of Je(2)/Je(1) and small pseudo-T-squared values are more convenient for the definition of the appropriate number of clusters.

We verified the normal distribution of the variables using different graphical methods according to sample size (Histogram, Stem and Leaf diagram, and Kernel Density test), and analyzed the differences between groups. First, an ANOVA test was carried out for each competence considering the cluster variable as grouping variable. Subsequently, an ANOVA test was applied for pairs of clusters, to facilitate the interpretation of the competence profiles.

TABLE 2 | Retained factors of EFA, method: principal factors, rotation: orthogonal varimax (n° of factors: 12; eigenvalues > 1; explained variance: 97.74%).

Factor	Variance	Difference	Proportion	Cumulative
Factor 1	5.64783	0.72006	0.1514	0.1514
Factor 2	4.92777	0.92413	0.1321	0.2836
Factor 3	4.00364	0.49332	0.1074	0.3909
Factor 4	3.51032	0.04418	0.0941	0.4851
Factor 5	3.46614	0.36234	0.0929	0.5780
Factor 6	3.10380	0.92300	0.0832	0.6612
Factor 7	2.18081	0.04436	0.0585	0.7197
Factor 8	2.13644	0.12455	0.0573	0.7770
Factor 9	2.01189	0.09125	0.0539	0.8309
Factor 10	1.92064	0.05536	0.0515	0.8824
Factor 11	1.86528	0.18694	0.0500	0.9324
Factor 12	1.67834		0.0450	0.9774

Prob > chi2 = 0.0000.

RESULTS

Having detected and eliminated outliers, the database contained 1081 cases. The results of the correlation analysis and EFA demonstrated the need to eliminate some items that did not fit well within the scales, due to insufficient correlation with the other items of the matrix (i.e., <30) (Pett et al., 2003). Use of the factor analysis technique to identify latent factors was validated. The sample was considered adequate with a KMO of 0.9330 for all variables and a significance of 0.000 from Bartlett's test of Sphericity.

The common factor model of EFA allowed the initial number of 111 variables to be reduced, leaving a total of 12 factors. These were retained according to the information provided by the Scree test (Catell, 1966) and the Kaiser criteria, and based on the eigenvalues or amount of variance of the items accounted for by a factor (Norris and Lecavalier, 2010). All the extracted factors had eigenvalues > 1 (**Table 2**), and these 12 factors explained 97.74% of the total variance. After ensuring that the extracted factors were not correlated, we applied an orthogonal rotation (varimax) to simplify the configuration of the factors and enhance their interpretability (Browne, 2001). The rotated factor loadings are shown in **Table A2** (additional material). Having shown that the internal consistency of the factors was high with a Cronbach's alpha of greater than 0.7 in most cases, the competences could be interpreted according to the different factor loadings.

The 12 factors correspond to competences included in the classification of Morris et al. (2013). Some of these competences are identified by specific factors, while others are now subdivided into more than one factor. This is the case for value creation with new products, services, and business models, and tenacity/perseverance. The first of these is divided into value creation through observation/experimentation and value creation through questioning, while the second is split into perseverance of effort and consistency of interest. **Table 3** shows the identification of each factor according to items with higher loadings, its Cronbach's Alpha, mean, and standard deviation. The entrepreneurial competences of the university population are then described through the interpretation of the items loaded in each factor.

(1) Networking and professional social skills. Competence that enables the establishment, development and maintenance of relationships with others to obtain work and career advantage (Forret and Dougherty, 2001). Networking is related to career outcomes such as income and promotion (Burt, 1992). The social capital created through the networking competence provides valuable information, resources, and opportunities. Individuals can use their networks to achieve entrepreneurial goals and advantages in terms of business competitiveness (García and Valencia, 2009).

(2) Creativity. Ability to create novel, original, unexpected, and useful outcomes through the relationship between previously unrelated objects (Sternberg, 1999; Lee et al., 2004). Creative thinking is an important element in problem-solving and decision-making, and fosters entrepreneurial intention (Hamidi et al., 2008). Thus, creative individuals are more likely to start and engage in entrepreneurial projects (Ward, 2004).

(3) Value creation through observation and experimentation. Ability to develop new products, services, and/or business models by observation and experimentation. Both observation and experimentation are considered crucial to the development of innovation and entrepreneurial initiatives (Mulder et al., 2007). The behavioral approach to entrepreneurship highlights the importance of what the entrepreneur does (Gartner, 1989). In this sense, an entrepreneurially oriented individual searches for information through non-verbal scanning and seeks experiences that enable innovation and the identification of new opportunities (Kaish and Gilad, 1991; Dyer et al., 2008).

(4) Value creation through questioning. Capability of developing new products, services, and/or business models by questioning the *status quo* and people's fundamental assumptions (Morris et al., 2013). In this sense, the information obtained serves to facilitate and improve the decision-making process. It is related to the concept of entrepreneurial curiosity, which is

TABLE 3 | Entrepreneurial competences and descriptive characteristics.

Factor	Ítems	Reliability (Cronbach's Alpha)	Mean	Std. Dev.
Factor 1: Networking and professional social skills	p13a, p13b, p13c, p13d, p13e, p13f, p13g, p13h, p13i, p13j, p13k, p13l	0.8841	−1.50e-09	0.9280179
Factor 2: Creativity	p6a, p6b, p6c, p6d, p6e, p6f, p8a	0.8726	−4.23e-10	0.8975807
Factor 3: Value creation through observation and experimentation	p9g, p9h, p9i, p9j, p9k, p9l, p9m, p9n	0.8607	4.33e-10	0.8948328
Factor 4: Value creation through questioning	p9a, p9b, p9c, p9d, p9e, p9f, p8b	0.8378	3.14e-10	0.9129371
Factor 5: Risk management and environmental control	p3a, p3b, p3c, p3d, p12b, p12d	0.5379	1.49e-10	0.9160554
Factor 6: Opportunity assessment	p2a, p2b, p2c, p2d, p2e, p4a, p4b	0.8210	4.92e-10	0.8850492
Factor 7: Bootstrapping and resource management	p7i, p7j, p7k, p7l, p7m, p7n	0.7196	8.64e-11	0.8496865
Factor 8: Perseverance of effort	p5f, p5g, p5h, p5i, p5j	0.7479	−2.17e-10	0.8500921
Factor 9: Opportunity recognition	p1b, p1c, p1d, p1e	0.6403	4.87e-10	0.8426086
Factor 10: Consistency of interest	p5a, p5b, p5c	0.7596	−6.91e-10	0.8547087
Factor 11: Community engagement	p13m, 13n, 13o, p13p	0.7382	−2.10e-10	0.8655921
Factor 12: Resilience	p10e, p10f, p11a, p11b, p11c	0.7430	−7.58e-10	0.8221428

known to be a motivational system oriented toward investigation, i.e., an interest in novelty and a tendency to search for answers to learn tasks related to entrepreneurship (Jeraj, 2014). This curiosity is positively related to entrepreneurial value creation, fostering the generation of business ideas (Peljko et al., 2016). Cubico et al. (2010) relate curiosity to innovation, which in turn is defined by them as an entrepreneurial aptitude.

(5) Risk management and environmental control. Ability to handle uncertainty and reduce hazards and the potential impact of the risk if it occurs. It also involves the ability to control and shape the environment (Morris et al., 2013). This locus of control is related to the conception of self-efficacy and is fundamental to the development of entrepreneurial intentions (Krueger et al., 2000). Risk and environmental handling are considered crucial to the decision-making process of an entrepreneur, who must deal with unexpected situations and conflicting information (Zimmerer and Scarborough, 2002).

(6) Opportunity assessment. Ability to analyze the extent to which a recognized opportunity is viable and can provide competitive advantage. This is an evaluation of the content structure of opportunities in order to determine their attractiveness and decide whether they represent a business opportunity with a potential profit (Tang et al., 2012; Morris et al., 2013). It is thus related to opportunity recognition (see below). It is an important entrepreneurial ability that affects the decision-making processes used by entrepreneurs. Effective evaluation of the circumstances involved may result in improvement of the entrepreneurial initiative through the integration of both intangible (e.g., new knowledge or processes) and tangible (e.g., new products) resources (Haynie et al., 2009).

(7) Bootstrapping and resource management. Ability to access to resources and extract value from them. This also includes the ability to recombine and seek new ways of obtaining resources when these are limited (Politis et al., 2011). In this regard, the importance of the bootstrapping concept is that it refers to the development of methods to ensure the use of the resource at low or no cost. In this way, the resources need not necessarily be owned (Winborg, 2009). A resource is a tangible or intangible asset that is available and can be used for entrepreneurial purposes (Davidsson, 2005), therefore the acquisition and use of these resources determines the success of entrepreneurial initiatives (Politis et al., 2011).

(8) Perseverance of effort. Ability to persevere and sustain efforts to achieve intended objectives even when hardships or setbacks occur (Salisu et al., 2020). Along with consistency of interest (see below) it represents one of the two dimensions of grit, a psychological concept that is positively correlated with success and the achievement of long-term objectives (Duckworth et al., 2007). It is linked to the competence of perseverance described by Morris et al. (2013), and positively connected to entrepreneurial sucess. It is positively related to entrepreneurial success in that a persevering attitude is required to face the difficulties and obstacles related to the creation and development of ventures (Mooradian et al., 2016; Salisu et al., 2020).

(9) Opportunity recognition. Competence that encompasses both the recognition of links between trends, changes, and events that appear to be unconnected, and the pattern recognition behind these connections (Baron, 2006). It is based on the willingness to access information and requires a state of alertness, i.e., an ability to identify opportunities overlooked by others (Kirzner, 1979). Opportunity recognition is the catalyst of entrepreneurial activity (Dyer et al., 2008). According to Shane and Venkataraman (2000), there is no entrepreneurship without opportunity.

(10) Consistency of interest. Ability to stay focused and passionate over a long period of time by performing a particular task without changing interest or goals (Salisu et al., 2020). Along with perseverance of effort, this is the other of the two dimensions of grit (Duckworth et al., 2007; Arco-Tirado et al., 2018), and it is again related to the perseverance described by Morris et al. (2013). It is an important competence for entrepreneurship in that the creation of venture implies complex, multiple, and competing objectives whose scope requires a maintained focus over long periods of time.

(11) Community engagement. Social interaction that fosters participation in communities through the establishment, development, and maintenance of social relationships with different groups (Morris et al., 2013). Engagement in different communities provides a great diversity of social capital, which is considered positive for entrepreneurial initiatives. Thus, the existence of formal and informal networks within the social structure can enhance entrepreneurial activities and reduce their cost (Portela and Neira, 2002). Belonging to different communities provides a greater access to information and enhances the recognition of opportunities (Granovetter, 1995). Entrepreneurs therefore usually have a higher diversity of contacts in their networks than non-entrepreneurs (Renzulli et al., 2000).

(12) Resilience. Ability to adapt to environmental changes in situations of threat, adversity, tragedy, trauma, or stress whilst maintaining a positive mindset (Salisu et al., 2020). It is related to the ability to transform a situation of adversity into an enjoyable challenge (Greitens, 2015), and is an important competence both for the entrepreneurial initiative and for the sustainability of ventures over time, determining entrepreneurial success (Fisher et al., 2016). Individuals who run businesses need a resilient attitude to overcome numerous setbacks, e.g., financial shortfalls, which can occur especially in times of crisis (Pal et al., 2014).

The hierarchical cluster analysis developed to identify homogenous groups in the sample, considering the 12 identified competences as variables, shows evidence of different competence profiles. Both Caliński-Harabas and Duda-Hart's Je(2)/Je(1) stopping rules point to an optimal solution of 4 clusters. The truncated dendrogram (**Figure 1**) shows a visual interpretation of the grouping.

TABLE 4 | Number of cases and mean of the entrepreneurial competences by cluster (total *n* = 1081).

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
n	309	114	254	404
%	28,6%	10,5%	23,5%	37,4%
1. Networking and professional social skills	−0.322	0.458	0.517	−0.208
2. Creativity	−0.088	0.242	0.250	−0.158
3. Value creation through observation and experimentation	−0.149	0.345	−0.063	0.056
4. Value creation through questioning	−0.163	−0.005	0.133	0.042
5. Risk management and environmental control	−0.831	0.253	−0.220	0.703
6. Opportunity assessment	0.057	0.434	−0.074	−0.119
7. Bootstraping and resource management	−0.350	0.299	0.042	0.157
8. Perseverance of effort	−0.200	0.268	−0.138	0.164
9. Opportunity recognition	−0.006	0.153	0.261	−0.202
10. Consistency of interest	0.199	0.736	−0.670	0.061
11. Community engagement	−0.190	1.099	0.220	−0.304
12. Resilience	0.195	0.269	−0.164	−0.121

Table 4 shows the number of cases and the mean of the 12 entrepreneurial competences by cluster.

The information provided by the statistical tests together with the average values for each competence by cluster, as expressed graphically in **Figure 2**, allows the interpretation of the competence profiles and yields the following results.

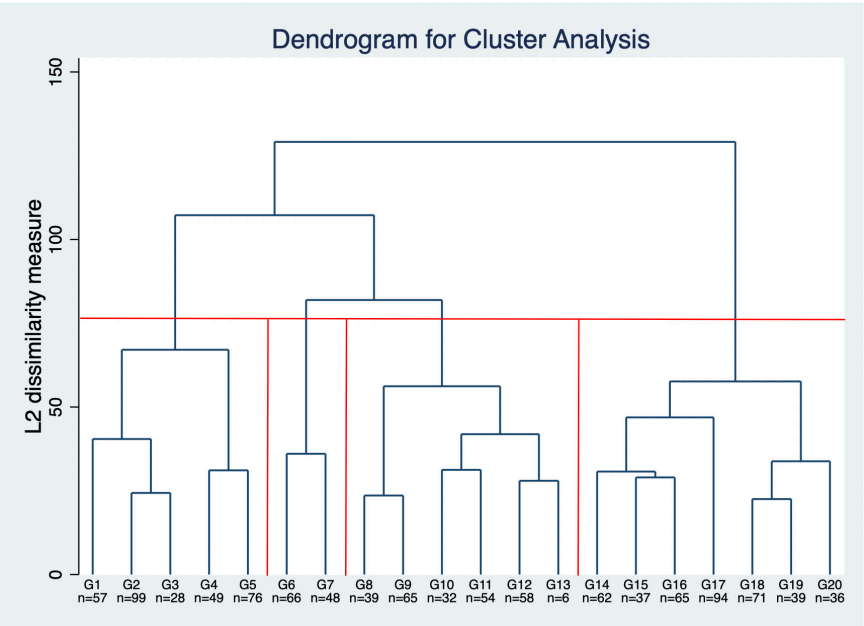

FIGURE 1 | Truncated cluster-dendrogram of Ward's Hierarchical agglomerative method. The red line shows the four-cluster-solution representing the different competence profiles of university students.

Profile 1: Below-average scores for most competences. Low levels of development of key competences for entrepreneurial practice, in particular poor networking and professional social skills, bootstrapping and resource management, or risk management and environmental control. The best scores for this profile are found in the competences of resilience and consistency of interest. Opportunity assessment is also somewhat more developed than in two of the other three profiles. Nevertheless, low levels for the remainder of the entrepreneurial competences indicate that although people in this profile may recognize opportunities and may have the ability to work on their goals over a long period of time, with a positive mindset that facilitates adaptation to environmental changes, they nevertheless lack the necessary tools to launch an entrepreneurial project and develop it successfully. Thus, given the low scores in both absolute and relative terms, this profile can be referred to as the *low entrepreneurial profile*.

Profile 2: This profile is characterized by high scores in all twelve entrepreneurial competences, which are all more pronounced than they are in the other profiles. The students in this second group have highly developed social skills in both professional and community settings. In this sense, their engagement in community projects is considerable. They know how to evaluate opportunities and generate value from them, more through observation and experimentation than by asking questions. They are also those best able to manage resources when these are limited. Aside from their outstanding social skills, the competences linked with psychological attributes are also highly developed. They are resilient, persevering, and above all consistent in their interest, being able to maintain focus on long-term objectives and develop entrepreneurial projects in a sustainable way. This cluster is therefore called the *top entrepreneurial profile*.

Profile 3: Members of this group stand out in certain entrepreneurial competences, with above-average scores. However, this profile is also characterized by deficiencies in other ways. Students with this profile present a high level of social skills, as for Profile 2. However, this group is characterized by the tendency to develop them in a professional context, rather than in community settings. They also have high competence scores in opportunity recognition, creativity, and in creating value by asking questions, as opposed to the previous profile, which is characterized by higher levels of observation and experimentation. By contrast, they have lower levels of competence in areas linked to management. In this sense, students in this profile are less successful in developing competences of experimentation, opportunity assessment, resource management, or risk management and environmental control. The greatest competence deficiency of students in this group is found in their low levels of perseverance, consistency of interest, and resilience. These last two competences are linked more closely to psychological factors, and here they present levels below the other three groups. This profile is nevertheless potentially entrepreneurial in that it relates to the gathering of relevant competences to start and develop an entrepreneurial project, for example opportunity detection, creativity, networking and communication. Due to the outstanding professional social skills of this group this profile can be defined as the *social entrepreneurial profile*.

Profile 4: This profile also brings together important entrepreneurial competences, yet it shows deficiencies in others. Students belonging to this group show below-average networking

FIGURE 2 | Different entrepreneurial profiles found for university students. The *x*-axis shows the 12 entrepreneurial competences used to determine the profiles. The *y*-axis shows the means of standardized scores (+1 denotes one standard deviation better than the average sample score).

and professional social skills. These scores are more than half a point below those of profiles 2 and 3. Opportunity recognition, opportunity assessment, and creativity are also underdeveloped competences in this group, with averages below those in the other profiles. Even so, these students stand out for above-average levels of competence in other areas such as value creation, bootstrapping, resource and risk management, and control of the environment. They are persevering people with consistency in their interests, in which they score better than those in profile 3. These results show complementarity with profile 3, in that neither group has high levels in all the entrepreneurial competences, but the areas of greatest deficiency in one are the most developed in the other, and vice versa. Thus, while profile 3 stands out in terms of social skills, detection of opportunities and creativity, profile 4 is characterized by highly developed managemental skills and *grit*-related competences. For this reason, the fourth profile can be termed the *grit entrepreneurial profile*.

Several statistical tests were carried out to validate these results and determine the existence of significant differences between profiles. First, the graphical tests of normality show the normal distribution of the twelve competences, which allows the use of ANOVA tests. The results show evidence of differences in all competences ($p < 0.005$), which corroborates the identification of 4 distinct profiles. The ANOVA tests for pairs of profiles show significant differences between profiles (**Table 5**). The *low entrepreneurial profile* contains differences with the other profiles in most of the competences. The differences between the other groups lie in the competences used for their definitions. In this sense, the *social entrepreneurial profile* is similar to the *top profile* in networking and professional social skills, creativity, value creation through questioning, and opportunity recognition. In the same way, the *grit entrepreneurial profile* presents similarities with the most developed profile in perseverance of effort. The results shown by the ANOVA tests reinforce the complementarity of the *social* and *grit* profiles. This pair of profiles present the biggest differences in their critical competences. In this sense, the competences related to social capital (community engagement and networking/professional social skills) and to the *grit* construct (perseverance of effort and consistency of interest) present the highest statistical differences (significance level: 0.000), demonstrating the importance of these concepts in the definitions of entrepreneurial competence profiles.

TABLE 5 | Significant differences of competence by pair of profiles (low, top, social, and grit).

		Top	***Social***	***Grit***
1. Networking and professional social skills	*Low*	0.0000***	0.0000***	0.1005
	Top		0.4765	0.0000***
	Social			0.0000***
2. Creativity	*Low*	0.0008***	0.0000***	0.3198
	Top		0.9293	0.0001***
	Social			0.0000***
3. Value creation through observation and experimentation	*Low*	0.0000***	0.2438	0.0052**
	Top		0.0000***	0.0027**
	Social			0.0769*
4. Value creation through questioning	*Low*	0.1140	0.0000***	0.0049**
	Top		0.1220	0.6524
	Social			0.2083
5. Risk management and environmental control	*Low*	0.0000***	0.0000***	0.0000***
	Top		0.0000***	0.0000***
	Social			0.0000***
6. Opportunity assessment	*Low*	0.0000***	0.0727	0.0082**
	Top		0.0000***	0.0000***
	Social			0.5294
7. Bootstrapping and resource management	*Low*	0.0000***	0.0000***	0.0000***
	Top		0.0034**	0.0844
	Social			0.0651
8. Perseverance of effort	*Low*	0.0000***	0.3950	0.0000***
	Top		0.0000***	0.2222
	Social			0.0000***
9. Opportunity recognition	*Low*	0.0606	0.0002***	0.0014**
	Top		0.2590	0.0000***
	Social			0.0000***
10. Consistency of interest	*Low*	0.0000***	0.0000***	0.0152*
	Top		0.0000***	0.0000***
	Social			0.0000***
11. Community engagement	*Low*	0.0000***	0.0000***	0.0200*
	Top		0.0000***	0.0000***
	Social			0.0000***
12. Resilience	*Low*	0.3688	0.0000***	0.0000***
	Top		0.0000***	0.0000***
	Social			0.5245

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.

DISCUSSION

University students are a heterogeneous population in terms of entrepreneurial competences, therefore they present different levels of development in the 12 identified competences. Furthermore, four entrepreneurial competence profiles are identified, which leads to an answer in the affirmative to Q1 (Is the university population heterogeneous in terms of entrepreneurial competences and is it possible to identify different entrepreneurial profiles among university students based on their competences?) Heterogeneity is a positive feature of the population, since the diversity of competences enriches entrepreneurial activity and leads to improved performance. In other words, to meet the great variety of challenges and unforeseen events of the entrepreneurial process, multidisciplinary entrepreneurial teams with different competences are recommended (Weisz et al., 2010).

Considering that only one of the profiles presents uniformly low levels of entrepreneurial competences, it can be said that almost three quarters of the population has entrepreneurial potential. Thus, 71.4% of the students have a *top*, a *social* or a *grit entrepreneurial profile*, implying that they have entrepreneurial competences with which they could start and/or develop a

business, although in some cases it would be necessary to strengthen certain competences. The *top entrepreneurial profile*, characterized by high levels in all the competences, comprises 10.5% of the population. These students have exceptional resources for entrepreneurship and stand out for their social skills and their *grit* development, a feature related to psychological capital (Contreras and Juárez, 2013). These competences are also the most differentiating elements in the other two potential entrepreneurial profiles: the *social* and the *grit profile*, each named on the basis of these competences. Even if all 12 competences are important for the design and practice of entrepreneurial activities, we identify four competences that are critical in understanding the diversity of profiles and their complementary nature, namely networking and professional social skills, community engagement, perseverance of effort, and consistency of interest. We can therefore answer in the affirmative for Q2 (Are there key competences that are critical to differentiating between competence profiles and improving the competence levels of students?). With reference to the definitions given in the theoretical review, which indicate that the concept of competence consists of both innate and acquired characteristics, it can be seen how the highlighted competences are related more to levels of personal ability than to developed or acquired knowledge or tools (Morris et al., 2013). As confirmed by Chiru et al. (2012), they are connected to values and attitudes, and depend on personal traits.

The first two competences mentioned above stand out and are key to the definition of the *social profile*. Thus, students belonging to this group have higher levels of social capital, a concept that has been related broadly to entrepreneurial activity and success. Social capital is understood to be a determining factor of economic growth. "The existence of formal and informal networks within the social structure can enhance many activities and make them less costly, which implies having a capacity for better development" (Portela and Neira, 2002, p.31). Social capital is determined by the relationships and resources that emerge in a network, which actors can access by being immersed in it (Nahapiet and Ghoshal, 1998). The network of contacts is one of the most valuable and determining tools for entrepreneurial activities, and becomes especially relevant in the early stages of a project (Van de Ven et al., 1984). The strategic relationships established through networking encourage the creation and sharing of knowledge, and also promote the development of other skills. It can thus be explained why profiles characterized by developed social skills and community engagement are also accompanied by high levels in other competences. In the case of the two entrepreneurial competence profiles with higher social skills (the *top profile* and the *social profile*), both creativity and opportunity recognition are prominent. This could be a result of the information flows of the social networks, given that these represent the ways in which opportunities are recognized (Vohora et al., 2004). In the same way, the exchange of information leads to learning, through which creativity and innovation are enhanced, competitiveness is improved, and consequently entrepreneurship is promoted.

The other competences identified as critical to the development of entrepreneurial human capital form the *grit* construct and characterize the so-called *grit profile*. These competences are considered to be predictors of entrepreneurial behavior (Arco-Tirado et al., 2019), which explains the importance of this group of students. *Grit* is defined as the maintenance of effort and interest to achieve challenges and long-term objectives (Duckworth et al., 2007), and has a positive relationship with innovation and performance in entrepreneurial environments (Mooradian et al., 2016). People with a greater consistency of effort and greater perseverance of interest are thus more likely to opt for entrepreneurship as a career choice (Wolfe and Patel, 2016), and to reach higher levels of entrepreneurial performance, exhibiting a greater commitment to work (Eskreis-Winkler et al., 2014). These characteristics also enhance an individual's knowledge and growth (Dweck, 2010).

Grit is the fuel for entrepreneurship and self-employment (Arco-Tirado et al., 2019), and its two dimensions must therefore be enhanced throughout higher education. Specifically, in relation to young adults, Wolfe and Patel (2016) identify a positive effect of *grit* in the fostering of self-employment, since the qualities of passion and perseverance contribute to counteract limitations associated with age, such as the difficulty of accessing human, social, and financial resources. This is the case for students with a *grit profile*, who show strong perseverance but low levels of social capital in their competences. The fostering of perseverance and consistency of interest over time also has a positive effect on self-efficacy. Development of *grit* qualities boosts higher levels of self-confidence (Verheul et al., 2012), which in turn increase the ability to manage adverse situations, and to improve the consequent self-perceived ability to succeed. In this way, the development of *grit* can help to increase the acquisition of other competences. It might be useful to take this into account when designing entrepreneurial training programs, especially those intended for students belonging to the low entrepreneurial profile, who need encouragement to develop all their entrepreneurial competences.

This study contributes to both theory and practice. It fulfills a perceived gap in the research on entrepreneurial competences among students, providing a classification of entrepreneurial profiles and highlighting the competences that are key to the differentiation between these profiles, and to improve the levels of entrepreneurial competence of students. From an applied point of view, the results are relevant for university education and knowledge transfer. The ability to differentiate between competence profiles is helpful for the design and development of training programs that foster the acquisition of entrepreneurial competence effectively. In this respect, the identification of competence profiles is a key element in facilitating the achievement of educational and entrepreneurial goals (Alda-Varas et al., 2012). The enhancement of entrepreneurial competences is recommended through education in entrepreneurship, especially at university level (Dickson et al., 2008). The present study also makes a positive contribution to the transfer of knowledge, ultimately increasing the entrepreneurial activity of students. Thus, training in this area is key to improving access for students to the labor market, increasing entrepreneurial intentions and promoting self-employment (Bae et al., 2014; Lanero et al., 2011;

Sánchez, 2013). Furthermore, successful entrepreneurial education is considered key to dealing with the challenges seen in the world's economies (Chiru et al., 2012). Therefore, the results are applicable to the development of both short- and long-term strategies, to promote entrepreneurial activity and develop increasingly solid and interconnected ecosystems, taking into account the role of the Entrepreneurial University as an engine of economic development, specifically facilitating the generation of entrepreneurial human capital (Audretsch, 2009).

In further research, it would be interesting to delve deeper into the process of competence acquisition, in order to determine the importance of the context in which competences develop, allowing differentiation between competences developed personally, academically, or professionally. Other variables could also be incorporated into the study, such as the entrepreneurial intention or the entrepreneurial activity, in order to identify the relationship between the development of competence, the entrepreneurial initiative, and real performance through business creation. Also important is the analysis of students' characteristics in each of the groups. In this sense, future studies could integrate sociodemographic variables that provide information about the students that make up each of the profiles. This would provide more information to establish comparisons between groups, while at the same time enabling multivariate analyses focused on defining the explanatory variables that determine belonging to the profiles, such as gender, age, nationality, degree, educational level, or professional experience. Entrepreneurial education is also understood to be a key factor in this regard, therefore inclusion of this aspect in future studies would enable the analysis of differences in competence level between students who have received entrepreneurial training and those who have not. Comparisons between groups could help to determine the most important educational strategies and to provide information on the quality and utility of entrepreneurial training programs. Finally, further study on the characteristics, backgrounds, and process of competence acquisition of students belonging to the *top entrepreneurial profile* is important to improve our understanding of how competence develops for these more successful cases.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

Both authors collaborated and contributed to the conception and design of the work, collected and analyzed the data, wrote the manuscript, performed the substantial contributions to revising the work critically, and contributed to the article and approved the submitted version.

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ANNEXES

TABLE A1 | Classification of entrepreneurial competences and student assessment questionnaire (Morris et al., 2013).

Competence	Item code	Item description
Opportunity Recognition	p1a	I am an avid information seeker.
	p1b	I am always actively looking for new information.
	p1c	I often make novel connections and perceive new or emergent relationships between various pieces of information.
	p1d	I see links between seemingly unrelated pieces of information.
	p1e	I am good at "connecting dots."
	p1f	I often see connections between previously unconnected domains of information.
Opportunity Assessment	p2a	I have a gut feeling for potential opportunities.
	p2b	I can distinguish between profitable opportunities and not so profitable opportunities.
	p2c	I have an extraordinary ability to smell profitable opportunities.
	p2d	I have a knack for telling high-value opportunities apart from low-value opportunities.
	p2e	When facing multiple opportunities, I am able to select the good ones.
Risk Management/Mitigation	p3a	My skills in recognizing and assessing risks are strong.
	p3b	There is not much the entrepreneur can do about risk.
	p3c	Risks cannot really be managed.
	p3d	I understand a lot about how to manage risks.
	p3e	Dealing with risk is a learned skill.
Conveying a compelling vision/seeing the future	p4a	I am always seeking new opportunities in my life.
	p4b	I believe in a bold and daring view of the future.
	p4c	I am able to paint an interesting picture of the future.
	p4d	The future is very hard to see or envision.
	p4e	I find it difficult to get others committed to my vision or dreams.
	p4f	I find that I am able to inspire others with my plans for the future.
Tenacity/Perseverance	p5a	New ideas and projects sometimes distract me from existing ones.
	p5b	My interests change from year to year.
	p5c	I have been obsessed with a certain idea or project for a short time but later lose interest.
	p5d	I have difficulty maintaining my focus on projects that take more than a few months to complete.
	p5e	I have achieved a goal that took years of work.
	p5f	I have overcome setbacks to conquer an important challenge.
	p5g	I finish whatever I begin.
	p5h	Setbacks don't discourage me.
	p5i	I am a hard worker.
	p5j	I am diligent.
	p5k	I am a persistent person.
	p5l	I don't let past failures hinder future performance.
	p5m	I don't get easily frustrated when things don't go my way.
	p5n	Nothing is more important than the achievement of my goals.
Creative Problem Solving/Imaginativeness	p6a	I demonstrate originality in my work.
	p6b	I am creative when asked to work with limited resources.
	p6c	I identify ways in which resources can be recombined to produce novel products.
	p6d	I find new uses for existing methods or equipment.
	p6e	I think outside of the box.
	p6f	I identify opportunities for new services/products.
	p6g	Freedom to be creative and original is extremely important to me.
Resource Leveraging/Bootstrapping	p7a	When I think about starting a venture, being able to access resources is far more important than actually owning and controlling those resources.
	p7b	It is important to me that the business owns all the necessary resources for its operations.
	p7c	The need for resources can be solved without any costs, for example by using resources that others control.
	p7d	Without sufficient savings or access to money, it is very hard to start a business.
	p7e	There is always a way to obtain a resource even if you cannot afford it.

(Continued)

TABLE A1 | Continued

Competence	Item code	Item description
	p7f	prefer to use well-planned and calculated market research tools when investigating the need and interest in my product/service.
	p7g	I prefer to use informal methods when investigating the need for or interest in my product/service (for example by asking people of my acquaintance, making my own observations etc.)
	p7h	When I am to realize a business opportunity I only invest as much as I can afford to lose.
	p7i	Mobilizing resources in unusual ways.
	p7j	Gaining leverage from limited resources
	p7k	Reducing your resource requirements (economize).
	p7l	Finding ways to actually create new resources, competences, technologies.
	p7m	Establishing strategic relationships based on reciprocity.
	p7n	Responding to challenges and tasks by redeploying resources in different ways.
	p7o	Using others people's resources instead of your own.
Guerrilla actions	p8a	I am very comfortable thinking and acting in guerrilla ways.
	p8b	I could quickly identify three guerrilla ideas to help any start-up venture.
Value Creation with New Products, Services, Business Models	p9a	I am always asking questions.
	p9b	I am constantly asking questions to get to the root of the problem.
	p9c	Others sometimes get frustrated by the frequency of my questions.
	p9d	I often ask questions that challenge the status quo.
	p9e	I regularly ask questions that challenge others' fundamental assumptions.
	p9f	I am constantly asking questions to understand why products and projects underperform.
	p9g	New business ideas often come to me when directly observing how people interact with products and services.
	p9h	I have a continuous flow of new business ideas that come through observing the world.
	p9i	I regularly observe customers' use of products and services to get new ideas.
	p9j	By paying attention to everyday experiences, I often get new business ideas.
	p9k	I love to experiment to understand how things work and to create new ways of doing things.
	p9l	I frequently experiment to create new ways of doing things.
	p9m	I am adventurous, always looking for new experiences.
	p9n	I actively search for new ideas through experimenting.
	p9o	I have a history of taking things apart.
Ability to Maintain Focus yet Adapt	p10a	Once I have identified an approach for accomplishing a task, I find it very difficult to switch to a completely different approach.
	p10b	I find it easy to modify or change my ideas about how something should be done.
	p10c	Once I figure out something that works, I tend to resist changes to that particular approach.
	p10d	I tend to look for the right answer, rather than realize there might be multiple ways to get to an end result.
	p10e	It is easy for me to modify my approach to a task if the situation calls for it.
	p10f	When I feel that my approach to a given task is not working, I find it quite easy to change to another approach.
Resilience	p11a	I actively look for ways to replace the losses I encounter in life.
	p11b	I look for creative ways to alter difficult situations.
	p11c	I believe that I can grow in positive ways by dealing with difficult situations.
	p11d	Regardless of what happens to me, I believe I can control my reaction to it.
	p11e	I only set goals which I know I can reach without the help of others.
	p11f	When I need help, I don't hesitate to ask a friend to help.
	p11g	I hesitate to ask others to help me.
	p11h	My friends and family frequently don't live up to my expectations of how they should act.
	p11i	I really resent anyone telling me what to do.
Self-Efficacy	p12a	Entrepreneurs are not really able to create and shape their own markets.
	p12b	As regards competing in the marketplace, the entrepreneur is the victim of forces he/she cannot control.
	p12c	There is little point in engaging in detailed analyses and planning, because events will occur that I cannot control.
	p12d	I can shape whatever environment in which I find myself operating.
Networking/Social Skills	p13a	Given professional contacts a phone call to keep in touch.
	p13b	Sent thank you notes or gifts to others who have helped you professionally in your work, school or career.
	p13c	Asked a business professional unrelated to you to serve as a reference
	p13d	Sent e-mails, cards or other communications to keep in touch with professional contacts.
	p13e	Gone to lunch with persons who can help you professionally.

(Continued)

TABLE A1 | Continued

Competence	Item code	Item description
	p13f	Participated in social gatherings with people that you work with in a non-campus job.
	p13g	Attended social functions for purposes of building professional relationships.
	p13h	Gone to lunch with a boss or supervisor.
	p13i	Attended meetings of professional-related organizations.
	p13j	Attended professional seminars or workshops.
	p13k	Attended meetings of civic and social groups, clubs and so forth.
	p13l	Given professional seminars, workshops or public speech.
	p13m	Attended conferences or trade shows.
	p13n	Participated in church work projects.
	p13o	Participated in church social functions.
	p13p	Participated in community projects.
	p13q	Served on a community board, committee or task force.

All items measured with a five-point Likert scale. Items p7i-p70 (Not at all comfort–Very comfort). Items p13a-p13q (Not at all–Quite frequently). Other items (strongly disagree-strongly agree).

TABLE A2 | Factor loadings (varimax rotation); *n* = 1081; n° of factors: 12.

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10	Factor 11	Factor 12
p1a									0.4011			
p1b									0.5216			
p1c									0.5918			
p1d									0.5609			
p1e		0.3372							0.5209			
p1f		0.3095				0.3875			0.3399			
p2a						0.6160						
p2b					0.3663	0.5852						
p2c						0.7088						
p2d						0.6150						
p2e						0.4769						
p3a					0.5579							
p3b					0.3001							
p3c					0.3073							
p3d					0.3224							
p4a						0.3344						
p4b						0.3136						
p5a										0.5831		
p5b										0.6561		
p5c										0.6811		
p5f								0.4942				
p5g								0.4723				
p5h								0.6515				
p5i								0.6199				
p5j								0.5984				
p6a		0.6969										
p6b		0.6983										
p6c		0.6572										
p6d		0.6237										
p6e		0.6554										
p6f		0.5533										
p7i							0.5239					
p7j							0.5062					
p7k							0.5147					
p7l							0.6490					
p7m							0.5476					
p7n					0.3585		0.3410					
p8a		0.3510										
p8b				0.4925								
p9a				0.7024								
p9b				0.6339								
p9c				0.7268								
p9d				0.6928								
p9e				0.5965								
p9f				0.3684								
p9g		0.3942	0.5311									
p9h		0.3356	0.6053									
p9i		0.3734	0.5792									
p9j		0.3055	0.5888									
p9k			0.6314									
p9l			0.5859									
p9m			0.6490									

(Continued)

TABLE A2 | Continued

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10	Factor 11	Factor 12
p9n			0.3878									
p10e												0.4592
p10f												0.5193
p11a												0.5258
p11b												0.3931
p11c												0.4627
p12b					0.5619							
p12d	0.4115				0.3397							
p13a	0.5811											
p13b	0.4592											
p13c	0.5886											
p13d	0.6904											
p13e	0.6520											
p13f	0.6713											
p13g	0.6457											
p13h	0.6284											
p13i	0.5933											
p13j	0.5045											
p13k	0.4509											
p13l	0.4524											
p13m											0.4874	
p13n											0.7455	
p13o											0.6108	
p13p											0.4031	
p13q											0.3002	

Blanks represent factor loading <0.3.

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Psychological Determinants of Investor Motivation in Social Media-Based Crowdfunding Projects: A Systematic Review

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Background: Using the power of Internet, crowdfunding platforms are currently changing the traditional landscape of fundraising. Social media-based IT platforms in particular are bringing the creators of crowdfunding projects closer than ever to potential investors. A large variety of factors function as determinants of individuals' intention to participate in crowdfunding and have an intertwined impact on funding as the ultimate project goal.

Objectives: For a better understanding of investor behavior in social media-based crowdfunding projects, this paper covers identifying, analyzing, and classifying general and specific factors of investor motivation, based on the literature in the field.The main focus is the relationship between the affordances provided by social media-based crowdfunding platforms and the psychological determinants of investor motivation in innovative start-up projects.

Methods: Using IEEE Explore, Clarivate Web of Science, ScienceDirect, and Scopus, we conducted a systematic review of the existing research on the emerging role of crowdfunding as a disruptive technology in financing the start-up innovative projects. The paper explores the main determinants of investor motivation and aims to streamline the success factors in crowdfunding campaigns.

Results: A total of 1,216 publications were identified after searching the aforementioned databases and, upon refining the results, 515 articles were considered for the final sample. After reading the titles and abstracts, the sample was reduced to 78 articles that were read in-depth and synthesized in accordance with the defined research questions. The selected articles were clustered into three main categories: general studies, determinants of investor behavior, and success factors.

Conclusions: In the new global economy, crowdfunding platforms have become the nexus between the emerging creators of innovative products and services and the necessary funding sources. This connection is possible via a cumulative collection of contributions from multiple investors recruited from the audience of the selected platform, without time or space constraints. However, the determinants of the investment decision

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are very different in the case of social media-based crowdfunding platforms compared to determinants in the mainstream environment. This paper surveys these motivators and reveals how platform features can be used to persuade individuals to make a financial contribution toward the success of a project.

Keywords: project management, start-up, disruptive innovation, social media, crowdfunding platform, investor motivation, crowdfunding success factors

INTRODUCTION

There is a growing body of literature that recognizes the importance of crowdfunding, which has emerged as a powerful, popular, and achievable means of funding projects worldwide (Nevin et al., 2017; Rodriguez-Ricardo et al., 2018; Brem et al., 2019; Kim et al., 2020a). The first mentions of the concept in academic literature dates back to 2010, but the number of published articles increased significantly in recent years as a result of the rising interest for using the conjugated power of individuals organized dynamically into "crowds" using technology, as well as due to this financing means becoming legally recognized in more and more countries around the world (Smith and Hong, 2016).

Crowdfunding implies an open call on the Internet, made with the intention of reaching large crowds, in order to get the necessary financial resources to support specific purposes. As a result, relatively small contributions are cumulatively collected from a large pool of people online. The fundraising process is most often called *a campaign*. A campaign can be seen as a project in itself, described as a set of activities with a clearly defined start and end point, geared toward reaching a specific goal—in this case, the goal is to raise the necessary funds in order to carry out the project proposed by the campaign creator (for instance: developing a new product or service). There are three categories of participants in crowdfunding campaigns: (1) the person(s) or the organization requesting funds for a project or a cause (in the case of start-ups, which are the object of this paper, this refers to an entrepreneur), (2) the crowd of potential investors (backers, funders) providing the resources, and optionally (3) the crowdfunding platform. The third element has become increasingly important in recent years: crowdfunding initiatives seem to garner genuine traction via social media-based platforms, by exploiting the truly interactive features that can be "designed and re-designed by humans with relative ease" (Choy and Schlagwein, 2016). Compared to traditional ways of obtaining money, social media-based platforms allow participants to interact with the beneficiaries of the funds via comments, reactions, etc., to follow-up on the status of the crowdfunding campaign and the progress of the funded project. Furthermore, crowdfunding enables reaching out to an unlimited number of geographically dispersed people for the purpose of such a campaign (Mendes-Da-Silva et al., 2019).

Crowdfunding has several unique particularities: it presents a mixture of entrepreneurship with social network participation, in which the customers play an unexpected role as investors; it is time-constrained and involves a variety of roles, including the promoters who disseminate information about the project over social media platforms and the backers who pledge funds for the project (Lu et al., 2014); it has the power to remove barriers to entry (Smith and Hong, 2016); it empowers the users' potential to innovate, as the ideas of many t individuals get support and can be transformed into new products and services (Brem et al., 2019; Jaziri and Miralam, 2019). For these reasons, crowdfunding is more convenient for project creators than mainstream financing channels. Entrepreneurs can present their ideas and plans to a wide audience, in a friendly and interactive environment, and the audience can support the entrepreneurs without requiring them to provide complex business plans and financial indicators that are often difficult to achieve (Wang and Xue, 2019). According to Allison et al. (2015) and Smith and Hong (2016), unlike traditional fundraising methods, crowdfunding has fewer restrictions and a higher financing. Mainstream financing parties, such as banks and venture capitalists, are less interested in backing up start-ups and their projects, which are often in an unpromising embryonic stage. In general, these investors seek projects proposed by mature organizations, with a low level of risk, and have a rather passive attitude. They tend to be interested in the return on investment instead of the product. It is for this reason that crowdfunding is a new and appealing alternative for entrepreneurs, used to generate financial resources without having to call upon traditional sources. Moreover, investors are often potential experts and clients who can support the production and sale process for the products and services proposed by the entrepreneurs. Crowdfunding platforms offer a potentially transformative experience, giving start-ups the possibility to raise funds from a very large number of investors who might become consumers in the future. According to Mollick and Robb (2016), crowdfunding enables the democratizing of financing by eliminating barriers, diminishing restrictions and disseminating innovation. Brem et al. (2019) highlights the impact of crowdfunding platforms at a governmental level, showing that they can be used for the equitable distribution of financing for innovation and thus supporting the underestimated economic power of investor-users.

The benefits of crowdfunding are important in motivating entrepreneurs and do not strictly refer to obtaining assets or financial resources. In the case of start-ups, these can also be substantiated in non-financial benefits, such as attracting employees, engaging the collective intelligence of the crowd, advanced promotion of the products and services or using same as market research and obtaining client feedback, drawing attention from the media, as well as building a pool of future

clients. Hu et al. (2015) believe that a crowdfunding campaign can be an efficient marketing and engagement platform for start-ups and for entrepreneurs who wish to promote products that are still unknown. Also, in different types of campaigns, clients are willing to pay for premium access to the product to be developed once the campaign is completed, thus helping to estimate the demand for these new products on the market, as such demand would be difficult to estimate using other methods. Investors get the chance to see companies grow from their incipience, to ascertain if the idea is worthwhile and if a need for radical change becomes apparent throughout the development (De Luca et al., 2019). The chances of products and services being accepted are positively impacted by consumer engagement in the design and development process, and campaign success is an optimal means of highlighting the quality of the project. De Luca et al. (2019) have identified eleven categories of benefits of crowdfunding for entrepreneurs, benefits that are associated with: obtaining financial resources (fund raising and cost management), strategy (business viability and quality of the formulated strategy), marketing (research, client relations, demand), actual operations (product design and development), human resource management (team management), supply chain management (potential partners), and personal aspects (entrepreneurial implications, such as replicating successful experiences, testing communication skills, self-affirmation, boosting confidence and motivation, moral support, etc.). In his turn, Foster (2019) synthesized five reasons why entrepreneurs find crowdfunding attractive: (1) it allows them to finance new projects, keeping their equity capital and avoiding debt; (2) they create a preliminary market, by attracting clients before production is completed; (3) getting their clients engaged in a unique manner, by creating a conversation around the product or service, which can result in obtaining valuable feedback on design and functions, which does not happen in the case of traditional forms of financing; (4) reducing the negative impact of implicit biases associated with underrepresented entrepreneurs; (5) it allows for efficient use of the entrepreneurs' social networks in an inexpensive manner. Crowdfunding is sometimes the only means of financing start-ups, given that mainstream sponsors such as banks and venture capitalists generally seek projects that are more mature and entail lower levels of risk, and are seldom willing to give a change to inexperienced entrepreneurs or to products having uncertain chances of success (Song et al., 2019), particularly given that start-ups financed via crowdfunding platforms are often underdeveloped at the time of their initial presentation. The feedback received from investors thus becomes very important and helps creators to adapt their campaign and anticipate any problems, to get to know their clients' preferences and to address the needs of as wide an audience as possible, which could then become loyal customers. From the entrepreneurs' point of view, Ingram et al. (2014) have identified three major characteristics of the best investors. Firstly, they provide a sufficient amount to cover risks and support the development of the business, in terms of number of employees, volume of products or services, or for advertising. Secondly, the investor brings in additional skills, expertise and a professional network. Lastly, the relation between investors and founders is seen as a potential partnership.

For these reasons, this unconventional instrument is associated with the power to eliminate middlemen from the risk capital industry, with an effect similar to the ones produced by Uber in urban transportation or Amazon in retailing (Smith and Hong, 2016), and to metamorphosise the entrepreneur financing ecosystem (Jaziri and Miralam, 2019) from a series of ivory towers often not accessible to those knocking at their gates into a dynamic, reconfigurable and fertile network. All the aforementioned characteristics transform IT crowdfunding into a genuinely disruptive technology, with a great potential to stimulate innovative projects. Crowdfunding mechanisms are legally recognized by the governments of more and more countries, which leads to their rapid development and increase in popularity worldwide, beyond the traditional western space. The development is rapid or promising in countries such as China (Wang and Xue, 2019) or ASEAN-5 (Indonesia, Malaysia, Singapore, Philippines, and Thailand) (Dikaputra et al., 2019), Eastern-European countries such as Poland and Romania (Fanea-Ivanovici and Siemionek-Ruskan, 2019), but still hesitant in African countries (Jaziri and Miralam, 2019).

After an initial success in the artistic field, online crowdfunding addressed entrepreneurial area, in domains such as technology, knowledge-based start-ups and new product development (Hemer, 2011; Rodriguez-Ricardo et al., 2018). Access to crowdfunding through the Internet has paved the way for many innovative products and services, by reducing the funding gap for innovative start-ups—some funded products are Pebble, the first smartwatch, 3D printers, hardware products, video game consoles, etc.

Hervé and Schwienbacher (2018) analyse the innovative potential of the crowd' participation in the product creation process by providing feedback to the entrepreneur. This feedback can take various forms, including providing ideas on the development of the product during and after the campaign, and providing valuable information on the future demand for the new product. Presenting ideas on crowdfunding platforms can be very important for entrepreneurs, not only because they will access the necessary financial resources, but also for the flows of knowledge that can be collected from their project followers. The online crowdfunding platforms support entrepreneurs' innovative ideas by permitting an open dialogue in the platform and the input of diverse knowledge in their projects, original perspectives of interpretation of the problems they face, and various heuristics for finding solutions. The presentation of the project by a group approved by potential consumers and investors in social media allows fruitful conversations and collection of observations, questions and opinions that can act as catalysts for entrepreneurs and lead to the validation of the idea, to its improvement and its transformation from invention in innovation. New knowledge, with the ability to produce changes and to support the entrepreneurs in reaching their goals, is gathered from various actors. In today's world, due to the high level of technological change and complexity, the ability to successfully access and use knowledge-based values from complementary sources is essential, and crowdfunding offers entrepreneurs this opportunity.

On the potential investors' side of the story, as shown in Kuppuswamy and Bayus (2017), Rodriguez-Ricardo et al. (2018), and Allon and Babich (2020), the individual's levels of innovativeness and creativity and the satisfaction to see an idea turned into reality are key determinants to the intention to participate in crowdfunding. Other motivators identified in our analysis are the investors' desire to transfer their prior knowledge, expertise and experience in the project' field (Saxton and Wang, 2014; Dejean, 2019; Kim et al., 2020a), and the positive relationship between entrepreneur and investor, based on perceived sympathy, openness and trustworthiness (Mollick, 2014; Saxton and Wang, 2014; Agrawal et al., 2015; Moritz et al., 2015; Polzin et al., 2018; Foster, 2019; Mendes-Da-Silva et al., 2019; Song et al., 2019).

To attain the desired success, fund requesting parties and crowdfunding platform managers have to have a very clear understanding of the intentions and behavior of potential investors. It is only provided this condition is met that the project presentation will be able to draw sufficient supporters. The success of a crowdfunding project is entirely dependent on the participation of potential sponsors; this is why understanding their financing intentions and motivations is a fundamental objective of this area of research (Wang and Xue, 2019).

This paper sets out to pinpoint the differences between crowdfunding and the traditional financing mechanisms, to identify what the success of crowdfunding campaigns looks like, and particularly to analyse, based on a systematic review of the relevant literature in the field, the determinant factors of potential patrons' decision to invest in start-up projects. Subsequently, of all these factors we would particularly like to highlight the psychological factors (which we deem essential) and how the characteristics of social media platforms can capitalize on and potentiate them. The rest of this paper is organized as follows. We first provide a brief overview of research questions and methods used in Section Methods. Then, Section Results discusses the differences between crowdfunding and traditional fundrising mechanisms, arguments the disruptive character of crowdfunding, and presents exhaustively the determinants of individuals' intention to engage in start-ups' crowdfunding and the success factors of a crowdfunding campaign. Summary of main findings, limitations and conclusions are given in Section Discussion.

METHODS

This research investigates the emerging role of crowdfunding as a disruptive technology by exploring, among other aspects, the primary motivations of investor in crowdfunding projects. The paper attempts to answer the following four research questions:

1. What are the main characteristics for each type of crowdfunding campaign and the most important platforms used to attract investors?
2. Do the crowdfunding campaigns feature disruptive characteristics?
3. What are the investors' psychological motivations involved in crowdfunding campaigns?
4. What are the success factors of social media-based crowdfunding campaign for the start-up projects?

The research follows the design research paradigm presented in Gregor and Hevner (2013). We conducted the research in four major steps (**Figure 1**). For the first step we performed a comprehensive review of the current literature in the field of crowdfunding. We applied the content analysis technique, "a phase of information-processing in which communications content is transformed, through objective and systematic application of categorization rules, into data that can be summarized and compared" (Kassarjian, 1977). For the first step we defined the filter comprising database, keywords, and type of documents, where possible. We searched using the following electronic libraries: IEEE Explore, Clarivate Analytics Web of Science, Science Direct, and Scopus. We divided keywords into two complementary parts: "crowdfunding" AND (platform OR affordance OR disrupt* OR psychological OR start-up OR motivation) (**Tables 1**, **2**).

We tested our queries on a pilot group of articles and we added more keywords if any of the papers in this group was not retrieved by the query string. We restricted the search to articles, literature reviews, chapters and conference papers published in English. The initial group of results was comprised of 1,216 publications, with titles and abstracts related to our research topic. Given the fact that crowdfunding as a research topic is relatively new, we considered all types of scientific publications with no specific time range.

For the following step (i.e., step two) we used Rayyan QCRI[1] to eliminate redundancies and to extract the scope of the papers.

After the first filtering, we used VOSviewer to identify the main clusters regarding the research topic and to represent the concepts most frequently used in the titles and abstracts of the retrieved papers. VOSviewer is a free software available online at www.vosviewer.com. It allows for bibliometric mapping via identification of keywords determined function of frequency of occurrence thereof and the connection identified between them. The mapping technique is applied to a similarity matrix calculated based on a co-occurrence matrix. The whole network is mapped out in **Figure 2**. We eliminated general terms, such as article, need, action, case study, etc. In this network, the cycles represent keywords and their diameters indicate the number of occurrences. The distance between keywords reflects the relation between them in terms of co-occurrence links calculated based on the number of publications in which they are used together. Nine clusters were created using the collection of keywords with strong connections.

Based on the keywords from these clusters, in step three we selected articles using Rayyan QCRI. After this selection, the resulting group comprises 515 publications. The check of inter-rater reliability was performed by adapting the procedure used by Mura et al. (2017). In this respect, a sample of 70 articles were randomly selected from the group ($n = 515$) and three of the authors rated them according with a set of five criteria, representative for the selection. Authors judgments were

[1]Rayyan QCRI. https://rayyan.qcri.org/.

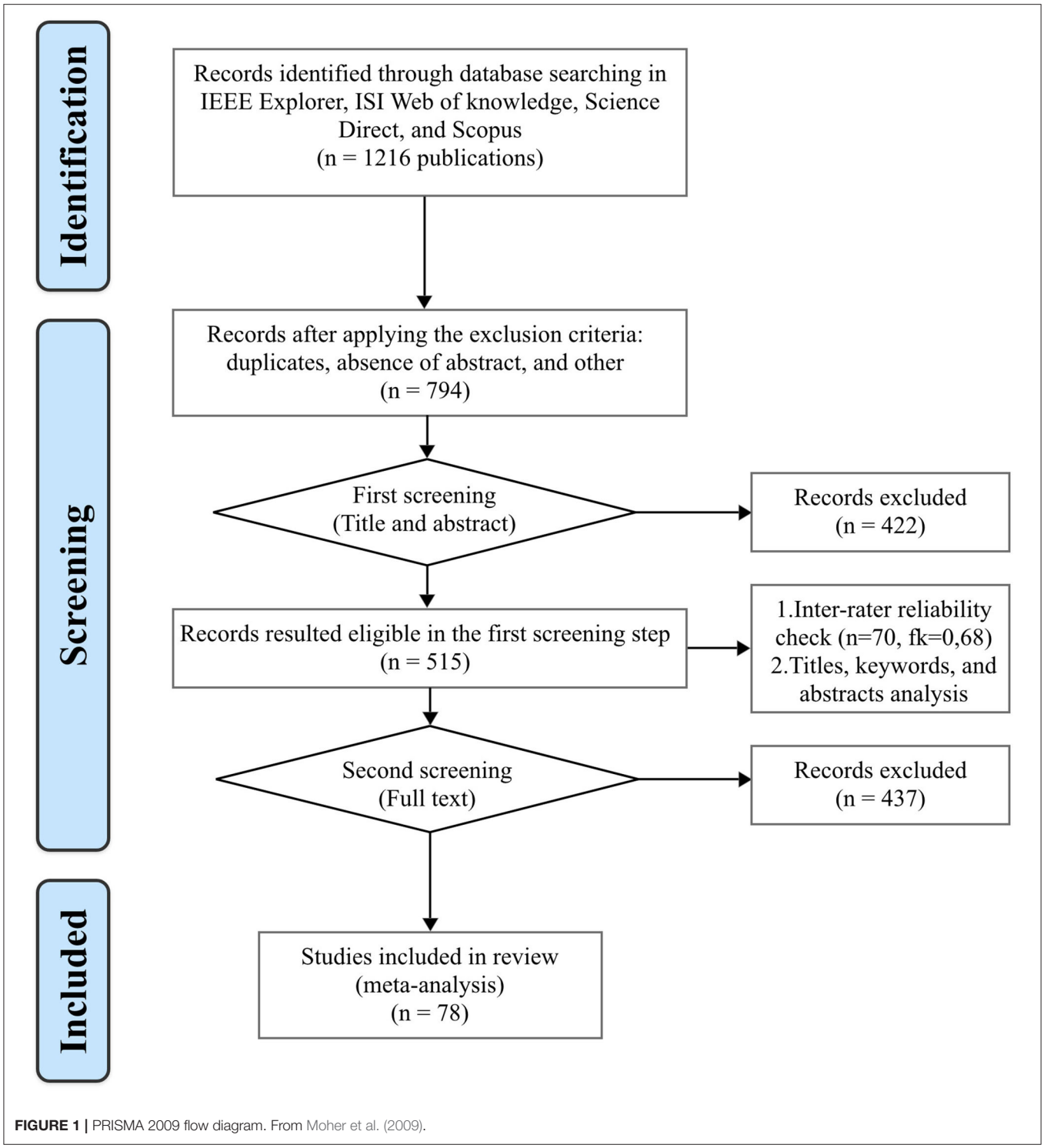

FIGURE 1 | PRISMA 2009 flow diagram. From Moher et al. (2009).

analyzed in SPSS (version 25) by using Fleiss's Kappa statistic. The result (fk = 0.68) returns a good (Laerd Statistics, 2019) level meaning that the strength of agreement between the judgments is acceptable. The result of the inter-rater reliability proved that the selected group of manuscripts ($n = 515$) are consistent with the selection criteria. To identify all relevant research, two review rounds were further performed: first based on title and abstract review and second based on full text eligibility review. The following criteria were applied for papers' abstract: first the article relevance for this study, but also the scientific background, the clarity of the abstract, the objectives of the research, and consideration of the limits of the research. We used these criteria

TABLE 1 | Queries applied for each database.

Database	Search queries
IEEE explore	["All Metadata":crowdfunding AND ("All Metadata":disrupt* OR "All Metadata":affordance OR "All Metadata":platform OR "All Metadata":start-up OR "All Metadata":psychological OR "All Metadata":motivation)]
Clarivate analytics web of science	TS=(crowdfunding) AND [TS=(platform) OR TS=(affordance) OR TS=(disrupt*) OR TS=(psychological) OR TS=(start-up) OR TS=(motivation)]
Science direct	(crowdfunding) AND (disruptive OR platform OR affordance OR disruptive OR start-up OR psychological OR psychological OR disruption)
Scopus	TLE-ABS-KEY [crowdfunding AND (platform OR disrupt* OR affordance OR start-up OR psychological OR motivation)] AND [LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "cp") OR LIMIT-TO (DOCTYPE, "ch") OR LIMIT-TO (DOCTYPE, "re")] AND [LIMIT-TO (LANGUAGE, "English")]

TABLE 2 | Search strategy for carrying out the systematic review.

Search strategy	Details
Keywords	(crowdfunding) AND (disruptive OR platform OR affordance OR disruptive OR start-up OR psychological OR psychological OR disruption)
Databases	IEEE explore, clarivate analytics web of science, science direct and scopus
Inclusion criteria	All papers considered relevant by title, abstract, and keywords
Exclusion criteria	Duplicates, absence of abstract, editorial, letter of editor, opinion, unpublished articles, working papers, and magazine
Period explored	Anytime
Language	English

to exclude those papers that are poor-quality or irrelevant for this research. In unclear cases, the decision to exclude or to include an article was made by consensus of all four authors. By applying previous assessment criteria, a large number papers did not meet the inclusion criteria and were therefore excluded.Strict exclusion and inclusion criteria were applied to limit the final selection due to the large number of results obtained throughout the search. All articles focusing on psychological determinants of individual investors in crowdfunding campaigns together with the factors influencing their success in start-up projects were selected. Studies meeting the following criteria were considered for inclusion in the final group: (1) analyzing the psychological determinants or motivations of individual investors in crowdfunding campaigns; (2) investigating crowdfunding campaigns that are dedicated to start-ups; (3) examining success factors influencing crowdfunding; (4) publishing in a peer-reviewed journal or conference proceedings; and (5) availability of full-text article. In this way, the search method that we have applied for the initial set of results ensures that biases and errors are minimized. The above criteria further narrowed down the results to 78 publications that were deemed relevant and reasonable for our research.

In step four, the selected articles were read in-depth and synthesized in accordance with the defined research questions. We recreated the map to analyse and highlight the connections between the analyzed concepts. The five clusters identified by VOSviewer are presented in **Table 3** with the following details: color, main and secondary words for each of them.

The map obtained via VOSviewer based on the keywords from the selected articles is presented in **Figure 3**. In this case, we also eliminated the general terms exemplified above.

The selected articles were grouped into three main categories: general studies, determinants of investor behavior, and success factors. Related sub-topics such as benefits, business impact, geographical influences or technology were also deemed of interest for identifying the investors' motivations in relation to crowdfunding. Based on the literature classification, we conducted a research process in order to answer the above-mentioned research questions.

RESULTS

The research results highlight the existence of a significant difference between crowdfunding and traditional fundraising methods in the context of the disruptive character of modern fundraising mechanisms. To showcase the study results, the following pages also illustrate the essential aspects identified inliterature, presenting determinants of individuals' intention to participate in crowdfunding, as well as the success factors of crowdfunding campaigns.

Differences Between Crowdfunding and Traditional Fundraising Mechanisms

The taxonomy and examples of crowdfunding platforms that are available for interested parties, as presented down below, help to highlight the differences existing between crowdfunding and the traditional mechanisms used worldwide for the purpose of raising funds.

Types of Crowdfunding

To put it most simply, we could break crowdfunding campaigns into campaigns with and without returns (Pichler and Tezza, 2016). Another distinction can be drawn between direct and indirect fundraisers. In the latter case, indirect means that entrepreneurs use crowdfunding platforms instead of directly reaching out to the crowd of potential investors. A study by Mollick (2012) highlights the role of platforms for campaign success, noting that it ensures access to the networks of founders and support for formulating the project specifications. In the absence of platforms, individual entrepreneurs launching their own initiatives should make considerable efforts to activate a network and to highlight the quality of their projects. The main types of crowdfunding campaigns are illustrated graphically in **Figure 4**.

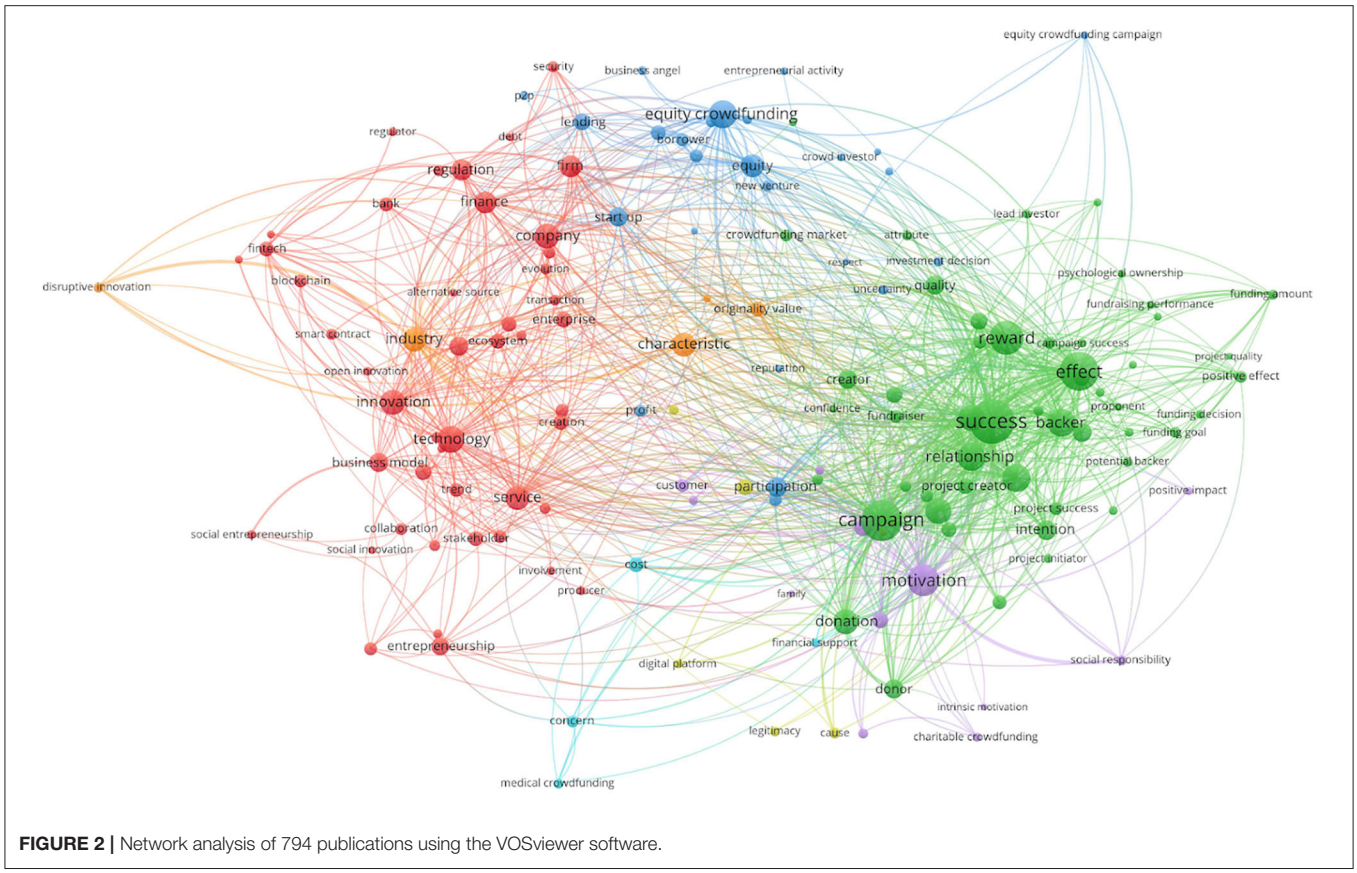

FIGURE 2 | Network analysis of 794 publications using the VOSviewer software.

TABLE 3 | Clusters identified via the VOSviewer platform.

Cluster	Main keywords	Other keywords
1 (green)	Crowdfunding	Disruptive innovation, development, innovation, market, value
2 (blue)	Project, platform	Crowdfunding platform, psychological ownership, reward
3 (purple)	Motivation	Startup, success
4 (yellow)	Backer, funding	Crowd, customer, venture
5 (red)	Entrepreneur, investor, campaign	Context, contribution, entrepreneurship, equity crowdfunding, future, investor, knowledge, risk

The types of crowdfunding (Block et al., 2018; Dai and Zhan, 2019; Dikaputra et al., 2019; Dospinescu et al., 2019; Jaziri and Miralam, 2019; European Commission, 2020) are:

- Equity crowdfunding, which entails selling a part of a business to the investors contributing to its growth. The method is similar to trading stocks on the stock market or to a venture capital. Many of the projects in the category of technology start-ups address this type of crowdfunding;
- Rewards-based crowdfunding, where investors expect to receive a non-financial reward in the form of goods or services for their contribution to the project. The typical projects financed using this solution are in the category of games, gadgets, music, and video;
- Donation-based crowdfunding, which entails small donations made by natural persons for the purpose of supporting charitable projects, without expecting a reward in return. Many of the campaigns are geared toward raising funds in order to pay for medical treatments;
- Debt-based crowdfunding, whereby a person or company loans money from a large number of people, undertaking to reimburse the amount within specific time intervals, along with other financial benefits. These are primarily focused on refinancing loans or paying off certain debts generated by the use of credit cards. These can take the following forms:
  - Peer-to-peer lending, a type that is very similar to traditional loans. In this type of crowdfunding, a company loans financial resources from contributors, which the company will reimburse along with a specific interest rate. The large number of investors makes the difference compared to traditional loans;
  - Debt-securities crowdfunding, via which natural persons invest in a debt security issued by the company, such as a bond;
  - Profit-sharing / revenue-sharing, which entails the sharing of future profits or revenues of a company with its current contributors;

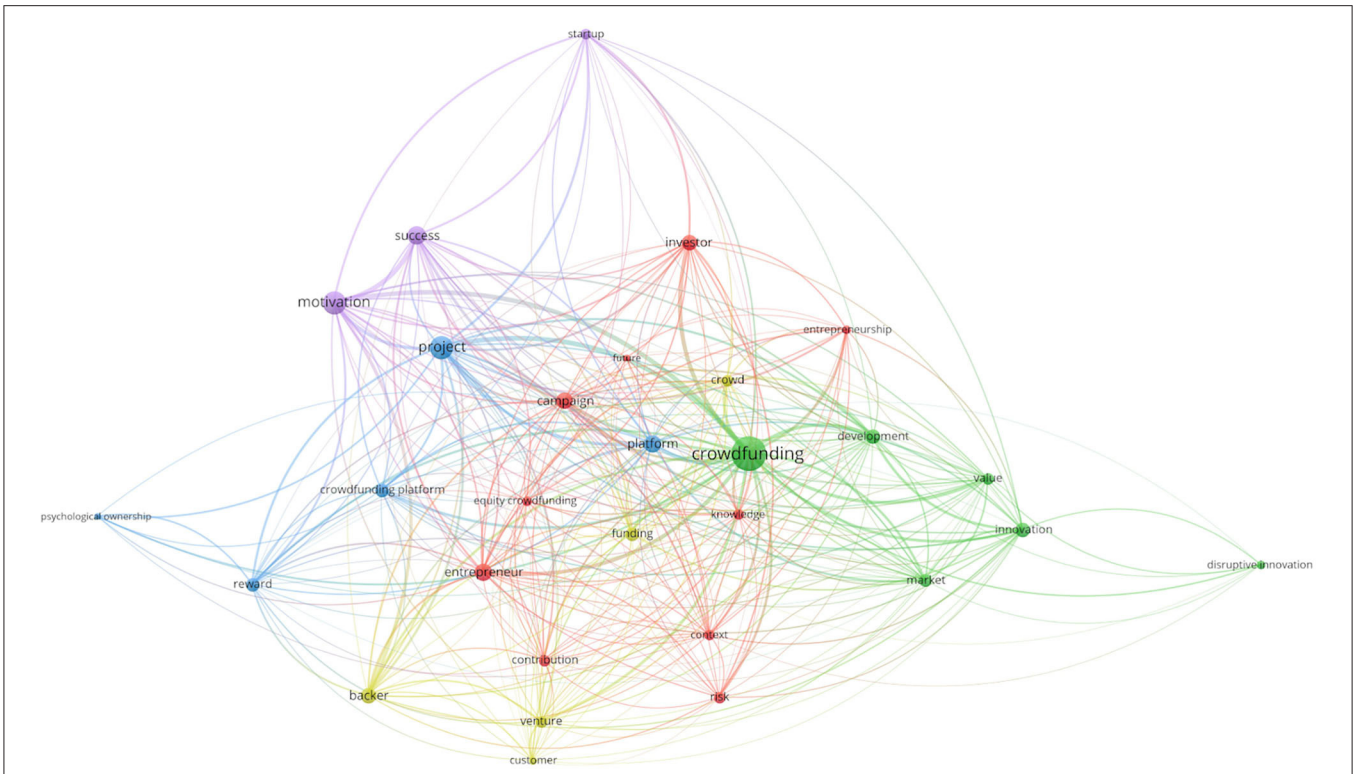

FIGURE 3 | Network analysis of selected publications.

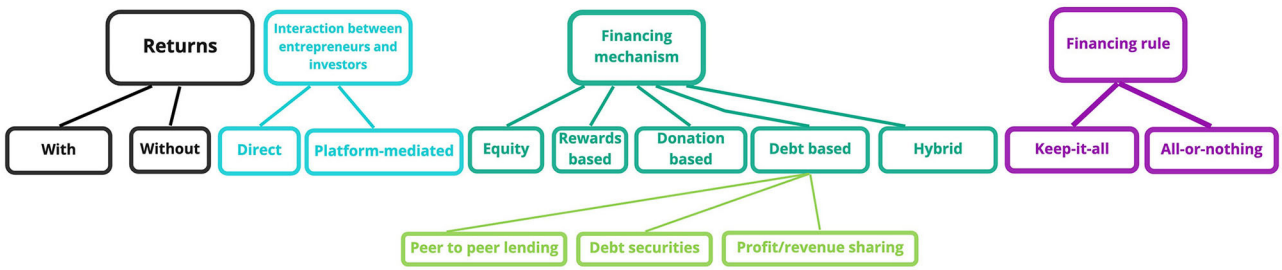

FIGURE 4 | Types of crowdfunding.

- Hybrid models combine different characteristics of the aforementioned types in order to achieve the same goal, i.e., to obtain the necessary resources for financing the projects.

Depending on the financing rule, i.e., the manner in which the entrepreneur receives the resources committed to their project, the literature highlights two common crowdfunding models: the keep-it-all mechanism and the all-or-nothing mechanism. In the former case (keep-it-all model), the entrepreneur receives all the funds that are committed to the project, irrespective of whether the predefined funding goals are achieved or not. In the latter case (the all-or-nothing model), the entrepreneur must collect the amount defined in their funding goal as a minimum, and in case of falling short they receive nothing at all (Foster, 2019).

Crowdfunding Platforms

In accordance with the results obtained following the analysis on the specialty literature, the most important platforms used to draw investors are as follows:

Kickstarter is the largest online crowdfunding platform in the U.S.A. This platform is a for-profit benefit corporation that considers both the benefits for society and the gaining of profits from its business activities. Kickstarter allows artists and other creatives, as well as companies with new and important products to promote their initiatives via a 30 days' "online campaign," and to receive financing in the form of "donations" in exchange for rewards, premiums or opportunities to purchase the product as soon as it becomes publicly available. Kickstarter does not sell or retail company stocks, but it does allow start-ups to obtain

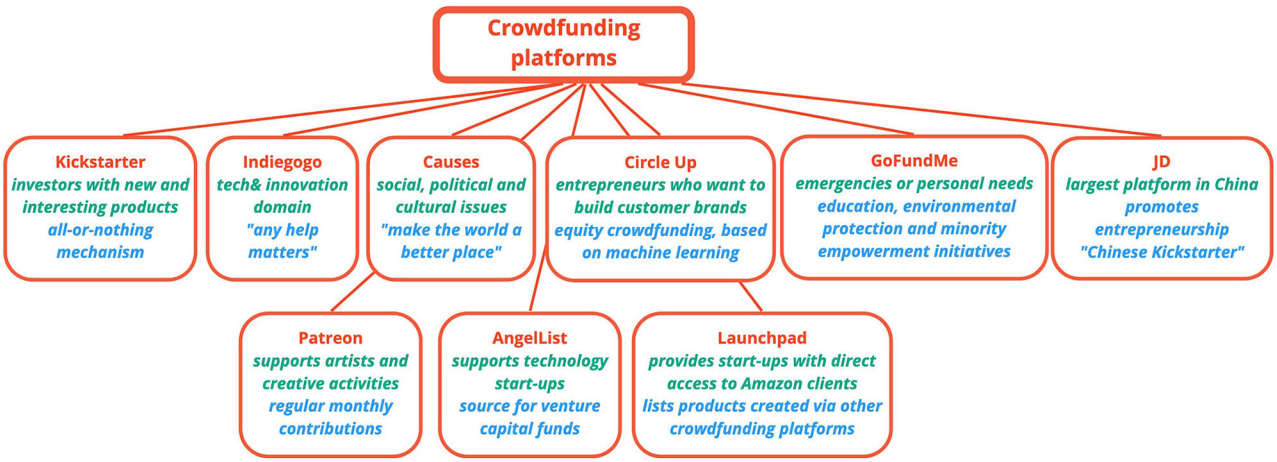

FIGURE 5 | Crowdfunding platforms.

small amounts as initial financing in order to launch their first batch of products (Smith and Hong, 2016). To this date, 183,274 projects have been successfully financed via this platform. The total dollars pledged amount to $5,050,482,941 and the number of backers adds up to more than 18 million. Approximately 33% of them contributed in financing several projects (Kickstarter, 2020). An interesting feature of the platform is its application of the all-or-nothing rule, whereby the patron's credit card is not charged until the campaign reaches its goal.

Figure 5 highlights the main crowdfounding platforms used to collect financial resources.

Indiegogo is another popular crowdfunding platform in the U.S.A., one of the first of its kind set up for this purpose, more flexible in terms of financing than Kickstarter, as it does not apply the all-or-nothing strategy and believing that any help matters. Approximately 19,000 campaigns are launched every month via this platform, most of these campaigns being from the tech & innovation domain. The platform also has specialists that offer support both for launching and keeping a campaign running, as well as after completing it, i.e., for implementing the proposed project (Indiegogo, 2020). Indiegogo competes directly with Kickstarter and is also present in Canada, U.K., France and Germany (Smith and Hong, 2016).

Causes is one of the largest non-profit crowdfunding platform dedicated to fundraising for social, political and cultural issues with a personal or community-level impact for the contributors. It presents itself as *a social network for people who want to make the world a better place* (Causes, 2020). It has more than 186 million registered users in 156 different countries. Both non-profit organizations and individuals can access the platform, raise money for their projects, find people with similar interests, and create petitions for advocacy.

CircleUp is an equity crowdfunding platform dedicated to entrepreneurs who want to build customer brands. The platform helped collect more than $390 million for 256 companies and 299 campaigns, but it is more suitable to entrepreneurs wanting to expand their business rather than those who want to launch an idea. The selection process is quite competitive and usually the creator must have a minimum $1 million turnover and growing equity in order for the project to be launched on the website. Helio, a component of the platform, uses machine learning to carry out the strategy of the company asking for help, i.e., it analyses public and private company data from public records, partnerships and information to identify potential investments.

GoFundMe is primarily used for emergencies or personal needs, such as education, environmental protection and minority empowerment initiatives (Smith and Hong, 2016), participation in events such as celebrations and graduations, or obtaining funds to finance medical treatments or procedures (∼1 out of 3 campaigns are for this purpose).

Patreon is particular in that the supporters and donors provide regular monthly contributions to ensure ongoing support for creative activities. It is particularly dedicated to supporting artists. As of its incorporation, the platform drew more than 5 million registered contributors in the following categories video/films, podcast, comedy, comics, games, and education; the contributors support 150,000-plus beneficiaries with more than $1 million.

AngelList states that it has invested $ 1 billion in technology start-ups and that several venture capital (VC) funds use AngelList as a sole source of their flow of transactions (AngelList, 2020).

Launchpad lists the products created via crowdfunding platforms such as Kickstarter, Indiegogo, Hax and CircleUp. Amazon launched this sales program in July 2015 to help start-ups get their products on the market. This platform provides start-ups with direct access to millions of Amazon clients. Amazon Launchpad is a good example of how established companies can leverage the retailing potential in the early lifecycle of their products (Brem et al., 2019).

JD is the most famous and largest reward crowdfunding platform in China, taking up 38.9% of the market share of China's

TABLE 4 | The disruptive character of crowdfunding.

Disruptive innovation characteristics	References	Why crowdfunding campaigns for startups projects are disruptive in nature?	References
Disruptive innovation creates a new market by providing a different set of values, which ultimately (and unexpectedly) overtakes an existing market. It is often social and collaborative: people with motivation, passion and expertise use web-based tools to get involved in making the world more prosperous and sustainable. Disruptive innovation is open, unpatented–shared innovation is seen as a state of mind that spreads virally.	Hislop, 2005; Tapscott and Williams, 2010; Hurmelinna-Laukkanen, 2011	Crowdfunding emerged as an alternative to the traditional venture capital or to initial public offerings, for the purpose of raising funds with a lower dilution of entrepreneurs' own equity. Start-ups often require direct and quick access to external financing, and crowdfunding has fewer restrictions and a higher financing rate compared with traditional fundraising methods. Crowdfunding evolved in a solid, powerful, popular, and achievable means of funding projects worldwide and is legally recognized in more and more countries around the world.	Cable, 2010; Allison et al., 2015; Oranburg, 2016; Smith and Hong, 2016; Nevin et al., 2017; Rodriguez-Ricardo et al., 2018; Brem et al., 2019; Song et al., 2019; Kim et al., 2020a
		Crowdfunding is social and collaborative: it uses social media-based platforms with truly interactive features. Potential investors and consumers interact with the entrepreneurs via comments, reactions, etc., they follow-up the status of the crowdfunding campaign and the progress of the funded project.	Choy and Schlagwein, 2016
		Crowdfunding empowers the users' potential to innovate, as the ideas of many individuals get support and are transformed into new products and services. It disseminates innovation by creating and using new valuable knowledge through the collaboration between entrepreneurs, investors and final users of a product/service.	Hu et al., 2015; Mollick and Robb, 2016; Brem et al., 2019; Jaziri and Miralam, 2019
Disruptive innovation removes barriers to entry and offers entrepreneurs direct access to the market.	Christensen et al., 2002; Kostoff et al., 2018	Crowdfunding has the power to remove barriers to entry. Entrepreneurs can present their ideas and plans to a wide audience, in a friendly and interactive environment, and the audience can support the entrepreneurs without requiring them to provide complex business plans and financial indicators that are often difficult to achieve. The mechanism support innovative projects, with a high level of risk.	Cable, 2010; Smith and Hong, 2016; Wang and Xue, 2019
		Crowdfunding eliminates the disadvantages of geographical distances between creators and investors. The crowdfunding mechanisms spreads to more and more countries around the world.	Yang et al., 2016; Dikaputra et al., 2019; Fanea-Ivanovici and Siemionek-Ruskan, 2019; Mendes-Da-Silva et al., 2019; Wang and Xue, 2019
		Crowdfunding enables the democratizing of financing by eliminating barriers and diminishing restrictions. It supports the equitable distribution of financing for innovation and the underestimated economic power of investor-users.	Mollick and Robb, 2016; Brem et al., 2019
Disruptive innovation is technology-based, introduces or expands new products/service functionalities, provides products or services with a distinctive structure in terms of costs or prices and allows for the involvement of new consumers/clients in product or service development.	Montgomery et al., 2018	Crowdfunding platforms provide numerous technological advantages such as cost reductions, the access of creators to the resources of investors, efficiency, flexibility and saving the time required for accessing the funds.	Hu et al., 2015; Menon and Malik, 2016; Oranburg, 2016; De Luca et al., 2019; Foster, 2019; Allon and Babich, 2020

reward crowdfunding market; the crowdfunding platform is also called the Chinese Kickstarter (Wang and Xue, 2019).

The Disruptive Character of Crowdfunding

Crowdfunding is a good example of social and collaborative innovation and it has a substantial disruptive potential (**Table 4**). In the Green Book of Innovation (European Commission, 1995), innovation is regarded as synonymous with the successful manufacture, assimilation and exploitation of novelty features in the economic and social sphere, addressing both the individual needs and the needs of society as a whole. Tapscott and Williams (2010) use the term *social innovation*, referring to a form of innovation present in all the sectors, in which people having motivation, passion and expertise use web-based tools to engage in the endeavor of making the world more prosperous, just and sustainable. Innovation is seen as a state of mind, in which

technologies and collaboration are used as catalysts, factors of change with the final goal of ensuring better results for the society. In many cases, these changes are determined by disruptive technologies that permeate societies so deeply that they change their culture and economy. Nowadays, authors consider that the Internet is the most powerful platform that is able to facilitate and accelerate new creative destructions. According to them, "people, knowledge, objects, devices, smart agents converge into many-to-many networks, where new innovations and social trends disseminate at viral speed." The topic concerning the input of technologies in "generating a new era of prosperity, innovations and collaboration between companies, communities and individuals" is also discussed by Friedman (2007). Referring to *collaborative innovation*, Hislop (2005) and Hurmelinna-Laukkanen (2011) state that the expansion and potential of global networks, the importance of positive network externalities, the need to reach a critical mass of products and the new means of electronic distribution of knowledge have determined companies to accept collaboration in their innovative activities. Nowadays innovation is carried out in a fragmented manner and at a fast-forward speed, obligating innovators to find their place in network-teams with various configurations, capable to quickly respond to challenges.

Disruptive innovations introduce new technology-based business models that allow the direct access of the population to products and services that would otherwise be too expensive or too complex (Christensen et al., 2002). They can create new markets by appealing to people that previously did not have the necessary resources and skills to get involved in supporting the development of a specific domain. Furthermore, according to Kostoff et al. (2018), disruptive innovations generate growth in the industries they access or the creation of entirely new markets.

Montgomery et al. (2018) have studied the disruptive potential of crowdfunding in real estate projects and identified the following general characteristics of disruptive innovations: they are based on technology, they introduce new functionalities or expand on existing ones, they provide products or services with a distinctive structure in terms of costs or prices, they have limited functionalities and allow for the involvement of new consumers/clients on the market.

Start-ups are innovative projects with high risks, yet significant growth, which often require external financing (Cable, 2010). According to Oranburg (2016), crowdfunding is a newly emerging means of financing start-ups via external investments. It can be very useful primarily for start-ups whose main goal is to produce certain social benefits, as people can be inspired to finance such projects that create public goods. In reality, however, the successful campaigns organized on top platforms such as Kickstarter and Indiegogo are primarily dedicated to developing consumer goods–for instance, one of the most important 15 crowdfunding campaigns was created for such a product (Oranburg, 2016).

With respect to the connection between the characteristics of disruptive innovations identified in the literature and the financing of start-ups, we note that the use of crowdfunding type campaigns also provides numerous technological advantages, the most significant of which are cost reductions, the access of creators to the resources of investors independently of their geographical location, efficiency, flexibility and saving the time required for accessing the funds. This means of financing projects has lower costs compared to classic loans due to the low value of taxes and fees (Menon and Malik, 2016). For investors, the advantage resides in the allocation of small amounts of money, the application of low fees, and the possibility to be directly involved in projects they deem interesting. Moreover, crowdfunding platforms have also simplified both the process of obtaining funds and the process of making investments. All the activities can be carried out online, i.e., signing documents, transfer of funds, monitoring the evolution of the investments, which entails savings in terms of time and financial resources. Furthermore, platforms also provide information to investors, who can carry out analyses on potential investments, of which they can select the ones that best suit their portfolio strategy, risk profile or other criteria. They ensure an audit of the proposed projects before they get posted. However, as these check-ups are not carried out rigorously by all, the reputation of the platform is seen as a major factor for investors in their selection of projects (Wang and Xue, 2019). The benefits of the Internet are undeniable in the case of crowdfunding. It makes it possible for this type of financial involvement to exist in order to support projects and it eliminates the disadvantages of geographical distances between creators and investors (Yang et al., 2016).

Many start-ups that have no access to the other sources of funds, resort to venture capitals for their initial financing. However, venture capital companies or funds reject the majority of proposals advanced to them and only invest in companies that could offer them a high yield on the invested funds. This is why start-ups in several different industries are analyzing crowdfunding as an alternative to the traditional venture capital or to initial public offerings, for the purpose of raising funds in a different manner, with a lower dilution of their own equity (Smith and Hong, 2016).

In the case of start-ups, the amounts offered by venture capital funds substantially exceed the funds obtained via crowdfunding campaigns. One famous example is that of Oculus Rift, a virtual reality headset that obtained $ 2.4 million via Kickstarter and continued to receive $ 75 million worth of financing via venture capital. Subsequently, it was purchased by Facebook for $ 2 billion (Allon and Babich, 2020). As for the entrepreneurs, the success of campaigns brings about the pressure of carrying out their obligations, but what happens in reality after campaigns are over is a topic that requires further research.

Determinants of Individuals' Intention to Engage in Crowdfunding

Allon and Babich (2020) identify the following motivations of investors: the perspective of financial profit, enjoyment of collaboration (with entrepreneurs or other funders), competition (for instance: gaining advantages for early contributions or access to oversubscribed investments), creation, contribution to a cause (supporting a community cause, such as environmental

TABLE 5 | Determinants of individuals' intention to engage in crowdfunding.

Categories		Determinants of individuals' intention to engage in crowdfunding	References
Individual motivations	Extrinsic	(Perspective of a) financial profit, material rewards or other similar benefits	Herzenstein et al., 2011; Moritz et al., 2015; Cox et al., 2017; Kuppuswamy and Bayus, 2017; Dai and Zhan, 2019; Dikaputra et al., 2019; Allon and Babich, 2020
		Competition (e.g., obtaining an advantage for early participation)	Allon and Babich, 2020
		Consumption (e.g., priority usage of the funded product/service)	Allon and Babich, 2020
		Quantity and the quality of information provided by the campaigns' creators	Hornuf and Schwienbacher, 2015; Nevin et al., 2017; Wallace et al., 2017; Alcántara-Pilar et al., 2018; Foster, 2019
	Intrinsic	Increasing self-esteem	Estellés-Arolas and González-Ladrón-De-Guevara, 2012
		Creation, innovativeness, the desire to see an idea turned into reality	Kuppuswamy and Bayus, 2017; Rodriguez-Ricardo et al., 2018; Allon and Babich, 2020
		Charitable behavior, altruism	Yang et al., 2016; Cox et al., 2017; Kuppuswamy and Bayus, 2017; Dai and Zhan, 2019; Allon and Babich, 2020
		Development of individual skills	Estellés-Arolas and González-Ladrón-De-Guevara, 2012
	Image enhancement	Prior knowledge, expertise and experience in the project field	Saxton and Wang, 2014; Dejean, 2019; Kim et al., 2020a
Social motivations	Extrinsic	Contract formalization	Foster, 2019; Allon and Babich, 2020
		Cultural factors, cultural differences	Harrison et al., 2010; Lutz et al., 2013; Devos et al., 2015
	Intrinsic	Enjoyment of collaboration (with entrepreneurs/other investors)	Allon and Babich, 2020
		Social recognition or social identification with the crowdfunding community, sense of belonging	Estellés-Arolas and González-Ladrón-De-Guevara, 2012; Nevin et al., 2017; Rodriguez-Ricardo et al., 2018; Dai and Zhan, 2019; Allon and Babich, 2020
		Relationship between entrepreneur and investor (perceived sympathy, openness and trustworthiness)	Mollick, 2014; Saxton and Wang, 2014; Agrawal et al., 2015; Moritz et al., 2015; Polzin et al., 2018; Foster, 2019; Mendes-Da-Silva et al., 2019; Song et al., 2019

protection), consumption, charity, sense of belonging, and contract formalization (an official status for the agreement between the entrepreneur and investor) (**Table 5**).

Personal and social traits are able to increase individuals' intention to participate in crowdfunding, as identified by Rodriguez-Ricardo et al. (2018) in a study on a general audience of potential crowdfunders. *Innovativeness and the social identification with the crowdfunding community have a positive effect on the intention to participate*, *on attitudes toward helping others and on interpersonal connectivity*, which indirectly determine the intention to contribute to the campaign (mediated by social identification with the crowdfunding community). The investors' perception on the degree of innovation of the presented product, on its quality and its creator's skills determine a positive attitude and involvement in crowdfunding. Wang and Xue (2019) and Choy and Schlagwein (2016) also discuss *individual vs. social motivation*. Nevin et al. (2017) refer to social identity, a person's sense of "who they are," based on the social group to which they belong.

Studying intrinsic motivation (altruism, the purely internal satisfaction derived from the act of giving), extrinsic motivation (the desire to acquire material rewards or other benefits), and image enhancement motivation, Cox et al. (2017) discovered that *among solely intrinsically motivated funders, those with a desire for image enhancement will contribute with greater monetary amounts to any given campaign compared with funders with no desire for image enhancement.* Another aspect noticed by the researchers refers to the economic profitability of the project as a factor of extrinsic motivation reported to intrinsic motivation. Although rewards are an important incentive (Dikaputra et al., 2019), there is a wide variety of intrinsic incentives that determine individuals to get financially involved in supporting a project, such as *peace of mind, altruism, reciprocity or benefits for the community via implementation of the projects* (Yang et al., 2016; Necula and Strîmbei, 2019). Kuppuswamy and Bayus (2017) highlight the importance of *prosocial behavior* in the case of reward-based crowdfunding: the supporters of the projects wish to make a profit, while also contributing in

turning an entrepreneur's idea into reality. In their endeavor to define crowdsourcing, Estellés-Arolas and González-Ladrón-De-Guevara (2012), note the motivation of investors' involvement as a means to satisfy a certain type of need, whether economic or social, such as social recognition, increasing self-esteem, or developing individual skills. Considering the fact that the most popular type of crowdsourcing is crowdfunding, the aforementioned motivations are also applicable in this case. According to Dai and Zhan (2019), the prosocial motivations of consumers that help creators reach their funding goals substantially impact the financing activities on these platforms and can exceed the economic considerations highlighted by previous research. The prosocial motivation is the internal condition that activates, directs and supports the pursuit of goals and increases as their completion date approaches, a phenomenon known as *the goal gradient effect*. The mentioned authors show that drawing closer to the goal has a higher positive effect on the level of support for the project if the project is drawing closer to its financing term, if the target amount is relatively small, or if the project has limited early support. As a result, aside from the declared benefits, in the case of reward-based crowdfunding, investors also have intrinsic motivations. They wish to feel that individual contributions have a positive impact on the project, which determines them to engage in prosocial behaviors.

Regarding the relationship with the project creator, Polzin et al. (2018) distinguished between in-crowd and out-crowd funders (funders with and without ties to project creators) and discovered that *in-crowd investors rely more on information about the project creator than out-crowd investors*. For financial return crowdfunding, financial information becomes less important once a strong relationship is established with the project creator. The advice for project creators is to target information to specific audiences based on their relationship strength across different types of crowdfunding projects. Also, Moritz et al. (2015) signaled that *perceived sympathy, openness and trustworthiness in the relationship between entrepreneur and investor* is of significant importance. Mendes-Da-Silva et al. (2019) identify the entrepreneur's network of close contacts as a factor that might play a central role in funding. In the same vein, Mollick (2014) shows that personal networks are associated with the success of crowdfunding efforts. The entrepreneur's position in their social network works as an indicator for the success or failure of the proposed project (Foster, 2019). Agrawal et al. (2015) notice that in the first phases of a crowdfunding campaign, family members and friends are important patrons. In the first phases, social networks can contribute toward improving the reputation of start-ups and can operate as a signal in respect of their quality (Song et al., 2019). Consequently, for the success of start-ups, developing the social networks of entrepreneurs is an essential prerequisite. However, additional knowledge is also necessary concerning consumer marketing and social networks to ensure the boosting of communication efficiency. On the other hand, the lack of entrepreneur preparedness makes it necessary to provide detailed information about the product, which increases the vulnerability in terms of intellectual property right theft. Foster recommends that entrepreneurs should not rely exclusively on a high level of support from the strong connections in their social network, and that instead they should aggressively promote their project to as many audiences as possible (Foster, 2019).

The *quantity and the quality of information* needed to allow entrepreneurs and potential investors to be interested in each other is also a key point of the process. This aspect is even more important in the early stage when poor information is available and information reliability is not very clear. Hornuf and Schwienbacher and also Foster find that specific kinds of information, such as *updates to investors*, significantly drive investment as funders update their preferences in light of the project assessment (Hornuf and Schwienbacher, 2015; Alcántara-Pilar et al., 2018; Foster, 2019). Information asymmetry, along with the heterogeneity of participants in crowdfunding campaigns, at the level of both patrons and entrepreneurs, as well as the control mechanisms of specialized platforms, impact the result of the projects. This especially refers to the differences between the information held by the two parties, caused by contradicting interests between the potential entrepreneur and investors. Usually, investors do not possess the skills required for assessing the projects and technologies proposed by the entrepreneur, while entrepreneurs tend to be reluctant about revealing all the information about the proposed products/technologies and their potential on the market. Consequently, it is difficult for investors to identify the information they need to assess the quality of start-ups and to distinguish between promising and unprofitable investments (Meoli et al., 2019). The matter of asymmetry is very important in crowdfunding campaigns that are carried out online for a short period of time. For instance, due to information asymmetry, non-profit projects that have a lower variation of value are more likely to obtain more financing (Moritz et al., 2015). Potential entrepreneurs could highlight the quality of projects by showcasing certain features thereof in order to help overcome the uncertainty and information asymmetry and to grant credibility to the project. Social networks support the flow of information signaling the quality of the projects and entrepreneurs (Polzin et al., 2018). Being more active on social media and having a higher level of engagement with the crowd will have a positive impact on the overall funding of a crowdfunding campaign (Nevin et al., 2017). Charities and non-profit organizations recognize the value of online social media platforms for influencing consumer responses, particularly among younger consumers (Wallace et al., 2017).

Another category of studies analyzed the financing decisions and/or the behavior of patrons in the traditional environment compared to those involved in crowdfunding. Unlike professional investors, those who support projects in crowdfunding campaigns are substantially influenced by non-standard information, as well as by the status of the campaign. For instance, projects with multiple "backers" or that closer to being successfully financed can draw more potential investors, a phenomenon known as the "herding effect" (Herzenstein et al., 2011). Their study was conducted based on information sourced from prosper.com. In one of their previous studies, they also discovered that information *that cannot be verified affect the investors' decisions more than objective and verifiable information*.

Trust, knowledge in the domain of the project, expertise and experience could be also factors of the crowdfunding decision. Saxton and Wang (2014) consider that the *presence of trust* is fundamental for crowdfunding and has a direct impact on the intention to invest. To gain the investors' trust, entrepreneurs have to provide accurate and complete information to potential investors from the very start. The level of trust indicates the extent to which investors believe the start-up has the capacity to succeed and to achieve the desired results. Moreover, a high level of trust also boosts the clients' willingness to share the necessary personal information to purchase the products or services that will be supplied by the company and correlates positively with consumer loyalty. According to Kim et al. (2020a), the extrinsic and intrinsic motivation impacts the level of trust in the project. Although crowdfunding platforms provide various means to collect information about the project founder, such as the founder's previous experience, motivations and details about the project, tacit knowledge remains important in establishing trust and mutual commitment (Dejean, 2019).

In regards to *cultural differences* on crowdfunding dynamics, some studies draw on the cultural entrepreneurship literature to assess whether a borrower's cultural alignment with their own country increases or decreases funding speed (Harrison et al., 2010; Lutz et al., 2013; Devos et al., 2015).

Success Factors in Crowdfunding Campaigns

The success of a crowdfunding project/campaign can be reflected in the performance of targeted fundraising. When the amount of funds collected via a crowdfunding project/campaign exceeds the target amount, then the crowdfunding project can be deemed successful (Dikaputra et al., 2019).

Chen et al. (2020) classify the factors influencing the success of crowdfunding campaigns into two categories, i.e., static factors and dynamic factors, with different effects function of the campaign phase. Static factors refer to those elements that do not change during the fundraising campaign, such as the entrepreneurs' social capital, information about the projects' description and the funding goals. Dynamic factors, on the other hand, change as the fundraising process progresses. These factors refer to financing performance, project popularity and the public's reactions to the entrepreneurs' attitude.

Previous studies show that, although there is quite a large number of successfully financed campaigns, many of them fail to achieve their ultimate goal. For instance, according to the statistics provided by Kickstarter, only 37.81% of the projects promoted via this platform met their target goal (Kickstarter, 2020). Success is influenced by factors such as the duration of the campaign (Mollick, 2014), the financing project (Muller et al., 2013), certain expressions, readability and length of description, project advertising mode (text, photos, video, etc.) (Greenberg and Gerber, 2014; Dey et al., 2017), frequency of information updates, existence and level of rewards (Greenberg and Gerber, 2014) and the number of shares on social media platforms (Kaartemo, 2017). The factors that influence the evolution of the campaign within social media networks are both qualitative (for instance: video footage/animated images) and quantitative (the size of the entrepreneur's social network, the number of comments or number of updates).

Yang et al. (2016) identified two essential components for the success of crowdfunding campaigns, which are directly connected to entrepreneurs. First of all, the entrepreneurs' social network plays an important part, and it should be as sparse as possible in order to be more efficient. Second of all, the entrepreneurs' experience and the decisions they make during the project are an important factor. Studies show that the entrepreneurs that have previously run successful projects have higher chances of obtaining new financing (Koning and Model, 2014). Also, providing detailed information about the project, the implementation plans and associated risks have a favorable influence on the chance to obtain financial resources (Ahlers et al., 2015). Chen et al. (2020) classified the success factors in two cathegories, static and dynamic. **Table 6** aim to complete the above mentioned classification with other factors as they have been identified in the literature.

According to Xu et al. (2014), a campaign that features frequent updates with progress report information, newly added contents, answers to questions, added rewards, etc. has 26% higher chances to succeed than a similar campaign with information that is not updated. Moreover, there are some platforms (such as Kickstarter) that rank the projects on their page based on their popularity. Block et al. (2018) discovered that posting an update has a significant positive effect on the number of investments made by the crowd and the collected amount. The effect is not entirely immediate, but rather gains traction a few days after publishing the update. Furthermore, the effect of the updates loses its statistical significance once there is an increase in the number of updates posted during a campaign. Using plain and clear language in the updates boosts crowd participation, while the length of the update (number of characters) has no effect (Mitra and Gilbert, 2014). As for the contents of an update, we discover that the positive effect can be attributed to updates about new developments regarding the start-up, such as new financing, business developments and cooperation projects. Updates on the initial team, business mode, product evolution and advertising campaigns do not have significant effects. Updates allow start-ups to signal their value to the crowd and to establish their credibility and legitimacy during a crowdfunding campaign. Consequently, creators should generate daily traffic on the webpage of the project, which can be achieved by frequently updating the provided information. A study conducted by Moradi and Dass (2019) shows that crowdfunding campaign creators should use negative framing, such as using counterfactual language to highlight the costs associated with the lack of contribution in the description of their project, as this type of framing has a positive impact on the level of financing. Other similar elements with a positive effect on the favorable decision of investors are brief text updates, the presence of a link to a website where the project is presented, the presence of comments (Dikaputra et al., 2019).

Success is related to certain characteristics of the individuals seeking to raise funding. For instance, studies suggest that campaigns launched by women or by teams that include at least

TABLE 6 | Success factors in crowdfunding campaigns.

Category	Success factors	References
Static	Entrepreneurs' social capital	Chen et al., 2020
	Entrepreneurs' funding goals	Chen et al., 2020
	Existence and level of rewards, including prior financing received by the entrepreneur or the existence of multiple financing parties (venture capitalists or business angels)	Greenberg and Gerber, 2014
	Entrepreneurs' previous experience in the project field	Koning and Model, 2014; Yang et al., 2016; Kleinert et al., 2018
	Size of the project	Dikaputra et al., 2019; Xie et al., 2019
	Certain characteristics of the individuals seeking to raise funding: gender, location of the initiator(s) (peripheral geographic areas, proximity), team size	Agrawal et al., 2015; Moleskis et al., 2018; Dejean, 2019 Greenberg and Mollick, 2017; Moleskis et al., 2018; Sauermann et al., 2019
	Risks associated to the project	Ahlers et al., 2015; Moleskis et al., 2018
	Quality of the implementation plan	Ahlers et al., 2015
	Platform features (reputation, trust, webpage visual design)	Dai and Zhan, 2019; Wang and Xue, 2019; Kim et al., 2020b; San Martín et al., 2020;
	The presentation of the project: images, video footage/animated images, text—use of certain expressions, readability and length of description	Muller et al., 2013; Greenberg and Gerber, 2014; Mollick, 2014; Ahlers et al., 2015; Dey et al., 2017; Koch and Siering, 2019; Moradi and Dass, 2019; Sauermann et al., 2019; Chen et al., 2020
	Emotional appeal, signaled popularity	Koch and Siering, 2019
Dynamic	Financing performance	Xie et al., 2019; Chen et al., 2020
	The public's reactions to the campaign and entrepreneurs' attitude	Koch and Siering, 2019; Chen et al., 2020
	Number of investors (goal gradient, herding effect)	Xie et al., 2019
	Duration of the campaign	Mollick, 2014
	Frequency and quality of information updates	Greenberg and Gerber, 2014; Xu et al., 2014; Ahlers et al., 2015; Block et al., 2018; Hornuf and Schwienbacher, 2018; Foster, 2019; Koch and Siering, 2019
	The popularity on social media platforms of the project and of entrepreneur (including advertising by photos, video, text, the size of the entrepreneurs' social network)	Lu et al., 2014; Mollick, 2014; Yang et al., 2016; Butticè et al., 2017; Kaartemo, 2017; Dikaputra et al., 2019; Sauermann et al., 2019; Xie et al., 2019; Yeh et al., 2019; Chen et al., 2020
	Entrepreneurs' decisions during the project	Koning and Model, 2014
	The social ties between geographical regions	Dejean, 2019
	Patents	Meoli et al., 2019

one woman have greater chances of success than campaigns launched by men or be male-only teams (Greenberg and Mollick, 2017; Sauermann et al., 2019). Other essential elements are the social interconnection of the creator via social media networks (Mollick, 2014; Butticè et al., 2017) or campaigns launched by persons located in peripheral geographic areas (Agrawal et al., 2015).

A study by Dikaputra et al. (2019) shows that in ASEAN-5 countries, small-sized projects are more likely to be funded; also, potential backers prefer large teams, which is consistent with the resource-based view of firms.

The success of projects is also influenced by the following factors: project characteristics—projects developed for non-profit purposes are more likely to be funded than projects created for-profit; budget–projects with small budgets have higher chances of reaching their goals; as well as the radical and innovative character of the projects, which substantially contributes to the chances of success. As far as the connection between the success of a crowdfunding campaign and its characteristics is concerned, the presented information, the presentation manner and how creators interact with the crowd are all essential. Researchers have established the following positive correlations: the quantity of information provided about a project correlates positively with the success of funding, the information provided in a visual form, including via videos, are particularly useful, frequent project information updates during the campaign can further increase the likelihood of success, support from a business angel or venture capitalist correlates positively with the success of the fundraising, campaign anticipation by providing information about the project via social media networks (Sauermann et al., 2019).

Another study conducted by Kleinert et al. (2018) shows that in the case of financing start-ups via equity crowdfunding-type campaigns, the existence of prior financing received by the entrepreneur from venture capitalists or business angels gives greater chances of success compared to projects that have not received such financing. Also, the existence of multiple financing parties has a stronger favorable effect than when there is a single financing party, and the existence of previous successfully completed campaigns has a positive influence both on the number of investors and on the probability of financing, particularly in the case of companies with low human and social capital, as well as in initial phases when uncertainty is very high.

In a study on Taiwan and Japan, Yeh et al. (2019) developed a useful framework comprising two aspects and four factors that support crowdfunding success. Specifically, they highlight the aspects of attraction-promotion and cognition-promotion and the factors of media richness, attention, signaling and kindness. The authors analyse how the aforementioned factors influence the success of crowdfunding so that founders can use these factors to obtain the funding they need and increase the probability of success for their project. In a study on a Chinese crowdfunding platform (taobao.com), Xie et al. (2019) also used a set of five variables (detailed below) to perform a regression analysis so that the effect of each variable can be quantified. They discovered a significant positive relationship between the funding amount and funding target, as well as the number of investors and number of followers having a positive effect on the funding amount. The results of the statistical analysis identified the above as the most influential variables for funding success in four project categories: (1) science and technology, (2) entertainment, video, design, and animation, (3) agriculture and donation, and (4) games and books. In their research, Leone and Schiavone (2019) determine that the success of crowdfunding can result from a greater adoption of the founders' social capital size, and from other post-failure revisions (e.g., product redesign, different funding period).

Koch and Siering (2019) find that emotional appeal has a positive impact on successful project funding, along with signaled experience or popularity. They also show that both information and risk disclosure have a positive influence on funding success. As such, a higher amount of information transmitted through text messages, pictures, and videos reduces uncertainty regarding the project and diminishes the investors' resistance and hesitation. At the same time, they proved that too much information harms the funding process.

Moleskis et al. (2018) perform an econometric analysis investigating how the three success factors (risk, lender proximity, and gender) impact the nature of the project. They analyzed humanitarian and entrepreneurial projects.

Underlying project quality is identified by Mollick (2014) as an important determinant of success in crowdfunding. The temporal distribution of customer interest in regards to a project is reciprocally affected by both the freshness and the remaining duration of the project. The results of a project are more deeply correlated with the early promotional activities on social media rather than its own properties. A project is popularized via massive promotion, whereas the keystone of its success is established in the intensive interactions between participants (Lu et al., 2014).

Platform features are important and can potentiate the other factors. It has been demonstrated that the number of likes, shares, favorites, retweets, the number of posts, the quality of posts, response speed, engagement in a campaign influence its success. Investment decisions are rooted in such collective network interactions (Hornuf and Schwienbacher, 2018). Of the more special features that help boost the level of investor engagement we would note the *stretch goals* feature, which allows projects that have already been successfully financed to continue the campaign and to up the *ante, offering extra products or additional features for investors that wish to continue to participate* (Foster, 2019). Furthermore, Foster (2019) also shows that the platform helps potential investors to assess the support provided by their social network and thus reduce the information asymmetry. The results of a study conducted by Kim et al. (2020b) show that the willingness to get involved in a crowdfunding campaign is influenced to a larger extent by the trust in the platform than in the fundraising party. The platform perceived risk is also postulated by San Martín et al. (2020) as capable of influencing individuals' attitudes toward and intention to participate in a crowdfunding project. Crowdfunding platform reputation and webpage visual design are also identified by Wang and Xue (2019) as major factors in making the decision to invest in a campaign. Dai and Zhan (2019) advise crowdfunding platform managers to consider the sponsors' prosocial motives when designing platform functionalities. To attract sponsors that are willing to have an impact on projects that are close to their funding goals, they could consider activating an advanced search option by goal proximity. Moreover, from a project planning perspective, crowdfunding platforms should pay attention to the progress of all the projects in the same category and dynamically decide when to launch new projects, in order to reduce competition between projects that are close to reaching their funding goals and new projects.

In the case of equity and debt crowdfunding, which are subject to stricter legal regulations, platforms are on the one hand making the relations between supporters and entrepreneurs official, replacing the informal family and friendship ties (Agrawal et al., 2014), and on the other hand they can be used as an alternative retail channel (Allon and Babich, 2020).

The cost of distance in the geographical flow of crowdfunding cannot be neglected. In fact, most metropolitan regions shape the geography of funding. According to Dejean (2019), the social ties between regions are one of the important factors in determining the flow of funding. However, could the number of immigrants in a region or labor mobility increase the crowdfunding flow, or does the elasticity of distance remain important and do social ties between regions determine the flow of funding? By means of social networks, we appreciate that it is possible to mitigate this tendency.

Meoli et al. (2019) *have studied the role of patents in the attraction of investors in reward-based crowdfunding.* Unlike professional investors, such as venture capitalists, for whom holding a patent for the product to be developed via the start-up is a favorable argument for financially supporting the project, in the

case of backers the authors identified that this aspect correlates negatively. One reason could be the association of patents with a higher technical complexity, which causes individuals to perceive patent-based projects as more high-risk, less familiar in terms of the scope of use, and less engaged in social causes. Moreover, they signal a high level of innovation, which causes them to be perceived as very removed from the market and less usable by the general public.

DISCUSSION

The systematic analysis carried out in this paper revealed a large body of literature produced on the topic of crowdfunding, with an emphasis on its role as a feasible means of funding projects around the world.

Summary of Main Findings

The study achieved its objectives by producing several key findings.

1. The literature analysis has shown that crowdfunding is considered a social and collaborative innovation platform that proves to comprise a considerable disruptive potential. As with other disruptive innovations, crowdfunding introduces new business models that are technology-related and facilitate its use on a less complex and less expensive basis. Moreover, crowdfunding as a disruptive innovation has the following main features: it relies on technology, it adds new functionalities or builds on existing functionalities, it provides products or services with a distinctive structure in terms of costs and that are conducive to involving new consumers in the market.
2. Consistent with the literature, this study found a large variety of factors among the determinants of individuals' intention to participate in crowdfunding projects. Personal and social traits appear to boost the individuals' intention to engage in crowdfunding. Another set of factors include the intrinsic (altruism, the internal satisfaction derived from the act of giving), extrinsic (the desire to reap material rewards or other benefits), and image enhancement motivations. In this respect, among intrinsically motivated funders, the study shows that those with a desire for image enhancement are stimulated to increase their financial contribution to any given campaign compared to those with no interest for image enhancement. Consequently, the economic profitability of the project as an extrinsic motivation factor, in relation to the intrinsic motivation is also very common among the factors. Although rewards are an important incentive, there is a wide range of intrinsic incentives such as gratitude, altruism, reciprocity, or community benefits through project implementation that stimulate funders to become involved financially to support a project.
3. This study confirms that the factors influencing the success of crowdfunding campaigns are divided into two categories, namely static and dynamic factors. While static factors do not change during the campaign (such as the entrepreneurs' capital, project description, and funding targets), dynamic factors change as the crowdfunding process progresses. The latter category of factors refers to funding performance, project popularity and public reaction to the attitude of entrepreneurs. Another set of factors for the success of crowdfunding campaigns include the social network, the expertise and experience, and the decisions made by entrepreneurs during projects. Studies show that entrepreneurs that have previously carried out successful projects and have a sparse social network are more likely to obtain new funding. Also, providing detailed information about the project, implementation plans and associated risks favorably influences the chance to obtain financial resources. Other success factors listed in the literature review are certain characteristics of the individuals seeking to raise funds (the inclusion of women in the crowdfunding project team), social interconnection (of the creator through social networks), project size (smaller projects are more likely to be funded) and the size of the team (potential backers seem to prefer large teams).

The main findings of the research are summarized in **Figure 6**.

Besides the theoretical contribution, the study also has practical implications, being of interest for the individuals/companies currently using or expecting to use social media-based crowdfunding campaigns in order to finance their innovative start-up projects in different parts of the world. In our opinion, there are two main categories of beneficiaries that could concretely fructify the results of this research. (1) For entrepreneurs interested in launching a start-up, detailed knowledge of the factors that motivate the members of the "crowd" to invest is useful in building the fundraising campaign in such a way as to achieve the desired result. The chances of success for the campaign and the project proposed by the entrepreneurs increase due to the correct choice of the platform (1), of the target group (2), by pertinent decisions on the included content and on the manner of presenting them (3) and by constructing messages that take into account the stimulation of many of the determinants identified by us above (4). In addition, our study reveals that the triggers of the funding decision differ from one stage of the funding campaign to another, that the types of funders (in-crowd, out-crowd) values different information, and, in addition, the success of a campaign also depends on how it allows the ICT platform to be built, the size of the project, etc. (2) For managers and designers of crowdfunding platforms, the study is of interest because it highlights the characteristics of the platforms that influence the success of the projects they present. The synthesized results can be used in the design of key functionalities, interface, platform usage scenarios, so as to stimulate investor participation, achieve the goal of entrepreneurs and foster innovation in the domain.

The study streamlines that understanding the crowdfunding financing mechanism (which proves to be more flexible compared to traditional mechanisms), the determinants of the decision to invest and the success factors can be very useful for entrepreneurs in turbulence periods such as the one generated by SARSCov2. The above pieces of information are forming a safety net aiming to transform innovative ideas into reality.

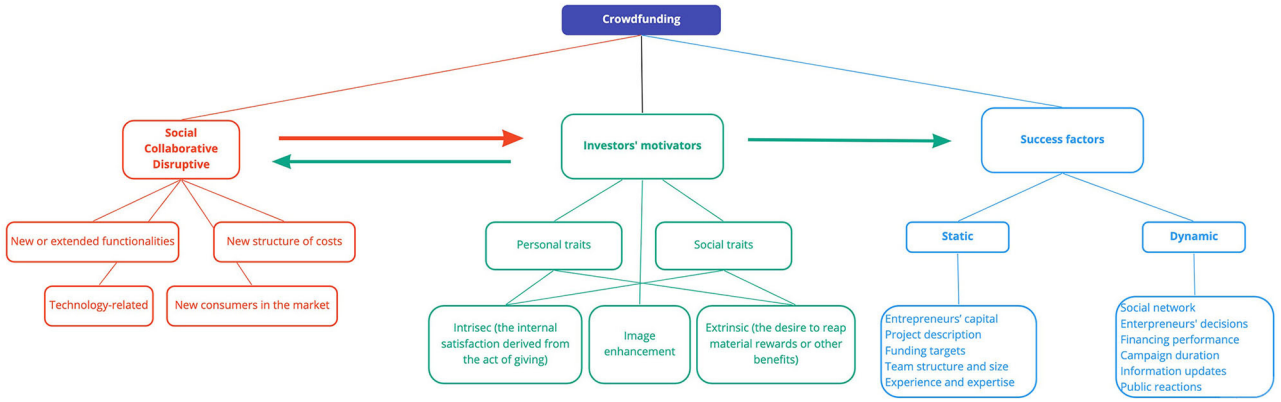

FIGURE 6 | The main findings of the study.

Limitations

This article is not lacking in limitations. The first limitation is the strictly theoretical character and the lack of empirical testing. Future research should focus on the empirical evaluation of psychological motivations underlying the engagement of individuals in supporting start-ups financially via crowdfunding-type campaigns. Another aspect is the fact that entrepreneurs aim to develop and supply highly varied products and services upon initiating a start-up. Future research should expand on and particularize the determinants identified in specific fields of activity. Even though there are certain limitations mentioned in regards to them, the motivations analyzed in this paper can be used to boost the chances of success for crowdfunding-type campaign creators. Similarly, they could use the success factors identified in this paper to coordinate their projects in such a manner as to increase their chances to collect the necessary financial resources. Furthermore, a limitation of this study is that the subject of crowdfunding is very topical, technology-driven, and therefore very dynamic. More papers are being published every day and the current results are subject to new amendments brought about by new technology advancement and legislative changes.

Conclusions

In principle, start-ups are innovative, often niche-type projects, that nevertheless engender high risks, but also a significant potential growth and that oftentimes require external financing which is quite difficult to obtain. The financing manner, the relevant competition, and the types of financed projects have evolved and increasingly migrated online, which further complicated the equation for selection, particularly due to the psychological determinants of investor motivation.

Following the systematic literature analysis carried out in this research endeavor, we noted that in comparison with traditional project financing mechanisms, crowdfunding platforms democratize the access to funds, giving a significant chance to start-ups that generate innovative—but often risk-prone—ideas. Thus, while traditional project funding usually entails submitting complex documentations in the context of a competition restricted by the formalities of professional language, focused on proving one's eligibility and the financial capacity of the applicant requesting the funds, followed by the analysis of the received proposals and offering an answer after a usually long period, crowdfunding platforms allow entrepreneurs to present their ideas to a very large mass of potential investors as soon as they deem themselves ready, pointing out the information they deem essential in a brief and dynamic presentation that can be updated instantly function of the feedback it elicits. The social and collaborative potential of crowdfunding platforms provides investors with significant further benefits aside from attaining the desired financial goal. As early as the phase preceding the conception of the project proposed for financing, by leveraging the advantage of direct communication via the platform, investors can contribute in the design of the product/service, in configuring a market for the latter, thus reducing the level of risk associated with each innovative idea.

However, the financing party—an individual in a crowd of individuals—is structurally and deeply different from traditional financers. Some factors that also matter in their decision to invest also include: the perception on the degree of innovation/quality of the proposed product or service, identifying with the entrepreneur and confidence in their skills, their proposed project and/or the community of financers, the benefits in terms of reputation, pragmatic rewards, as well as very strong elements of intrinsic motivation: personal satisfaction, altruism, reciprocity or the benefits to the community via the implementation of projects. Unlike traditional financing, what really matters in crowdfunding is the relationship that is created or improved between the entrepreneur and the potential investor. A mutual liking for one another, transparency, and the capacity to generate trust are essential when the project creator is unknown to the potential investor. The size and quality of the entrepreneurs' network are also essential elements for influencing investor behavior. Trust, as an essential attribute of the relationship between the two parties, is a direct determinant of the decision to invest.

One major conclusion of our study is that crowdfunding platforms have the capacity to reflect the qualities of proposed start-up projects in a favorable manner to the entrepreneurs, having an essential contribution in influencing the factors presented above and in project financing, provided that they are used correctly and to their full potential. The reputation and type of platform, its audience, the type of crowdfunding campaign used, the duration of the campaign, the quality and quantity of information provided, the means of presenting such information, the language used, how frequently they are made available to the public, how campaign creators interact with the crowd of potential financers are all aspects that need to be studied in depth and fully understood, so that each of them can be set in accordance with the type of proposed project, its creator's intentions, as well as the expectations of the crowd of potential investors—and ultimately so that they can synergically result in accomplishing the desired financing goal. Furthermore, it is important to highlight that our study also revealed a necessity in terms of project planning: we believe that crowdfunding platforms should pay more attention to the progress of all the projects in the same category and dynamically decide the optimal moment to launch new projects, in order to reduce competition between projects that are close to reaching their funding goals, which significantly reduces the probability of being funded.

The practice showed that many start-ups that have no access to the other sources of funding resort are increasingly resorting to crowdfunding to obtain financing in their initial phase, as venture capital companies or funds reject the majority of proposals advanced to them and only invest in companies that could offer them the perspective of a high yield on the invested funds. Start-ups from different industries see crowdfunding as a viable alternative to traditional venture capital or initial public offerings, for the purpose of sourcing funds in a different manner, while also having a lower dilution of their own equity.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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BRIEF RESEARCH REPORT
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Does the Use of Social Media Tools in Classrooms Increase Student Commitment to Corporate Social Responsibility?

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There is an increasing demand for ethical and Corporate Social Responsibility (CSR) practices by companies. This competence has to be introduced in students' training in business degree programs, and a check must then be done to determine if the students have come to appreciate the importance of CSR commitments. Using the framework of Stakeholders Theory, this work aims to examine students' perceptions of ethical and CSR practices and commitment to different stakeholders, as well as the factors that lead students to act in a socially responsible way. Furthermore, we hope to identify how the perception of CSR can be improved when Web 2.0 and social media tools that have proven effective in transmitting emotions and values are used in classrooms to teach these ideas. To this end, a survey was carried out in the year 2019 with 1,030 first-year students; it was administered at the beginning of the semester and also at the end of the semester after the training activities had been carried out. The main finding of the research is that students start with the belief that ethics and CSR are developed for reasons of image and legitimacy; however, after receiving training on these topics through tools that take into account emotions and values, they start to value the importance of the company as an agent of social change. The main practical and managerial implication is that methods based on Web 2.0 and social media tools are useful to teach ethics and CSR; the theoretical contribution is that students take into account the welfare of others. This finding contributes to Stakeholder Theory in a higher education context.

Keywords: Corporative Social Responsibility, business ethics, higher education, digital technologies, social media

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SOCIAL MEDIA IN CSR TRAINING IN UNDERGRADUATE STUDIES

The financial scandals of the early 2000s have led to greater demand for ethical behavior in the business world (Brunton and Eweje, 2010). The demand for Corporate Social Responsibility (CSR) necessitates the training of students to solve CSR-related problems to help them to identify how and why to address those problems (Hosmer, 2006; Brunton and Eweje, 2010).

Universities must provide the necessary skills and knowledge to determine the social, ethical and environmental effects of business activities (Brampton and Maclagan, 2005). Thus, in curricular

design, universities should integrate aspects of ethics and social responsibility (Nelson et al., 2012; Stonkutë et al., 2018). It is necessary to know students' beliefs about the ethical commitments of companies when they arrive at university in order to determine the most appropriate teaching tools to instruct them in social responsibility. Specifically, we propose the use of social media in the early stages of ethical training, which has been understudied and about which there is a considerable knowledge gap.

In this sense, the aim of this article is, on the one hand, to examine students' perceptions of companies' ethical and CSR practices, commitments and reasons, and, on the other hand, to see how this perception can be improved when social media tools are used in classrooms to transmit and discuss concepts using case studies and readings related to ethics and CSR. We look at CSR to examine how technology might affect student performance, specifically the process of learning ethical competence. The knowledge that university students acquire affects how they identify the main ethical and CSR commitments that a company must assume (Holland and Albrecht, 2013). Instruction in this area leads students to recognize the firms' commitment to different stakeholders and to know the reasons that have led the companies to act according to ethics and CSR. The main contributions of this work lie in providing the literature with data on the most efficient methodologies and tools for effectively teaching concepts related to ethics and CSR for students starting their undergraduate studies.

The role of the instructor in the teaching–learning process is essential for the planification, transmission, and acquisition of students' knowledge and skills (Serrano and Pons, 2011). To perform this role correctly, the instructor must be able to apply methodological strategies (e.g., learning and assessment) appropriate to the students' needs and to use Information and Communication Technologies (ICT) to help improve teaching–learning processes (Triadó et al., 2014). The instructor analyses the participants' answers to cases to see the factors on which the students focus their attention, as these are the critical elements that must be addressed in order to guide the presentation of the cases to encourage a more socially responsible vision for students in which they make ethical decisions. The focus is on the students, the group, the networks in which they interact, their participation and the way they are invited to participate in those networks (Berthon et al., 2012); this is necessary for any contribution to have value in bolstering our understanding of the complex problems that arise from CSR.

In CSR, participants are not recipients of training but producers of it. It is important to point out that the participants are the driving force in this media world; hence, it is critical that the instructor perfectly know the tools and their use to achieve the purpose of their ethical training, which facilitates appropriate decision-making in CSR actions. Again, participants are not recipients of training but producers of it.

Based on the knowledge they have been taught, university students identify the main ethical and CSR commitments that a company must assume (Holland and Albrecht, 2013). Stakeholders Theory is the most widely used theory in the business world (Freeman and Reed, 1983). This theory takes into account the different expectations and demands of society and stakeholders (Carroll, 1979; Arco-Castro et al., 2020) and considers the role of concern for others. This is the approach taken in teaching. The training that is provided should have an impact on students, and their attitudes and beliefs should change as a result of the training (Cohen et al., 2001). Training in business ethics can bring about a change in personal values and attitudes (Balotsky and Steingard, 2006).

Web 2.0 tools and social media have a place in the field of education. Their use enables students to acquire professional competencies (Lei, 2010). University education should promote the use of social networks insofar as doing such enables and facilitates communication, cooperation, interaction, and the exchange of knowledge (Aral et al., 2013; Sigala and Chalkiti, 2015). The skills required in business go beyond formal classroom instruction, which indicates the need for the development of new teaching methodologies, where, with the introduction of blended learning techniques (López-Pérez et al., 2011), Web 2.0 tools have a place (Rae, 2010). This mainly takes the form of social networks, although wikis or concept maps are also used. Education must incorporate methodologies that introduce flexible technological tools that enhance and enable creativity, dialogue, curiosity, and emotion, as well as their application to personal and real-world problems and opportunities (Rae, 2010).

These types of technological tools may be relevant in the teaching of ethics and CSR, since learning ethics includes emotions, values (Rodriguez-Gomez et al., 2020), and social interaction, and teaching methods based on Web 2.0 can be helpful given that social media tools have proven effective in those areas (Shrivastava, 2010; García-Morales et al., 2020). It is important to point out that creative participants are the driving force in this media world, hence, the importance of the teacher knowing the tool and its use, so that the tool can serve a purpose in ethical training that facilitates appropriate decision-making in CSR actions.

We use ICT to refer to technology that has been developed specifically to reinforce academic content as a support for face-to-face instruction. We examine how such technology might affect student performance, specifically how it affects the learning process of ethical competence, by looking at CSR (López-Pérez et al., 2011; Montiel et al., 2018; García-Morales et al., 2020). In this sense, we propose the following research hypotheses:

H1: Social media improves students' perception of business ethics and CSR.
H2: Social media improves students' opinions about business CSR commitments.
H3: Social media improves students' understanding of why companies act in a socially responsible way.

METHOD

Sample Selection

Our work aims to analyze university students' perceptions of CSR and ethics issues in their first-year of university studies and to consider the evolution that this perception undergoes when this

content is taught using social media tools. A survey was carried out on first-year students matriculated in an introduction-level financial accounting course at a university in Andalusia in 2019. The class had a total enrollment of 1,030 students.

For the selection of the sample, we only considered students who attended at least 80% of the classes. We obtained a total of 510 valid questionnaires at the beginning of the semester (49.51% of those enrolled), which made up the final sample (sampling error 3.15%, confidence level 95.5%, $Z = 1.96$, $p = q = 0.5$). In addition, 374 valid questionnaires were obtained at the end of the semester (36.31% of those enrolled; sampling error 4.18%, confidence level 95.5%, $Z = 1.96$, $p = q = 0.5$).

To develop competence in ethical and CSR issues in their students, instructors used a series of practical examples (case studies and readings) that were distributed throughout the semester via social networks. These materials incorporate analysis of some ethical and CSR aspects of specific ethical concerns in companies. To learn about the ethical dimensions of the subject, students first received a brief explanation during class time by the instructor about the objectives of a case or reading. They then were given time to document and work on the assignment before going on to solve it using social media tools. The instructor proposed cases of ethical issues related to firms that appeared on Twitter. These news resources show the company as an agent of social change in the sense that it employs a series of resources, interacts with society and cannot ignore the demands of the different stakeholders involved or affected by business activity, including the larger community. They also illustrate specific policies that the company could follow on social and environmental matters and suggest the possible effects of those policies on the company's financial outcomes (mainly, the income statement and the ethical distribution of added value). Likewise, the role played by each stakeholder in the business activity was discussed on Facebook groups and forums, and students' work was evaluated by other groups of students (García-Morales et al., 2020). The instructor concluded the discussion by explaining the reasoning behind each policy's *raison d'être*. Finally, the final exam included ethical and CSR issues on which students had to comment.

Measurements

A survey was carried out at two different points in time (the beginning and end of the semester) using a Likert rating scale (ranging from 1 to 5; value 1: strongly disagree, value 5: strongly agree; the questionnaire is in **Annex**).

Previous research in this field was taken into account in preparing the survey, which was divided into three parts to investigate students' perceptions of a company's CSR actions (*CSR perceptions*), the importance of the different CSR strategies that it carried out (*CSR commitment*) and the reasons why it chose to act in a socially responsible way (*CSR reasons*; see **Annex**). Specifically, the following variables were measured:

CSR perceptions: The scale proposed by Abdul and Ibrahim (2002) was used to measure ethical perceptions of society. The questionnaire included six items.

CSR commitment: The variables that measured the company's social commitment were obtained from the models proposed by Zahra and LaTour (1987), Kraft and Singhapakdi (1991), and Nga and Shamuganathan (2010), with a total of 21 items.

CSR reasons: We based our reasons on the articles by Kha and Atkinson (1987), Pivo (2008), Brønn and Vidaver-Cohen (2009), and Pedersen and Neergaard (2009), which analyze these topics from the point of view of ethics and socially responsible action. The questionnaire included nine items.

To evaluate the fit of the measurement model, all constructs needed to have high internal consistency, as determined by their compound reliability (CR) and shared variance (SV) scores (Del Barrio and Luque, 2012; see **Table 1**).

TABLE 1 | Measurement-model results.

Variables	α	C.R.	AVE
CSR perceptions	0.878	0.85	0.60
CSR commitment	0.892	0.81	0.50
CSR reasons	0.853	0.82	0.43

The constructs have satisfactory levels of confidence, as indicated by the composite reliability ranges (0.81–0.85) and ranges of SV coefficients (0.43–0.6). Likewise, for each factor, the composite reliability exceeded 0.70 and the average variance extracted (AVE) of 0.5 indicated good construct reliability (Hair et al., 2010). In addition, internal consistency and reliability were at a satisfactory level, as is reflected in the Cronbach's alpha scores, and each factor presented a value above 0.8, reflecting good internal consistency. This led us to accept as valid the constructs used to define the variables of the model that we wanted to contrast.

Research Methodology

Descriptive statistics were paired with a *t*-test to test the hypotheses. Previously, Levene's test was used to check the equality of the variances. The *t*-test for independent samples is used to test a hypothesis of the equality of two means and is the most powerful test available when the normality of the sample is satisfied (Lehmann and Romano, 2005). Thus, in this article, we used the parametric test (*t*-test) to test the differences between pairs in order to determine whether the difference in means between the groups was statistically significant.

RESULTS

With regard to the first section of table in the **Annex**, which refers to students' perceptions of ethics and CSR (*CSR perception*), the students thought that society's highest ethical demands on companies are that they should meet society's expectations and that ethical practices have an effect on a company's image (items 4 and 6 had the highest averages, **Annex**). This seems to indicate that students have a perception that society demands that companies manage the interests of different stakeholders and that not doing so has a negative effect on their image. The perception that citizens do not feel defenseless against the actions of companies (the average for item 1 is the lowest in the block:

3.23 at the beginning and 3.36 at the end of the semester, **Annex**) validates this interpretation.

According to the data in this first section, except for questions 2 and 5, all other questions are significant. The values obtained at the end of the semester, however, are for the most part not greater than those that were obtained at the beginning (see **Annex** averages), which leads us to reject hypothesis 1. At the end of the semester, students perceived the power of the company to be greater than they had at the beginning, indicating their perception that society feels vulnerable to the actions of companies (the average at the end of the semester is 3.36 for item 1) since they believe that companies respond less to the legal requirements and demands of society and place less importance on the repercussions that their ethical actions may have on their image (higher averages at the beginning of the semester: 3.70 for item 3, 4.36 for item 4 and 4.34 for item 6, **Annex**). This indicates that students have preconceived ideas of ethics and CSR. It seems, therefore, that these initial thoughts are difficult to change or reinforce (Cohen et al., 2001), despite the use of Web 2.0 and social media tools in the teaching–learning process.

In the second section, with regard to *CSR commitment*, the aspects that scored highest were those related to the product and the employees (see **Annex** averages for items 22 to 27), followed by economic benefits and environmental factors (see **Annex** averages for items 8–10 and 12). For students, the company's CSR commitment is related to the nature of the company's main activity.

It seems that students do not place much importance on the company's role as a social agent or in promoting ethical solutions (low mean scores for items 24–26, 30, and 31). It is here, however, that, together with the employees' aspects, the main significant differences are found (see **Annex**, items 13–15, 19, and 20), which would lead us to partially accept hypothesis 2. The results show that after training in ethics and CSR, there is variation in students' perceptions of the company's commitment to social issues (Holland and Albrecht, 2013; Rodriguez-Gomez et al., 2020).

Finally, with respect to the third section (*CSR reasons*), students consider the companies' motives to act ethically to be for the sake of the company's reputation, image and leadership, as well as to respond to society's demands and to achieve success and profit (where averages were 4.18/4.00 for item 28, 4.10/4.02 for item 31, 3.98/3.87 for item 34 and 3.95/3.83 for item 35). The perception of what they think society demands from companies, which we analyzed in the first block, coincides with the reasons they think justify the ethical thinking of companies.

It is evident that, according to the students, the reasons for companies' ethical behavior are utilitarian, since the ethical behavior of the companies is linked to their reputation, image and success; it is intended to help obtain benefits rather than to act altruistically. In behaving ethically, their aim is simply to avoid the negative consequences of unethical behavior (Cacioppe et al., 2008). Nevertheless, the students understand that acting according to ethical and CSR criteria is a way of participating in society by satisfying the interests of stakeholders and that the success of the company depends on its ethical commitment (items 29, 34, and 36) (Holland and Albrecht, 2013), and this leads us to accept hypothesis 3 (see **Annex**).

DISCUSSION AND CONCLUSION

This article aimed to analyze students' perceptions of business ethics and CSR when using Web 2.0 and social media tools to develop ethical competence.

The results show that students perceive that companies try to respond to society's ethical demands and that ethical practices have an effect on companies' images (Brunton and Eweje, 2010). They also believe that the main reasons for a company's carrying out CSR policies are for purposes of reputation, image, leadership, success, and profit (Hosmer, 2006).

As students are trained in CSR, however, they become more aware of the power of companies, perceiving society as having less ability to demand that a company meets society's expectations and demands. This finding shows that students do not have a clear notion of the ethical requirements and legitimate interests of society that a company should respect and serve (Barnett et al., 1994).

When students delimit a company's ethical commitments toward society, they highlight aspects related to the employees and the products, as well as the pursuit of economic benefit without philanthropic commitments. Therefore, students have a reduced vision of the ethical commitments of companies, and instructors should be required to introduce more cases that lead students to consider a broad model of ethics that is in line with the current demands and requirements of the market and society (Triadó et al., 2014). The training of the students, however, has led to changes, especially in relation to the commitments that the company must assume regarding social aspects (Shrivastava, 2010; García-Morales et al., 2020). This finding supports the applicability of Stakeholders Theory.

Therefore, in relation to the main contribution of our article—the effect that Web 2.0 tools and social media have on the perception of companies' CSR commitments—we must highlight several conclusions. To get started, these tools do not seem sufficient to change students' previous conceptions of business ethics and CSR. The adoption of collaborative and interactive methodologies affects their perceptions of the social commitments that companies must assume (Aral et al., 2013), but it does not provide the broad vision of ethics that CSR entails. This finding indicates the first implication of this study, which is the need to use other teaching methodologies in addition to those examined here. It appears that on social issues, through their use of social media, students come to understand the important role that companies play in society. This finding is in line with previous research (López-Pérez et al., 2011; García-Morales et al., 2020). We understand that continuing to work along these lines and through these methodologies can lead us to see that the company really is an active participant that can facilitate social change in all its aspects. Another research implication is that this methodology is appropriate to develop the students' social

vision of companies. The results indicate that this type of creative, flexible and collaborative methodology, where communication and interaction are encouraged and which develops emotions, curiosity, and a critical sense, is suitable for the development of ethical competence and can address current problems in the field of business (Berthon et al., 2012).

These conclusions lead us to ask ourselves questions that can inform future research. In view of the results, the research has several implications related to two areas that can strengthen the development of ethical competence. First, analysis of the answers provides the instructor with evidence to guide the discussion of the cases toward critical aspects that must be addressed. Second, it is necessary to do more work with the material provided prior to the discussions and to encourage student participation in the forums to give continuity to the student experience so that they can continue working on these ethical considerations throughout their undergraduate studies (Serrano and Pons, 2011). The fact that the experience was developed in first-year students who are only taught introductory material may partially explain the results. This constitutes the main limitation of the research.

In this sense, and as a future line of research, we would like to contrast the results of our survey with an examination of students in their final year to analyze the effect of these tools on students' learning of various areas of CSR across their undergraduate experience. At the same time, we would like to incorporate other tools, such as the development of an app, the creation of a wiki or complementary concept maps.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/participants or patients/participants legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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ANNEX

	t-test		Mean	Mean
	t	Significance (two-tailed)	Beginning	End
FIRST SECTION (H1): CSR PERCEPTION				
1. The average citizen feels helpless against the actions of the company	−2.2	0.028**	3.23	3.36
2. The company is critical of the ethical performance of most companies	1.47	0.146	3.43	3.33
3. Legal requirements influence the ethical behavior of firms	1.81	0.069*	3.7	3.58
4. Organizations must act in a manner consistent with the expectations of society on ethical issues	2.88	0.004**	4.36	4.17
5. Whenever companies generate an acceptable return, they have a social responsibility that goes beyond the interests of shareholders/owners	−0.84	0.399	3.67	3.73
6. Ethical practices have an effect on the image that society has of the organization	1.71	0.087*	4.34	4.15
SECOND SECTION (H2): CSR COMMITMENT				
Environment				
7. Create a company that respects the environment	−0.782	0.434	3.34	3.41
8. Conserve resources and recycle materials	−0.415	0.678	4.03	4.06
9. Programs implement for pollution control and waste reduction	0.078	0.938	4.07	4.06
10. Programs implement for energy saving and reduction of water consumption	0.301	0.764	4.26	4.24
Economic				
11. Promotion of a balance among economic, social and environmental interests	−0.098	0.922	3.19	3.2
12. Economic benefits	−0.956	0.34	4.52	4.57
Social				
13. To be able to identify social needs clearly	−2.53	0.012**	2.89	3.23
14. To be committed to a social vision	−2.84	0.005**	2.58	3.06
15. To be highly motivated to defend social needs	−5.38	0.000**	2.52	3.04
16. To improve long-term social needs	−0.276	0.783	3.31	3.34
17. To promote a balance between social mission and social values	1.675	0.094	3.25	3.1
18. To improve long-term quality of life	0.637	0.524	3.6	3.5
Sustainability				
19. To be an agent of social change	2.63	0.009**	2.91	3.16
20. To promote ethical solutions	24.23	0.000**	2.25	2.73
21. To perform philanthropy	−0.709	0.479	3.4	3.44
Workers/employees				
22. Training and employee training	2.66	0.008**	4.45	4.57
23. Improvement of quality and safety at work	1.285	0.199	4.57	4.51
24. Employee satisfaction and integration	1.993	0.047**	4.52	4.6
Customer/product				
25. Improvement of the quality and safety of the product/service provided	−0.522	0.602	4.6	4.63
26. Provision of adequate information about the product/service provided	−0.27	0.787	4.35	4.37
27. Improvement after sales service and customer complaints	−0.447	0.655	4.28	4.3
THIRD SECTION (H3): CSR REASONS				
28. To improve the reputation and image of the company	0.616	0.538	4.18	4
29. To participate in society	1.788	0.074*	3.77	3.81
30. To identify with ethical problems	−0.958	0.338	3.71	3.77
31. To obtain a competitive advantage	1.098	0.273	4.1	4.02
32. To comply strictly with current legislation	−0.371	0.71	3.32	3.36
33. Through innovation themes	−0.976	0.329	3.37	3.44
34. To meet the demands of society	1.826	0.068*	3.87	3.98
35. To act ethically and affect profit	−0.076	0.039	3.83	3.95
36. Because the success of the company depends on the existence of an ethical commitment	2.55	0.011**	3.75	3.92

*Significance levels: *p < 0.10, **p < 0.05, **p < 0.01.*

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The Digital Transformation of Business Model Innovation: A Structured Literature Review

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This paper has a two-fold aim: to analyze the development of the digital transformation field, and to understand the impact of digital technologies on business model innovation (BMI) through a structured review of the literature. The results of this research reveal that the field of digital transformation is still developing, with growing interest from researchers since 2014. Results show a need for research in developing countries and for more collaboration between researchers and practitioners. The review highlights that the field is fragmented among disruptive technologies, shared platforms and ecosystems, and new enabling technologies. We conclude that digital transformation has impacted value creation, delivery, and capture in almost every industry. These impacts have led to the employment of a variety of new business models, such as those for frugal innovation and the circular economy.

Keywords: digital transformation, business model innovation, structured literature review, value creation, value delivery

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INTRODUCTION

The phenomenon of digital transformation (DT) has become very popular in recent years (Fitzgerald et al., 2013; Kane et al., 2015). Digital transformation or "digitalization" is "the integration of digital technologies into business processes" (Liu et al., 2011, p. 1728). The exploitation of digital technologies offers opportunities to integrate products and services across functional, organizational, and geographic boundaries (Sebastian et al., 2017). As a consequence, these digital technologies increase the pace of change and lead to significant transformation in a number of industries (Bharadwaj et al., 2013; Ghezzi et al., 2015), since they have the "power" to disrupt the *status quo* and can be used to drive technological change (Bharadwaj et al., 2013). Digital technologies have revolutionized the way industries operate (Dal Mas et al., 2020c), introducing the concept of "Industry 4.0" or the "smart factory" (Lasi et al., 2014). Digital platforms have created a new way of operating for companies and organizations in a "business ecosystem" (Presch et al., 2020), which has led to changing dynamics in value networks (Gray et al., 2013). Digital technologies have substantially transformed the business (Ng and Wakenshaw, 2017) and society, bringing fundamental changes through the new emerging approaches of the circular and sharing economy.

For strategy researchers, the three characteristics of digital technologies, namely, digital artifacts, digital platforms, and digital infrastructures (Nambisan, 2017) create opportunities for a layered modular architecture and present to firms the strategic choice of following a

digital innovation strategy (Yoo et al., 2010). This has drastically changed the nature of strategizing, since many digitized products offer new features and functions by integrating digital components into physical products (digital artifacts), and can simultaneously be a product and a platform (with related ecosystem). In this regard, the literature has coined the term "platfirms" to define those companies relying their business models (BMs) on a web platform (Presch et al., 2020). Moreover, digital infrastructures like data analytics, cloud computing, and three-dimensional (3D) printing are providing new tools for rapid scaling (Huang et al., 2017). Therefore, digitalization blurs the boundaries between technology and management, providing new tools and concepts of the digital environment that are changing dramatically the way firms face new managerial challenges, innovate, develop relationships, and conduct business (Verma et al., 2012; Bresciani et al., 2018).

The new digital environment requires firms to use digital technologies and platforms for data collection, integration, and utilization, to adapt to platform economy (Petrakaki et al., 2018) and to find growth opportunities to remain competitive (Subramanian et al., 2011). Besides, recent research shows that firms utilize external venturing modes (e.g., startup programs and accelerators; Bagnoli et al., 2020) to develop dynamic capabilities (Enkel and Sagmeister, 2020). Digitalization is therefore seen as an entrepreneurial process (Henfridsson and Yoo, 2014; Autio et al., 2018) where firms in pursuit of digital transformation render formerly successful BMs obsolete (Tongur and Engwall, 2014; Kiel et al., 2017) by implementing business model innovation (BMI), which is revolutionizing many industries. Indeed, the literature suggests that in designing an appropriate BM, it can be possible to benefit from the potential embedded value in innovation (Chesbrough and Rosenbloom, 2002; Björkdahl, 2009). For instance, firms adopting digital technologies consider data streams to be of paramount importance and assign to them a central role in supporting their digital transformation strategies (Zott et al., 2011), in contrast to traditional BMs frameworks (Pigni et al., 2016). For this reason, digital technologies inherently link to strategic changes in BMs (Sebastian et al., 2017) and consequently, the development of new BMs (Hess et al., 2016).

In the digital context, BMs have become a new unit of analysis (Zott et al., 2011) to examine the changing effects of digital technologies on the way firms produce and deliver value through BMI. As the literature suggests, BMI provides opportunities in capturing profits in a system of networked activities (Zott and Amit, 2010; Amit and Zott, 2012), and in enhancing firm performance (Foss and Saebi, 2017). The role of the BM is essential in identifying the crucial aspects behind a digital strategy. Indeed, it helps firms in applying the digital lens to innovate their BM to create an appropriate new value (Berman, 2012). However, this process is still evolving (Ferreira et al., 2019) and many questions remain unanswered for entrepreneurs and managers, especially in relation to the integration of digital transformation strategies and business transformation strategies (Matt et al., 2015), in order to realize the "digital business strategy" (Bharadwaj et al., 2013). Indeed, a recent study (Atluri et al., 2018) argues that digital transformation and the opportunities it creates for BMs in every sector are still in the beginning.

Given the increased interest in investigating the relationship between digital transformation and BMI in academia and its importance for practice as well, the purpose of this paper is to understand better what we currently know about the digital transformation of BMI. Specifically, our aim is to review and critique the state of research in the digital transformation of BMI literature, provide a comprehensive, holistic overview of the digital transformation of BMI covering many perspectives, and outline avenues for further research. We adopt Teece (2018) definition of BMs as "mechanisms for creating, delivering, and capturing value" to reflect the value proposition, target segments, value chain organizations, and revenue capture components (Foss and Saebi, 2017). For BMI, we apply the definition by Foss and Saebi (2017): "designed, novel, and non-trivial changes to the key elements of the business model innovation and/or the architecture linking these elements." According to this definition, BMI involves changes in the individual components and in the overall architecture of the BM.

From a theoretical perspective, this study contributes to these digitally-enabled types of BMIs, which make the emergence of BMs a promising unit of analysis for undertaking innovation strategies. It also responds to the knowledge gap in the literature and enriches our understanding in the digital transformation of BMs (Visnjic et al., 2016). In addition, the results of this study may help practitioners from a variety of industries who seek guidance to understand how digital transformation of BMI can be achieved through value creation and capture (Casadesus-Masanell and Ricart, 2010). This study may help especially practitioners in incumbent firms, since digital transformation of their BMI is a highly complex process requiring a sequence of interdependent strategic decisions (Aspara et al., 2013; Velu and Stiles, 2013).

The paper is organized as follows: the next section explains the method of data collection and analysis used for the structured literature review. This is followed by the results of the study and answering the three research questions addressed in the methodology. The following section focuses on discussing the existing gaps in the literature and avenues for further research. The final section of the paper discusses the conclusions, contribution, and implications for theory and practice.

METHODOLOGY

This paper adopts a structured literature review. According to Massaro et al. (2016), a structured literature review is "a method for studying a corpus of scholarly literature, to develop insights, critical reflections, future research paths, and research questions." The structured literature review was adopted because "it is based on a positivist, quantitative, and form-oriented content analysis for reviewing literature" (Massaro et al., 2016). This method follows a 10-step process that enables the researcher to "potentially develop more informed and relevant research paths and questions" (Massaro et al., 2016), advancing theory, which is the objective of the literature review (Webster and Watson, 2002).

We wrote a literature review protocol to guide us during the process of reviewing the literature. The protocol-driven approach offers researchers a framework to select, analyze, and assess papers with the aim of ensuring robust and defensible results through reliability and repeatability (Massaro et al., 2016). In the further step, we defined the research questions that aim to bring new insights from the literature review. We identified the following research questions in the protocol document:

RQ1. How has the field of digital transformation developed over time?

RQ2. What is the focus of the literature on the digital transformation of BMI?

RQ3. How has digital transformation facilitated BMI in the literature?

The next step was to determine the type of studies to consider for the review. We decided on the keywords to use to search for articles and the criteria for article selection. Following the keywords used in previous studies in the digital transformation literature, we decided to search using "digital transformation," "digital disruption," "technolog* change," "organis* change," "disrupt*" and "business model." As the specific aim of this study is to offer a holistic understanding of the digital transformation of BMI, we purposefully focused on scholarly empirical research that provides insights into how digital transformation is impacting the innovation of BMs. Nodes for coding were determined based on previous systematic literature review (SLR) studies (Massaro et al., 2015; Dal Mas et al., 2019, 2020a). According to these studies, nodes examine information related to authors, the time distribution of publications, country of research, the focus of the paper and methodology. We added nodes about industry sectors, the disciplines of the studies, theories used, and potential impact on the value creation, delivery, and capturing process. These nodes were added to gain deeper insights into the development of the field and suggest implications for further advancement. These nodes were integrated into a framework that served for the coding of the papers and the analysis of the results. The framework, with a description of parameters, is provided in **Table 1**.

After identifying the keywords and the framework for the study, we started the collection and selection of papers in a multi-staged process. Firstly, we searched in the Scopus database with the defined keywords in the protocol. This first search revealed 215 publications. In a second step, in order to control the quality of articles, we restricted the search to peer-reviewed journals in the Business and Management category that were ranked 3, 4, and 4* in ABS evaluation. With this additional restriction, we did not take into consideration book chapters, book reviews, and conference articles. In this second search, we, therefore, found articles published in peer-reviewed journals from 1996 to 2020, which reduced the number of publications to 126. After collecting all the articles, each paper was checked for the inclusion of keywords in the title, abstract, and keywords, in order to ensure that the articles fit the research objective of the study. The criteria for article inclusion required the existence of string words about both digital transformation and BMs, which were connected by the Boolean operator AND. When screening publications, we found only a few articles about digital transformation, which were published before 2014. Other articles talked about digital transformation or disruptive technologies, but not about the impact or the connection with BMI. The articles which were not focused on both disruptive technologies and BMI were excluded. At the end of the process, 54 articles were excluded, and the final sample of publications included 72 research articles.

We used the NVivo12 software package for the analysis of the final list of papers. The folder with the selected papers was imported into the software. Each article was coded based on the same nodes as specified in the framework in order to reach the aim of the SLR and avoid researcher bias. We created nodes that were related to the bibliographical information of

TABLE 1 | Classifying framework for literature review.

Parameters	Specifications/variables
Bibliographical/Source-info	
Author	Author demographics
Time distribution of publications	Year article published
Journal titles	Where the article is published
Country/Region of research	Origin of the data
Industry sectors	Empirical setting of the article
	Computer modeling and simulation
	Conceptual paper
	Explanatory
	Exploratory
	Mixed method
	Special issue
	Viewpoint
Methodology	Theoretical viewpoint
	Economics
	Entrepreneurship
	Finance and accounting
	General management and strategy
	Information systems
	Innovation and technology
	Marketing
	OB and HR
	Operations
Discipline	Other
	Disruptive technologies
	Shared platforms and ecosystems
Focus of the paper	New enabling technologies
	Theoretical perspective
	Actor-network theory
	Dynamic capabilities
	Relational view
	Discovery-oriented, theories in use approach
	Grounded theory
	Interpretative cognitive theory
	Value-chain approach
	Digitalization level-servitization
	Business model canvas
	Co-evolutionary perspective
	Portfolio theory
Theoretical perspectives	Not specified
	Digital transformation and value creation
	Digital transformation and value delivery
Impacts on value	Digital transformation and value capture

articles, methodology, discipline, the focus of the paper, and theoretical perspectives. These nodes were used to answer the first two research questions of our study. We created another node for the third research question, to code all the impacts of new enabling technologies on BMI.

After having coded all the papers, following the steps of the protocol, the research group shared the coding project among the members in order to verify that the coding complied with the research questions and the framework of the study and to ensure inter-code reliability. Next, analysis of the dataset developed insights and critique in the field of the digital transformation of BMI. Part of the work in this study was intended to advance the knowledge in the field of digital transformation, by highlighting gaps, identifying new avenues for research, and raising new research questions.

RESULTS

RQ1: How Has the Field of Digital Transformation in BMI Developed Over Time?

This section provides an overview of the development in the field of the digital transformation of BMI. It reports the findings related to the descriptive features of this emerging field of research.

Author Demographics

The list of analyzed articles shows that there does not seem to be any author domination in the field in terms of the number of publications. Ghezzi and Li are the only authors who published three papers. Several scholars contributed to the research field with two articles each (Bogers, Bose, Frank, Frattini, Gupta, Mangematin, and Wang). All the other authors have published only once in the field of digital transformation of BMI. Most of the articles are co-authored. The analysis of the 198 authors of the 72 publications reveals that most of the articles were written by academic scholars. There are no articles written mainly by practitioners, and collaboration between practitioners and scholars comprised of just a few of the publications. More specifically, these collaborations were carried out in very new topics such as platform-based ecosystems and intelligent goods in closed-loop systems. This implies a close relationship between the research field and practitioners, despite the wide practitioner-academic divide. This divide can result from paywalls in publications, and would be helpful to hold common conferences, encourage more engagement with practitioners, and provide open-access journals to overcome it. Otherwise, the growing divide between academics and practitioners results in field fragmentation, as subgroups will form on both sides of the divide. Greater collaboration between practitioners and academics is thus needed in the future to shape this field of study (Serenko et al., 2010). These demographics also suggest that four authors in this field of research have remained focused on exploring further aspects of BMI driven by digital transformation. For instance, Ghezzi published about strategy making and BM design in dynamic contexts in 2015 in Technological Forecasting and Social Change, and in 2017, he published in the Journal of Business Research. This trend of republishing after 2 years in a different journal from the first is also demonstrated in articles by Bogers (2016). The lack of specialization by researchers might also fragment the field further. In the future, more scholars should remain focused on further exploring other aspects of digital transformation impacts on BMI.

Time Distribution of Published Articles

The analysis shows that the first article about the digital transformation of BMs was published in 2009. This article was part of a case study of Kodak (Lucas and Goh, 2009), which missed the digital photography revolution when faced by disruptive technology. As can be seen from **Figure 1** below, only five papers were published within the next 4 years (until 2013) after the first paper was published. These first papers dealt mostly with a general understanding of the opportunities and barriers created by disruptive technologies on BMI (Chesbrough, 2010), such as, for example, in the case of latecomers that can capture value through a secondary BM (Wu et al., 2010). Publication on the topic remains poor and scattered until 2013 and research continues to highlight the importance of technological discontinuities in the creation of disruptive BMs and the challenge of dominant industry logics (Sabatier et al., 2012). Only Simmons et al. (2013) studied the role of marketing activities in inscribing value on BMI during the commercialization of disruptive digital innovations in industrial projects. Interesting enough, the production of knowledge is particularly active in 2020, which, at the time of the research, saw the articles published in Scopus as of mid-September. Twenty-one meaningful papers were listed in 2020, considering that the year was not finished yet and several more might be in press, forthcoming, or still to be indexed.

In the past 3 years, there has been a growing number of articles published in this field of enquiry, with 42 out of 72 articles published between 2018 and 2020. The greatest interest in publishing about the digital transformation of BMI was recent, where 53 articles (almost 74% of the total sample) were published since 2017. The gradual increase in publications reflects the need to carry out more research in this field, as the impacts and issues related to digital technologies become apparent in many industries. This is shown in articles published during 2014–2015, which try to explore the effects of digitization on incumbent BMs in more depth. Researchers investigated these effects in the publishing industry (Øiestad and Bugge, 2014), and with a special interest in understanding organizational or sectoral lock-ins in creative industries (Mangematin et al., 2014) and the newspaper industry (Rothmann and Koch, 2014). To overcome the challenges of strategy formulation and implementation in dynamic industries, Ghezzi et al. (2015) suggest a framework for strategic making and BM design for disruptive change.

The analysis again reveals the practitioner-led nature of research in this field. As demonstrated above, the time distribution of the articles highlights the relevance of studies in the field. Over time there has been a continuous change in the researched topics, shifting from the impact of disruptive technology on

FIGURE 1 | Journals of the selected articles.

incumbent BMs to the impact of digital technologies on the BMI of digital start-ups. This implies that the field shows characteristics of pragmatic science, where society benefits from the best combination between the relevance of the topic and the rigor of findings (Anderson et al., 2001). The high concentration of the distribution of publications in recent years reveals both the importance of the topic and the increased interest of researchers in this novel field of enquiry. These insights from the analysis of the distribution of articles inform us about the nascent stage this field of enquiry, with rapid growth in 2014. Serenko et al. (2010) consider three indicators to define field maturity: co-authorship patterns, the role of practitioners, and enquiry methods. According to these indicators, we observe that the publication of multi-authored manuscripts increased after 2014, especially in 2016–2017. We further observe more collaboration with practitioners during the 2016–2018 period. In terms of enquiry methods, as a newly emerging scholarly domain, the articles mainly develop theoretical frameworks, revealing the early stage of the field.

Moreover, addressing the topic of the academic-practitioners divide (Bartunek, 2007), the topic seems ideal as an opportunity to gather academics and professionals working together and create some exchange zones to foster a dialog (Romme et al., 2015). While scholars struggle to find robust data to develop sound theories, managers are the ones who see the potential of disruptive digital technologies and their real-world applications, including new BMs.

Journal Title

We identified the journals in which these articles were published and their distribution in each journal (**Figure 2**).

Our analysis shows that a total of 22 journals were captured in this review of literature. The Technological Forecasting & Social Change journal takes the lead for the majority of articles published (23 articles, 32%). The three other journals with a higher number of publications than others are Journal of Business Research, California Management Review, and Technovation. These journals have published seven, six, and five articles, respectively, for a total of 18 articles (25%). The remaining articles were spread over the rest of the journals, and a diverse range of disciplines. This topic seems to be practitioner-led, and with greater relevance recently for businesses, policy makers, and society. This is demonstrated in the Technological Forecasting & Social Change journal, firstly by Sung (2018), suggesting policy implications regarding Industry 4.0 in Korea. Jia et al. (2016) examine the commercialization efforts of a United Kingdom-based 3D printing technology provider to evaluate the financial viability of innovative BMs.

Country of Research

Part of our analysis was to identify and describe the geographical regions where studies have been conducted. **Figure 3** gives a classification of the countries that have been studied in the field of digital transformation of BMI. The left side of the graph includes studies carried out in

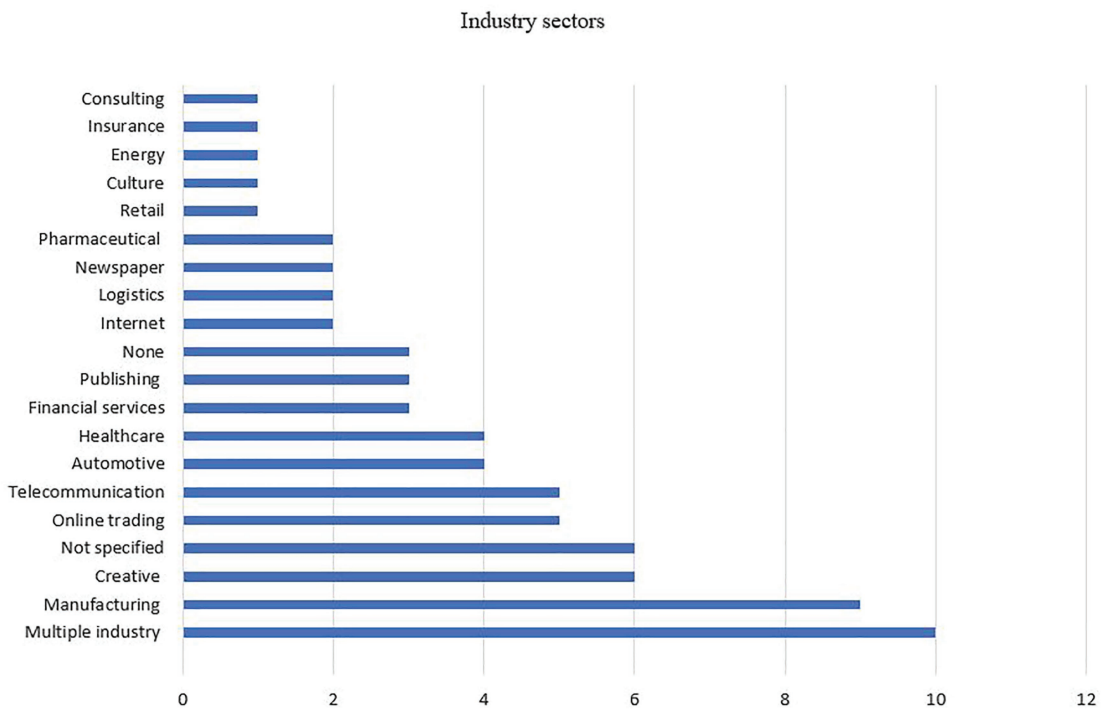

FIGURE 2 | Industry sectors analyzed in the selected articles.

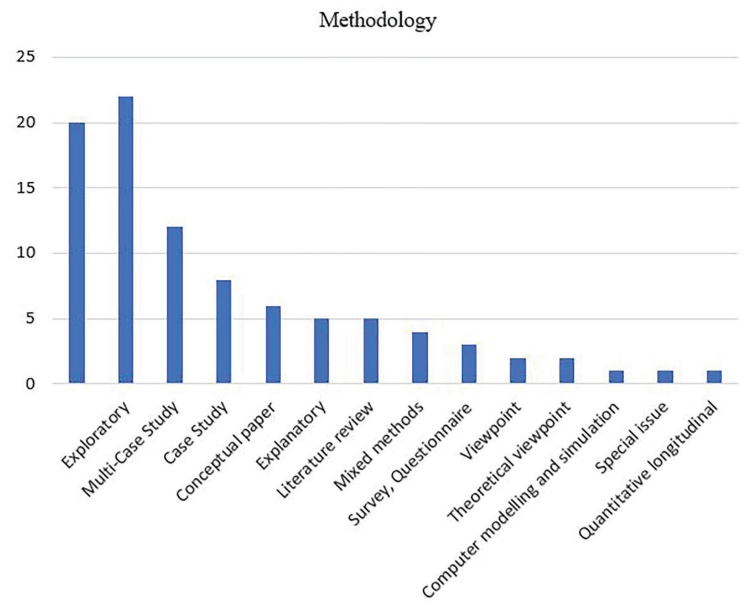

FIGURE 3 | Research methodology of the selected articles.

developed countries, and the right shows developing countries. The results show that most of the research in this field is conducted in developed countries, and within this, the digital transformation of BMI has been studied mostly in the United States and Germany. This concentration of research mainly in these two countries may be the result of governmental efforts, as in the case of German government support for Industry 4.0, or the European Union-funded

DIGINOVA digital project for advancing innovation in digital making (Potstada et al., 2016).

According to the analysis, other countries in Europe reflecting the same interest in researchers are the Netherlands, Italy, and the United Kingdom, with two publications in each country (except for the Netherlands, which accounts for three articles). In contrast, emerging and Far-East countries are very under-represented, with China publishing two papers, and India and United Arab Emirates with one article each. This implies that emerging and Far-East countries in general are either ignored or poorly analyzed, despite the presence of several digital firms (let us think about the giant multinational companies like Alibaba, Wechat, or Huawei in China). While there may be publications written in languages different than English or in books or journals not indexed on Scopus, more research is needed in these countries to define the boundaries of theorization in the digital transformation of BMI, which will lead to a better understanding of this phenomenon. As Ghezzi and Cavallo (2020) argue, generalization and the relevance of findings depend on the peculiarity of the context under examination. For this reason, a replication of research in other (mature) contexts should be carried out (Ghezzi and Cavallo, 2020). This will overcome the problem of generalizability with a single geographic region (Simmons et al., 2013).

Industry Sectors

In order to enhance our understanding of industry influences on the digital transformation of BMI, we classified the articles according to the industry sectors in which their empirical setting was based. As depicted in **Figure 4**, the articles are based in 18 different specific industries, with several papers referring to multiple sectors together, or not identifying one defined field under investigation.

The results also indicate an almost equal spread of articles among industries, and that there is no concentration in only a handful of industry sectors. Nevertheless, we can identify two groups of industries that are represented by a higher number of articles: manufacturing (nine articles) and creative industries (six articles). A closer examination of these industries shows that the manufacturing industry mainly dealt with consumer goods manufacturing, while creative industry sectors were represented by the accommodation industry and digital game industry. Most remaining articles were spread across the broad range of industry sectors. The focus on only a few industries can be a limitation for the generalization of findings. There is a need to study other industries, such as design, architecture, advertizing, and the fashion industry (Mangematin et al., 2014), which currently do not appear on our list.

Research Methods

Most studies conducted so far on the digital transformation of BMI have used an exploratory approach (**Figure 5**).

These studies aimed at achieving a first understanding of the phenomenon of digital transformation of BMI, which is indicated by the extensive use of qualitative research. This finding relates to the fact that digital transformation is a new phenomenon. Consistent with this, Li (2020) argues that we are facing a methodological challenge in the investigation of new emerging trends since these trends "are still at very early stages of development with limited empirical presence". For this reason, the author suggests using new research methods such as research prototyping and fictional design.

Few longitudinal studies have been carried out. This creates a need for future longitudinal studies, which will help in better understanding the sharing economy and peer-to-peer platforms (Akbar and Tracogna, 2018). The contributions of these studies mainly consist of offering frameworks and propositions derived from explorative research. There have been no further empirical studies to support or refute the suggested propositions. Few papers investigate the relationship between digital transformation and BMI following an explanatory methodology. A considerable number of papers (eight papers) are conceptual or theoretical

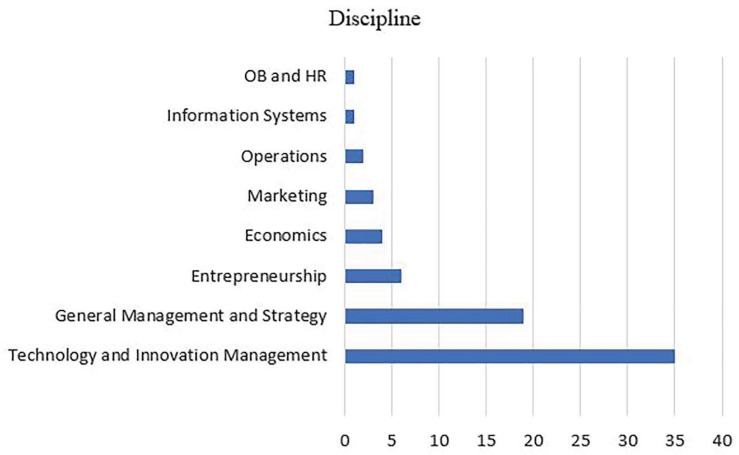

FIGURE 4 | Disciplines of the selected articles.

viewpoints. These insights suggest that the field of research in the digital transformation of BMI has the potential to be restricted to a single paradigm. The absence of positivist research will prevent the wider acceptance and development of the field.

Disciplines

Most of the research is undertaken in the disciplines of technology and innovation management, general management and strategy, and entrepreneurship. Few studies are from the disciplines of economics, information systems, marketing, and operations (**Figure 6**).

This might primarily be because the purpose of our study is too focused and bridges two different topics: digital transformation and MBI. The other reason might be these three disciplines are more concerned with the impact and implications of the phenomenon of DT. The dominance of only a few disciplines relates also to the journals that are interested in publishing on this topic. Since most of the articles have been published in Technological Forecasting & Social Change, California Management Review, the Journal of Business Research, and Technovation, this affects the disciplines that will be covered by research. The low presentation of articles focusing on operations and entrepreneurship is unexpected, however. This suggests that the field of digital transformation of BMI is fragmented between three major discipline areas, and the predominance of single-discipline research is noted. The fragmentation of the field has implications for the conceptualization and

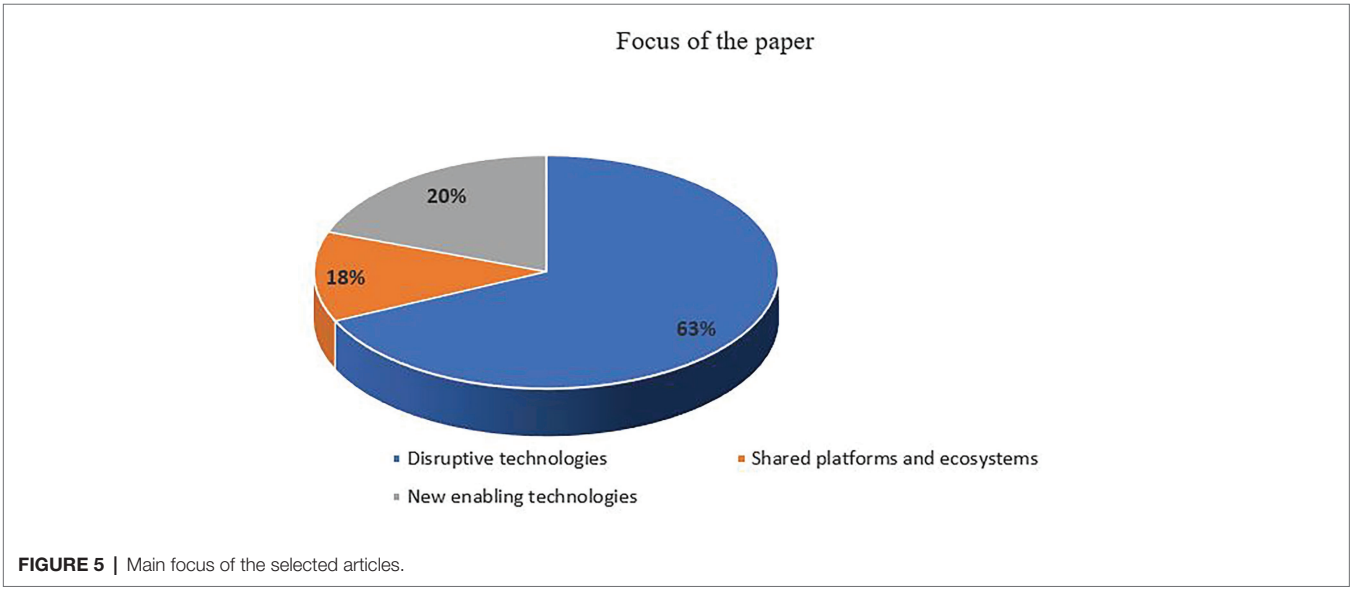

FIGURE 5 | Main focus of the selected articles.

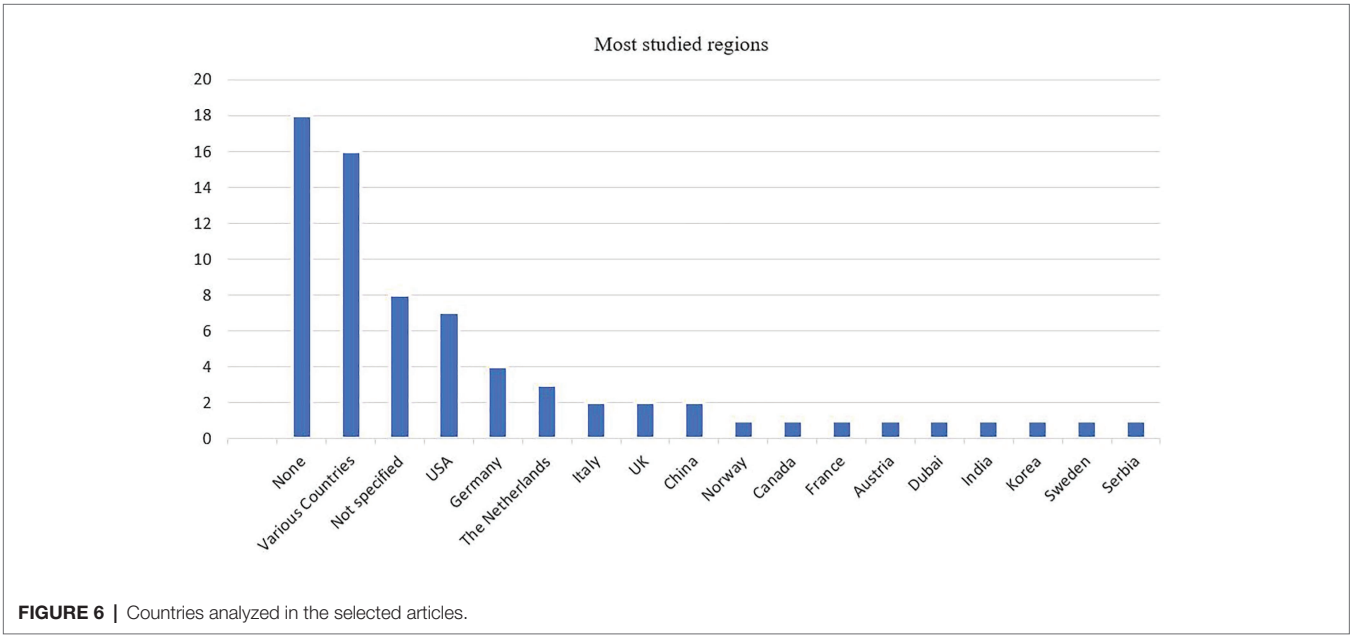

FIGURE 6 | Countries analyzed in the selected articles.

research methodology for the progression of the digital transformation of the BMI field.

RQ2: What Is the Focus of the Literature on the Digital Transformation of BMI?

Main Focus

The literature on digital transformation is dispersed between disruptive technologies, shared platforms and ecosystems, and new enabling technologies such as Big Data, the Internet of Things (IoT), Industry 4.0, Cloud computing, and digital fabrication (DF). Disruptive technologies in the literature refer to technologies that have the potential to introduce new product attributes, which could become a source of competitive advantage (Christensen, 1997); while a platform is defined as "any combination of hardware and software that provides standards, interfaces, and rules that enable and allow providers of complements to add value and interact with each other and/or other users" (Teece, 2018). Taken together, the platform innovator(s) and complementors constitute an ecosystem (Teece, 2018).

The majority of research in this field (49 articles, 63%) has focused on understanding the impacts that new disruptive technologies have on industries, identifying the areas of transformation in activities, processes, and BMs. Only few articles focus on understanding how the process of transformation takes place by drawing on different disciplines and theories.

An analysis of articles about disruptive technologies reveals that in earlier years, the literature (2009–2010) was focused on the challenges and opportunities created for incumbent BMs by these technologies. Some of the articles focus on the challenges faced by incumbents when managing radical technological change. As Chesbrough (2010) notes, there are many "opportunities and barriers in business model innovations" from technological advances. For instance, the case study of Kodak identified organization structure and culture as playing a crucial role in overcoming core rigidities to create new value from disruptive technologies (Lucas and Goh, 2009). Rothmann and Koch (2014) took a very divergent perspective, showing that the digital transformation of BMI fails when companies follow the same old strategic patterns and remain path-dependent. From 2013, focus shifted to ways to overcome these challenges. For example, Karimi and Walter (2016) argue that the adoption of a disruptive BM requires firms to give groups autonomy and allow risk-taking and proactiveness. Kapoor and Klueter (2013) suggested overcoming a firm's inertia associated with prevailing incumbent BMs by investing in research and development through alliances and acquisitions.

Nevertheless, disruptive technologies bring opportunities to firms who understand how environmental changes necessitate BM modifications. Wirtz et al. (2010) argue that the Web 2.0 phenomenon, based on social networking, interaction orientation, user-added value, and customization/personalization serves as a value offering to traditional internet-based BMs (content, commerce, context, and connection). Another opportunity considered in the literature relates to the introduction of disruptive technologies from advanced economies into emerging economies through a second BMI by latecomer firms (Wu et al., 2010). Firms can also use different tactics (compensating, enhancing, and coupling) to reconfigure their value propositions (Bohnsack and Pinkse, 2017). **Table 2** summarizes the challenges and opportunities of disruptive technologies, according to some of the contributions analyzed.

The second most important topic analyzed, as shown in **Figure 7**, focused on shared platforms or "platfirms" and ecosystems as new BMs for digital enterprises. **Table 3** below summarizes the focus of some of these studies and their findings. We can see that shared platforms and ecosystems are a very recent focus, studied between 2017 and 2018, however, we note that the literature has addressed a number of broad issues which relate to an initial understanding of platforms, starting with their classification into five typologies (Muñoz and Cohen, 2017), and the investigation of the role played by platforms in dealing with disruption (Alberti-Alhtaybat et al., 2019) and BMI (Gupta and Bose, 2019a). Our results show that there is an important focus on financial aspects of platforms and ecosystems. For instance, Teece (2018) and Helfat and Raubitschek (2018) focus on aspects of profiting from innovation, while Khuntia et al. (2017) consider the relationship between the evolution of service offerings and the financial viability of platforms. Analysis of the data also indicates a focus on the managerial issues and success factors of these digital platforms. Since digital enterprises operate in a highly dynamic environment, lean startup approaches (LSAs) have been studied within the strategic agility context. LSAs can be employed as agile methods to enable digital entrepreneurs to innovate BMs (Ghezzi and Cavallo, 2020). Piscicelli et al. (2018) identified the success factors of sharing platforms: the identification of a significant market friction, building of a critical mass of users before implementing a correct pricing level and structure, addressing the hurdles of competition and regulation, and positive interaction fostered between users.

The results shown in **Figure 7** indicate that research is also led by recent arising interest in big data (Urbinati et al., 2018), cloud computing (Nieuwenhuis et al., 2018), and

TABLE 2 | Challenges and opportunities of disruptive technologies.

Author	Opportunity	Challenge
Lucas and Goh (2009)		Organization structure and culture
Kapoor and Klueter (2013)		Overcoming firms' inertia associated with prevailing incumbent business models
Wirtz et al. (2010)	Web 2.0 serves as a value offering for traditional Internet business models	
Wu et al. (2010)	Second business model innovation by latecomer firms	
Bohnsack and Pinkse (2017)	Compensating, enhancing and coupling tactics to reconfigure value propositions	

TABLE 3 | Focus of literature on shared platforms and ecosystems.

Author (year)	Aim of the study	Results
Muñoz and Cohen (2017)	Typologies of sharing business models	Crowd-based tech business models, collaborative consumption business model, business-to-crowd business model, space-based business model (low-tech), and Utopian sharing outlier business model
Alberti-Alhtaybat et al. (2019)	Dealing with disruption	Building a unique business model based on technological innovations and agility
Gupta and Bose (2019a)	Business model transformation in pioneering digital firms	Technological affordances help companies to strategically learn to adapt to operating environment
Piscicelli et al. (2018)	Success factors for P2P goods-sharing platforms	Business model design and execution; and Ability to experiment and innovate business model
Ghezzi and Cavallo (2020)	Lean startup approaches (LSA) and BMI in digital startups	LSAs are agile methods for BMI for digital startups under conditions of environmental dynamism
Khuntia et al. (2017)	Influence of service offerings evolution in operational maturity and financial viability of Health Information Exchanges (HIE)	Shifting over time from transaction fees, to subscription or hybrid revenue based models
Helfat and Raubitschek (2018)	Profiting from innovation in digital platform-based ecosystems	Innovation, scanning/sensing, and integrative capabilities
Teece (2018)	Profiting from innovation in the digital economy	Understanding of relevant complements, good BM design, and supportive governmental policy
Kamalaldin et al. (2020)	Profiting from digital servitization	Understanding the relational components that can create value
Khanagha et al. (2020)	Profiting from innovation in the digital economy	Understanding the contribution of platforms to competitive advantage

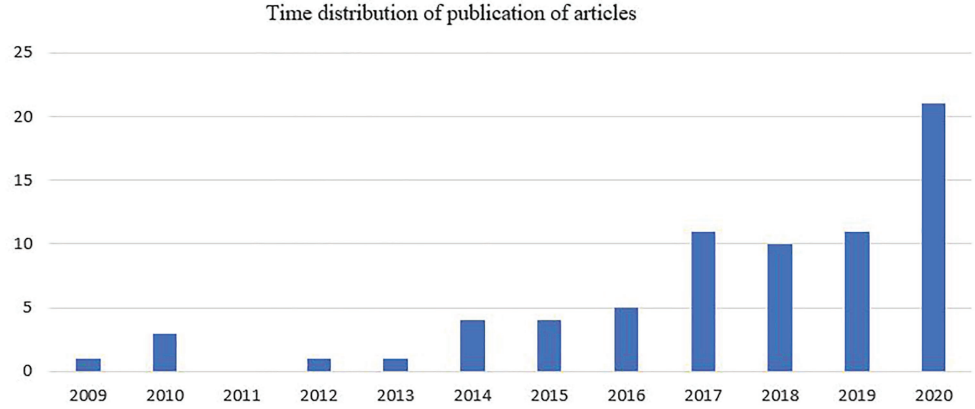

FIGURE 7 | Time distribution of the selected articles.

closed-loop systems in the circular economy (Rajala et al., 2018). These new enabling technologies allow firms to apply new BMs in support of sustainability issues. The growing intelligence of goods generates novel BMs, which rely on the intelligence of ecosystems within the activities for resources, by shaping closed-loop systems (Rajala et al., 2018). Firms are also engaging more in frugal innovations, allowing them to carry out resource-constrained innovations for emerging markets (Winterhalter et al., 2017).

To conclude, this section develops insights regarding the focus of the literature. The literature that is focused on disruptive technologies advances disruptive innovation theory by proposing culture, organizational structure, and cognitive leadership intentions as important factors affecting company responses to disruptive innovation. However, there is still a missing link in understanding the moderating role of disruptive technologies, based on their digital infrastructure and this requires more research into the conditions and the extent of BM transformations (Gupta and Bose, 2019a). The literature also shows that shared platforms and ecosystems, as well as new enabling technologies, are a very recent focus. In contrast to articles about disruptive technologies that focus on challenges and opportunities, articles about shared platforms consider a broad number of issues from typologies to managerial and financial aspects. Nevertheless, the results show that few articles focus on one topic and the focus shifts quickly, leaving topics under-investigated. This finding highlights the need for more research on topics that are under-investigated and represented by only a few studies. The scattered nature of the field might affect the accumulation of knowledge, as studies do not focus on previous findings.

Theoretical Perspectives

Theory development is essential for the proper advancement of knowledge in any field of research (Kuhn, 1970). To develop

a better understanding of theoretical perspectives in the field of digital transformation of BMI, we analyzed the articles and determined whether a theoretical perspective was apparent in each. We further analyzed articles that reflected theoretical perspectives and identified whether the theory was an existing one or a new theory. The results of this analysis revealed that the majority of articles (47 articles, 65%) was not based on any discernible theory.

Of the articles with an apparent theoretical perspective, we observed that the majority had adopted theoretical perspectives. Recent contributions (e.g., Vendrell-Herrero et al., 2017; Akbar and Tracogna, 2018; Helfat and Raubitschek, 2018; Teece, 2018) have started questioning and seeking more theoretical frameworks in order to explain and understand the digital transformation of BMI. Interestingly, disruptive innovation theory (Christensen, 1997) was the most popular with five contributions, and other theories were adopted only by single studies. The theory of disruptive innovation was initiated by Christensen (1997) to explain the replacement process of a mainstream innovation by innovations that are cheaper than those on the market and of inferior performance. In this dominant view within the field, which originates from a technological and innovation management perspective, DT is studied at an organizational and individual level of analysis. These researchers incorporate disruptive innovation theory in their studies to show how value generated from technology can be accelerated. For instance, the case study of Kodak (Lucas and Goh, 2009) recognizes culture and organizational structure as crucial elements in creating new value when disruptive technologies are introduced in an industry. Osiyevskyy and Dewald (2015) concentrate on the strategic decisions of managers and argue that responding to ongoing disruption with experimentation depends on a leader's explorative intentions.

More recent articles that relate the digital transformation of BMI to disruption theory concern topics based on managerial practices of inspiring and managing disruptive innovations in digital entrepreneurships, such as collaborative open foresight (Wiener et al., 2018) and knowledge management (Alberti-Alhtaybat et al., 2019). As Alberti-Alhtaybat et al. (2019) note about the logistic company Aramex that "current study seeks to illustrate their approach to logistics and their mindset regarding disruptive technologies, which is reflected in their particular business model." Also, for instance, Wiener et al. (2018) argue for collaborative open foresight as a new managerial solution for inspiring disruptive innovations.

We highlight other theoretical perspectives that provide a variety of perspectives on the digital transformation of BMs. Simmons (2013) takes an actor-network perspective to demonstrate that the digital transformation of BMI is a social process facilitated by the negotiation between the network of partners involved. Other researchers use different theoretical perspectives to understand DT of BMI. Akbar and Tracogna (2018) develop their research on transaction cost economics theory to explain the impact of transaction features on the emergence of sharing platforms. Teece (2018) and Helfat and Raubitschek (2018) ground their profit from innovation framework on dynamic capabilities theory. Teece (2018) builds on the recent importance of digital platforms, standards, appropriate regimes, complementary assets, and technologies to show that the mobilization of relevant resources and platform capabilities is an important dynamic ability in managing complements in the ecosystem in order to capture value from it. Similarly, Helfat and Raubitschek (2018) suggest that integrative capabilities are important for designing and orchestrating the alignment of activities and their products with other partners in the ecosystem BMs. Finally, Gupta and Bose (2019a) identify the factors impacting digital transformation of BMs based on affordances theory and attempt to develop a theory of strategic learning for digital ventures, as digital technologies offer firms the potential to develop strategic learning while they adapt continuously to their operating environment. Interestingly, more recent papers (Gupta and Bose, 2019b; Trabucchi et al., 2019) rely on the business model canvas framework (Osterwalder and Pigneur, 2012) to analyze in-depth the variables of innovation, which lead to competitive advantage and communication with the external stakeholders.

These findings suggest that the digital transformation of BMI was firstly related to disruptive innovation theory in the literature and that recently this trend is appearing again. The only difference is that while previous research addresses digital transformation as an extension of the disruptive theory that brings challenges and opportunities to the BM of incumbents, considering digital transformation a consequence of disruptive innovation, recent research relies on disruptive theory and is more focused on practices and methods to manage and inspire disruptive innovations.

To conclude, these theoretical insights suggest that digital transformation has brought a new conceptualization of BMs and new ways for value creation and capture. According to the transaction cost theory, sharing platforms are dominating as BMs, where the transactions between the parties have resulted in the creation of ecosystems. The creation of ecosystems and sharing platforms has pushed research into disruptive innovation theory to emphasize the commercializing value of disruptive technologies. Simons' article brings a new perspective to our understanding of digital transformation in companies, taking into consideration the moderating role of social aspects in creating value from digital transformation at a firm level. Further research should investigate which social aspects in the network of actors make more contributions to value creation. We also lack an understanding of how the social relationships of the actors in a network contribute value delivery and capture. This perspective of actor-network theory can be very helpful in studying sharing platforms and ecosystems, outside the boundaries of the firm.

Researchers suggest numerous ways for managing disruptive innovation in ecosystems and among firms – through coordination building (Teece, 2018), the implementation of strategic learning processes and structures (Gupta and Bose, 2019a), involvement in collaborative open foresight projects (Wiener et al., 2018), leveraging strategic partnerships through knowledge management (Alberti-Alhtaybat et al., 2019) and using agile methods that enhance strategic agility (Ghezzi and Cavallo, 2020). The digital transformation thus emphasizes not only competition but also collaboration, closing the gap between

stakeholders. Referring also to what we discussed previously in the focus of the literature section, digital transformation is enabling companies to work toward issues of sustainability by engaging them in circular and sharing economy approaches. BMs have thus become an open tool for everyday changes related to technological improvements and knowledge management concerning stakeholders and sustainability issues. The digital transformation of BMI now includes technological developments, relationships with stakeholders and sustainability issues in its framework. Our analysis, therefore, suggests that the digital transformation of BMI is a bridge that links the value of strategic innovation management required to solve problems to stakeholders, technology development and sustainability issues, with their opportunities to create and capture value. Further analysis may include the psychological aspects of the various stakeholders, who represent primary actors in the ecosystem, and who may still feature competing interests in the use of digital transformation and its outputs.

This section combines the results of the literature review to understand better the impact of digital technologies on value creation, and the capture and delivery of BMs. In the literature, digital technologies "are regarded to play a critical role in facilitating business model innovations in different sectors" (Li, 2020). New enabling technologies create new ways of doing business for companies and lead to the implementation of new ways of creating, delivering, and capturing value.

Digital Transformation and Value Creation

The value creation sub-component of the BM describes the products and services offered to the customer. The review of the literature shows that digital transformation is enabling companies to create new value in a diversity of ways. We identify below four means of value creation and explain each of them.

First, digital transformation allows firms to create new value through the revision and extension of their existing portfolio of products and services. For example, newspaper and book publishing industries adopted a servitization strategy to offer digital products to customers (Øiestad and Bugge, 2014). This extension of products and services relates specifically to the dematerialization of physical products and the switch from product to service logic. In fact, dematerialization and service logic have impacted the pharmaceutical industry through new approaches such as personalized medicine, nanobiotechnology, and systems biology, providing new therapeutic principles in this industry (Sabatier et al., 2012). Other cases in the literature include firms in the retail industry which have created new value by adding a new BMs through online retailing (Kim and Min, 2015).

Secondly, digital transformation enables firms to understand customer needs better and offer new value propositions in accordance with what they want. One type of value proposition creates high personalization with customers. For instance, novel value propositions can provide a high level of involvement for the customers in value co-creation through additive manufacturing and 3D printing technologies, as in the manufacturing industry (Bogers et al., 2016). High-value creations are also based on new BMs that rely fully on recent technological developments such as smart apps, drones, 3D printing, and crowdsourcing delivery to create new value for customers through new services. The adoption of these digital technologies has transformed companies in the logistics industry into technology enterprises, which sell "transportation and logistic solutions without being encumbered by heavy investments in assets" (Alberti-Alhtaybat et al., 2019). In contrast, other value propositions aim to satisfy only the necessary needs. In this case, firms offer new value propositions and even create new markets by addressing the needs of low-income customers in emerging economies (e.g., resource-constraints innovations in the healthcare industry; Winterhalter et al., 2017).

Third, we notice a tendency of some industries, such as financial services, hospitality and automotive services, and healthcare to employ disruptive technologies in their BMs, in order to find solutions for sustainability issues and a sharing economy approach. For instance, the automotive industry is adopting sustainable mobility (Bohnsack and Pinkse, 2017), creating new sources of value by offering a superior product or service (e.g., car-sharing services and mobile applications), or by coupling their products with other services (Bohnsack and Pinkse, 2017). Similarly, embedding the sharing economy approach in the financial services industry is bringing new innovations for processes and services (Gomber et al., 2018), leading to digital banking services, products, and functionality which enhance customer experience (Gomber et al., 2018).

Fourthly, we witness the creation of new value through digital platforms or "platfirms" (Presch et al., 2020) and ecosystems. Digital transformation provides the necessary digital infrastructure for everyone to connect to different actors in networks. For example, in the United States, digital transformation has created new Health Information Exchanges (HIE) organizations, using multi-sided digital platforms to offer information exchange services between different actors in the industry (Khuntia et al., 2017). In the telecommunication industry, the diffusion of data content through mobile devices and the innovation of network infrastructure technology has resulted in a mobile telecommunication ecosystem. In the hotel industry, the emergence of booking platforms (booking.com) and sharing platforms (Airbnb) have brought new value propositions to customers, which are cheaper and more authentic.

Digital Transformation and Value Delivery

Value delivery describes the way the activities and processes in a company are employed to deliver the promised value to the customer. The review of the literature reveals a significant change in the way value is delivered in digitally enabled BMs. Digital transformation has challenged core competencies, activities, capabilities, and the roles of firms (Ghezzi et al., 2015; Nucciarelli et al., 2017; Teece, 2018).

Firms are first required to examine their core competences to align themselves with the shift to digital formats and servitization (Øiestad and Bugge, 2014). Their new competencies should include knowledge of digital technologies in order to manage relations with customers efficiently and to use the interactivity of digital channels (Li, 2020). Firms should be open to incorporating new disruptive technologies in order to continuously innovate their operations (Alberti-Alhtaybat et al., 2019).

Second, rapid changes in the new ecosystem business environment introduce the need for new capabilities and more emphasis on specific existing capabilities. New capabilities are necessary to deal with changes in the value chain and ecosystem business environment. For instance, in the pharmaceutical industry, firms need to deploy specific assets and capabilities that relate to the orchestration and management of information flows in the network. Previous literature has highlighted the presence of projects relying on new digital technologies (in that case, the blockchain) to distinguish authentic drugs from fake ones (Dal Mas et al., 2020b). Integrative capabilities help companies capture value in ecosystems and leverage their assets (Helfat and Raubitschek, 2018). In other industries (e.g., telecommunication) marketing capabilities have to deal with decreased costs and technical abilities to deal with changes in the ecosystem. Firms need to be "agile" and leverage platforms and strategic partnerships.

Third, digital transformation implies a change in the activities and processes of the firm. When firms get involved in projects about sustainability, manufacturers in the automotive industry implement environmentally-friendly processes of manufacturing. This undertaking has led companies and suppliers to collaborate on open innovations projects, such as the "Mobility Scenarios for the Year 2030 – Materials and Joining Technologies in Automotive Engineering" (Wiener et al., 2018). The other example involves processes of frugal innovations in the healthcare industry, which are designed to reduce cost in all value chain activities (Winterhalter et al., 2017).

Fourthly, digital transformation has impacted the role of firms in the industry. The shift in the role of actors in the industry results from the entrance of new players. For example, the entrance of new players (web companies) in the telecommunication industry affects value delivery (Ghezzi et al., 2015).

Digital Transformation and Value Capture

The value capture of the BM involves the revenue model and its financial viability by focusing on revenue streams and cost structures. The literature review suggests that digital transformation creates various new for firms to decrease costs and increase revenue.

Firms capture value by new enabling technologies. Big data provide companies with the means to reduce uncertainty in decision-making (Urbinati et al., 2018) and to optimize processes and increase the efficiency and quality of products and services (Loebbecke and Picot, 2015). These attributes help firms identify new sources of value in other markets and to reduce the costs of adopting BMs over time.

Firms can capture value from superior value propositions. This is demonstrated in industries such as logistics where customers pay for superior service and solutions, or resource-constraint innovations, for the superior quality of a service network. In the pharmaceutical sector, firms capture value through new value propositions for which companies deliver service to patients. In creative industries, premium prices are based on the exclusivity and personalization level of the service offered (Li, 2020).

Digital transformation allows firms to capture value on platforms by leveraging new technologies and improved customer intimacy (Gomber et al., 2018). Research shows that value capture is influenced by the advancement of services provided, however, and transaction-based revenue models are not appropriate revenue models for achieving viability over time.

Future Research Avenues

Based on the results of our literature review, in this section, we discuss the gaps identified in the literature and suggest future research avenues that are relevant for theorizing. We suggest future research avenues, following the previously identified impacts of digital transformation on the new ways of creating, delivering, and capturing value.

Future Research Into Value Creation

Research is needed into understanding how companies should manage the trade-off between the cannibalization of existing products and investing in new advanced services for their customers. It remains unclear how companies can develop numerous value propositions for customers that are personalized and always require the co-existence of existing products and product-centric services. The impacts that adding or extending of BMs have on existing BMs are unclear.

It is essential for the manufacturing industry to understand how manufacturers can manage the customization of products and control the value co-creation process with customers (Bogers et al., 2016). In this avenue of research, it would be necessary to consider also the impact of future technological development on value co-creation; for example, how the combination of digital fabrication and Web 2.0 would create new means of value co-creation.

Further research is needed to identify how new BMs emerge, and how value creation is formed in the creative industries, by researching the different interactions among, for instance, crowdfunding platforms, entrepreneurs, and the crowd. There is a lack of knowledge about the effects that crowdfunding platforms have on value creation activities. It would be useful to understand how the collaborative and competitive dynamics of crowdfunding platforms create value for firms.

It remains unclear how agile practices can help firms to create value from digital technologies and customized services. Future research should also consider the application of agile practices in traditional industries. As firms in traditional industries in the context of ecosystems need to carry out more innovation with other firms, this opens an avenue for further research on how agile practices could become a source of value creation.

There is a need for much more research on understanding the role of single technologies such as the Internet of Things, Cloud computing, artificial intelligence, big data, and the blockchain. The application of these technologies in practice will bring direct knowledge for understanding the dynamics of value creation processes as a source of competitive advantage.

Value creation should also be studied regarding how to create value by generating content from customer data. There is still a call for further research into how firms should exploit all this information through analytics that will help them to design better value propositions for customers, according to their needs.

Value creation for customers should also be analyzed stressing the psychological impacts. New insights and inputs come, for instance, from the healthcare sector in dealing with the recent

COVID-19 pandemic, with terminal patients relying only on telemedicine to get in touch with their dear ones (Ritchey et al., 2020; Wakam et al., 2020), fostering new possible BMs for firms operating in that field.

Another avenue for further research is to define the boundary conditions under which BMs should be innovated, how often, and how this will impact value creation. Firms learn from the intense and continuous interaction with the high dynamism of the environment and need to undertake changes in the BMI. However, there is still a lack of research defining the boundary conditions driven from the technological advancements that impact value creation in the BMI.

Lastly, it is important to understand the role of new technologies in sustainable issues. It is still unclear how to create new value in the circular economy and from industries where sustainability plays a crucial role, for example, in the retail industry. The link between digital transformation and pro-environmental behaviors of customers, especially from a psychological perspective, appears as a pretty new and promising stream of research (Yusliza et al., 2020).

Future Research Into Value Delivery

There is a need for more research on ecosystems. The recent review shows how roles and interdependencies in the ecosystem change remain unclear. New activities, roles, and capabilities should be identified to enhance our understanding of how firms should orchestrate the new relationships in the ecosystem. Knowing how to develop the abilities to manage the delivery network is essential for key players.

The culture shift to advanced servitization requires more research. This is especially necessary for manufacturing companies that now provide digitally advanced services instead of products. This kind of mental shift is difficult for employees and remains a challenge for companies regarding how its delivery network should be organized. The cultural shift is especially important for distribution channels that call for digital servitization.

More research is also needed on understanding the new capabilities required for manufacturing firms that are involved in digital fabrication. More simulation studies should be carried out to better understand how supply chains will be designed for 3D printing.

There should be more research into identifying the role each technology has in enabling firms with new capabilities and roles. These results will offer a clear idea of the technology they should invest and how it should then be related to new capabilities. The attitude toward the use of technologies has been considered by the literature as a soft skill, rather than a technical one (Massaro et al., 2013; Dal Mas et al., 2021; Lepeley, 2021). The open debate concerns how much these skills can be learned, or at least fostered. Further investigation is needed to understand how such skills may be empowered through education in order to facilitate delivery and the translation of knowledge. In this regard, psychological aspects related to the attitude toward new technologies may be taken into consideration, following an interdisciplinary perspective.

Future Research on Value Capture

Our results show that investing in digital technologies is costly and undertaking the digital transformation of a firm requires a culture shift. Further studies should investigate how investments in technology relate to the feasibility of revenue models and value capture. Sometimes capturing value from investments in new technologies does not fully exploit the revenue.

Future research should increase our understanding of the value capture of ecosystems, where investments are high. Still, the profits captured by each collaborator actor in the ecosystem are only a fraction of their investment (Teece, 2018).

In the manufacturing industry, the paradigm shift to digital fabrication requires more research into understanding whether value capture is higher for the manufacturer or for the retailer. This can be important in deciding who can invest more in additive manufacturing and 3D printing technologies.

The types of revenue models that should be applied during the evolution of the services are still unclear. There is a need to carry out longitudinal research to explore further the best fit of the revenue models along the lifecycle of the product-centric services (Khuntia et al., 2017).

CONCLUSION

This paper uses a structured literature review to provide insights into the development of the field of digital transformation of BMI, to understand the impact of digital transformation on BMI and to provide avenues for further research. The review of the literature shows that the digital transformation of BMI is a new field of research with a growth in interest from researchers since 2014. As there is an increased interest from researchers, we expect a growing number of publications in the field. Our results show that this field of research has no dominating authors, implying that few authors remain focused on exploring further aspects of BMI driven by digital transformation. This hinders the knowledge-building process in the field, as only a few authors make use of prior findings to build cumulative knowledge. Indeed, we observe that topics have shifted over time from a focus on incumbents to digital start-ups and from disruptive technologies to new enabling technologies. This reveals the practitioner-led nature of research in this field, although there is a wide divide between academics and practitioners. For this reason, we suggest more collaboration between academics and practitioners, which will help the field to move from an early stage of maturity toward a mature stage. Collaborations may be facilitated by joint forums, think tanks, interventionist research by academics into firms, publications of the main research results in practitioners' sources like magazines, financial journals, or internet blog posts.

Our results suggest a need for research in developing and emerging countries, especially those from Asia, as they are significantly under-represented, despite their massive contribution to technological solutions. The manufacturing and creative industries dominate research. This raises the need to study other industries such as design, architecture, advertizing, and

the fashion industry (Mangematin et al., 2014) and creating more contents in those sectors, like healthcare, which is relying on DT to cope with the several global challenges, including the recent COVID-19 pandemic (Cobianchi et al., 2020; Dal Mas et al., 2020c; Wang et al., 2020). The extensive use of qualitative methodology also suggests that the potential of the field be restricted to interpretive theory building. This calls for more deductive test theory, which might be found if the field involves more interdisciplinary research in the future.

Our review shows fragmentation of the field between disruptive technologies, shared platforms and ecosystems, and new enabling technologies. The focus of research has been mainly on the understanding of impacts that new disruptive technologies have on industries, identifying the areas of transformation in activities, processes, and BMs. Few studies focus on understanding how the process of transformation takes place by drawing on different disciplines and theories. These insights reveal the scattered nature of the field and a quick shift of topics, leaving them under-investigated. Future research should, therefore, be based more on previous findings, thus helping with the accumulation of knowledge and the identification not only of practical gaps but also theoretical gaps.

We suggest that digital transformation has brought a new conceptualization of BMs to the value creation and capture mechanisms. The review of articles provides a variety of theoretical perspectives on the digital transformation of BMs. Disruptive innovation theory is the dominant theoretical perspective, based on which we propose that the digital transformation of BMI is a bridge that links the strategic management of a company's disruptive innovation required to solve problems with stakeholders, technology development, and sustainability issues to their opportunities to create and capture value. There is a need for further research grounded on theoretical perspectives of dynamic capabilities and actor-network theory.

The results of our study show that digital transformation has impacted value creation, delivery, and capture in almost every industry, although some fields are more investigated than others. Digital transformation enables firms to co-create value with customers through customized manufacturing; through the adoption of servitization strategies and extension of the existing portfolio of products and services; the creation of new value through digital platforms and ecosystems; and finally, allows firms to address solutions to sustainability issues and even address the very specific and particular needs of customers to enhance their experiences. These changes in value creation have required companies to examine their competences, roles, activities, and capabilities. Firstly, firms should possess first-hand knowledge of digital technologies to manage relations with customers efficiently. Secondly, firms should be prepared to shift their roles as new players enter the ecosystem. Thirdly, involvement in sustainability projects, frugal innovation, and circular economy requires a change in activities and processes. Fourthly, integrative capabilities have become necessary for firms to deal with changes in the value chain and ecosystem environment. The adoption of new enabling technologies allows firms to reduce uncertainty in decision-making and capture value from improved customer intimacy and superior service.

To advance research on digital transformation of BMI, we also suggest some future avenues with regard to impacts of digital transformation on value creation, delivery and capture. The identification of these theoretical gaps can be argued to help the advancement of literature on the digital transformation of BMI.

Our study has limitations. Firstly, this paper considers only research published in leading journals, listed in the ABS classification with 3, 4, and 4*. This can be a limitation due to missing results published in other journals that might be relevant for the aim of our study. Secondly, there are some implications from the conclusions of this study. The results are valid only for the specific time period we consider in this study, until September 2020. As we previously saw, since research in the field is experiencing high interest and an increasing number of contributions yearly, future research works could modify our findings. The conclusions derived in this research are based on exploratory research, where sometimes a single case study approach is followed (Wiener et al., 2018), or sharing platforms are evolving over time (Piscicelli et al., 2018) and where IT industry is characterized by short innovation cycles (Nieuwenhuis et al., 2018). Nevertheless, this research into the digital transformation of BMI can provide practitioners with new insights about the phenomenon, and will help them to continually innovate their BMs and remain competitive, as new technologies become more ubiquitous.

AUTHOR CONTRIBUTIONS

SV and MM conceived the idea of the paper. SV wrote the first draft. EB and FM reviewed and fixed the manuscript. All authors contributed to the article and approved the submitted version.

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A Comparison Analysis Between Pre-departure and Transitioned Expat-Preneurs

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This paper contributes to the understanding on the reasons that lead to entrepreneurship in other countries. We focus on expat-preneurs, those who decided to undertake business opportunities in other countries (before or after settling there). Using comparison analysis and logistic regression, we examine pre-departure and transitioned expat-preneurs' demographic characteristics and push-pull factors that lead them to expatriate. From a survey conducted in 2015-2016 of 5,532 Lithuanians expatriated in 24 countries, a sample of 308 respondents with their own businesses abroad was selected. This research contributes to the literature on expat-preneurs, with empirical evidence on pre-departure and transitioned self-initiated (SI) expat-preneurs. The results revealed that demographic features matter when studying such global entrepreneurs. It is a process experienced differently by males and females and, as such, it can be considered as gender selective. Thus, more pre-departure expat-preneurs are male than female, but there is a growing number of female transitioned expat-preneurs. Pre-departure expat-preneurs are older and less educated than transitioned ones and have been pushed to move abroad by issues such as political corruption or a non-supportive tax system, and are attracted by a higher possibility of self-realisation as well as the prestige of the host country. Meanwhile, transitioned expat-preneurs have been pushed to emigrate due to family reasons or too few employment opportunities in their home country.

Keywords: entrepreneurship, expatriate entrepreneurs, expat-preneurs, pre-departure expat-preneurs, transitioned expat-preneurs, self-initiated expatriates

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INTRODUCTION

Nowadays, more and more people work abroad. In 2017, it was estimated that there were 66.2 million expatriates worldwide, which represents 0.77 percent of the total global population (Finaccord, 2018; Hussain et al., 2019). "Being rooted in a profession rather than a country and trying to find the best possibility to work in that profession without being limited by national borders is what reflects the reality of many – especially highly skilled – individuals of our time" (Agha-Alikhani, 2018, p. 2).

The growing involvement of expatriates in the development of entrepreneurial businesses has been observed together with the increasing expatriation numbers (Sekliuckienė et al., 2014; van Rooij and Margaryan, 2019; Internations, 2020). Moreover, Baycan-Levent and Nijkamp (2009) highlighted that, in general, foreigners are more likely to become entrepreneurs than similarly

skilled native-born workers, and self-employment rates of foreigners in many countries exceed those of native-born.

Entrepreneurship of foreigners in host countries is a traditional field of interest for scholars who analyse diaspora entrepreneurship (Vemuri, 2014; Elo, 2016), migrant entrepreneurs (Engelen, 2002; Aliaga-Isla and Rialp, 2013; Sahin et al., 2014; van Rooij and Margaryan, 2019), and expatriate entrepreneurs (Du Plessis, 2009; Connelly, 2010; Zgheib and Kowatly, 2011). Despite these mentioned concepts, Vance et al. (2016) and, later, Selmer et al. (2018) proposed a new meaning of self-employed expatriates: expat-preneurs. These are not entrepreneurs within the context of "South to North" migration (a.k.a. "ethnic entrepreneurs" or "immigrant entrepreneurs") but are a new and growing reality of foreign global entrepreneurs who come from developed economies (Girling and Bamwenda, 2018), a definition which entails several differences, advantages, and disadvantages over traditional "ethnic entrepreneurs" (Selmer et al., 2018; van Rooij and Margaryan, 2019).

To date, expat-preneurs by themselves are not a very much analysed phenomena, despite the current context of globalisation. Vance et al. (2016) presented a concept of expat-preneurs, dividing them into pre-departure and transnational expat-preneurs, and posed potential research questions in this field. Paik et al. (2017) theoretically analysed self-initiated expatriates (SIEs) who become expat-preneurs and Selmer et al. (2018) focused on a comparison of SIEs with expat-preneurs coming from assigned expatriates (AEs). However, the aim of this paper is to compare the demographic characteristics and motivations to expatriate of pre-departure and transnational SI expat-preneurs, something that has not been done in previous studies.

As the basis for this study, we concentrate only on Lithuania. Since the restitution of Lithuanian independence in 1990 and the collapse of the Soviet Union, the Lithuanian net migration indicator has been negative (Migration in numbers, 2020). Therefore, Lithuania is a good example for a deeper look at the phenomena of expatriation. The following comparison analysis is based on Lithuanian expat-preneurs (people who moved from Lithuania and established businesses abroad).

Our paper is organised as follows. First, the meaning of expat-preneur is presented, with the focus on two types in particular: pre-departure and transitioned expat-preneurs. Second, the concept of expat-preneur and its demographic profile is reviewed, and an analysis of push-pull factors influencing the decision to leave the home country finalises the theoretical part of the paper. The research model and method are presented in the methodology section. The results of the quantitative research of Lithuanian expat-preneurs in 24 countries are provided later. Discussion, conclusion, limitation, future research directions, and practical implications finalize the paper.

THEORETICAL BACKGROUND

Theoretical Concepts

Self-Initiated Expatriates

The concept of SIEs was first introduced by Suutari and Brewster (2000), where the authors presented self-initiated expatriates in contrast with assigned expatriates, these being expatriates sent abroad by their employer (Arp et al., 2013). In comparison with AEs, SIEs are described as individuals who decide to look for international work-experience on their own initiative (Fitzgerald and Howe-Walsh, 2008; Andresen et al., 2014; Meuer et al., 2019; Andresen et al., 2020). In other words, they are conceptualised as free agents who cross organisational and national borders, unobstructed by barriers that constrain their career choices (Inkson et al., 1997).

Froese and Peltokorpi (2013) and Fee and Gray (2020) highlight that the demand for SIEs is on the rise, especially in Europe and Asia (McNulty et al., 2013). In addition, skilled SIEs constitute a valuable asset to the worldwide economy (Doherty and Dickmann, 2008; Fairlie, 2010; Hussain et al., 2019). Comparing statistical data of SIEs, 15 percent of them found a job on their own, 13 percent were sent by an employer, and 6 percent were recruited by a local company (Statistics Lithuania, 2016).

An essential characteristic of SIEs is that they leave their home country voluntarily for a predetermined period of time without the intention of becoming permanent citizens of the host country (Baruch et al., 2007; Al Ariss, 2010; Tharenou, 2010; Du Plessis, 2015; Vance and Paik, 2015; McNulty and Brewster, 2016; Meuer et al., 2019; Andresen et al., 2020). However, Al Ariss and Özbilgin (2010, p. 276) note that "the difference between SI expatriates and immigrant workers often remains implicit <. . .>. Both forms of expatriation are, in fact, not so different; many SI expatriates stay on a permanent basis and thus become permanent immigrants". Therefore, another feature presenting the difference between migrants and expatriates is status in the host country. While foreigners do not always have a permanent permit or visa pass to stay in the host country, they remain as expatriates and after this their status changes to migrants (Al Ariss and Özbilgin, 2010; McNulty and Brewster, 2016). Any intention of becoming permanent citizens increases with the duration of the stay in the host country (Kumpikaitė-Valiūnienė and Žičkutė, 2017).

Pre-departure and Transitioned Expat-Preneurs

'Expat-preneurs' is a concept presented by Vance et al. (2016). It defines employees who go or remain abroad to start a new business in a host country, or who join in local host-country entrepreneurial activities (Vance et al., 2016). Therefore, we could describe expat-preneurs as self-employed expatriates.

Literature on the subject establishes three main differences between ethnic entrepreneurs and expat-preneurs (Vance et al., 2016; Girling and Bamwenda, 2018). Firstly, expat-preneurs stay temporarily in the host country, but ethnic entrepreneurs stay long-term. Also, expat-preneurs are not "necessity-entrepreneurs." Finally, expat-preneurs usually come from a developed economy. It means expat-preneurs are in a more advantageous position than ethnic entrepreneurs, and they are not compelled by circumstances to stay in the host country or start their own business, but they do so of their own free will.

Vance et al. (2016) distinguish two different types of expat-preneurs. Some move abroad with an entrepreneurial purpose, or they try to expand their business from their home country to

a new location. It means that these people have 'entrepreneurial intentions' before moving abroad, which explains individual willingness to start a business (Díaz-García and Jiménez-Moreno, 2010; Bastian, 2017). These expatriates are called 'pre-departure expat-preneurs' (Vance et al., 2016).

The other type of expat-preneurs do not have any intention of being self-employed before departure. They decide to move abroad, leaving their employer or the status of unemployment. After being in the host country for some time, they then start up their own business. This group of expatriates is called 'transitioned expat-preneurs' (Vance et al., 2016). In addition, Block and Wagner (2010) call such type of entrepreneurs 'opportunity entrepreneurs' as they are more likely to be alert to business opportunities than others.

The rising field of research on 'pre-departure' and 'transitioned' expat-preneurs and the need for empirical evidence provides the drive for further exploration of these types of expat-preneurs, and to identifying their characteristics and differences.

Reasons of Foreigners to Become Entrepreneurs

Schumpeter's theory addresses how entrepreneurs take risks in the pursuit of their goals and profits (Girling and Bamwenda, 2018). According to Kirkwood (2009), research on entrepreneurship motivation shows that both push and pull factors play a role for any individual entrepreneurs wanting to open a business. Patil and Deshpande (2019), when analysing female entrepreneurial motivation, note that among the pull factors are passion, independence, capital availability, and self-growth of a person, and among the push factors are economic necessity, financial burden, and loss of employment. In addition, environmental conditions for establishing and developing a business are important too.

Regarding foreigners, more factors need to be considered. Theoretical approaches that accommodate this emerging trend come from studies into international ethnic entrepreneurship and migration flows (Ilhan-Nas et al., 2011; Kumpikaitė-Valiūnienė and Žičkutė, 2017; Girling and Bamwenda, 2018). In addition, in the context of entrepreneurial venture, theories such as the cultural approach and the mixed embeddedness theory pointing out demographic and cultural traits (that a population shares) could explain the level of entrepreneurial success for foreigners (Masurel et al., 2002; Girling and Bamwenda, 2018; Arseneault, 2020).

The literature on migrant entrepreneurs focuses on migrants coming from undeveloped or developing countries to developed countries. The study by Moremong-Nganunu et al. (2018) on the biggest migrant entrepreneurial ethnic groups, such as Arabian, African, Asian, and South Asian, noted that entrepreneurial capabilities vary among different ethnic groups. Corresponding to the embeddedness theory, Bloch and McKay (2015); Rogerson and Mushawemhuka (2015), and Dannecker and Cakir (2016) found that good support in the host country and social-cultural capital are very important for entrepreneurial success. After literature analysis on migrant entrepreneurs, Agoh and Kumpikaite-Valiuniene (2018) highlighted the main conditions leading migrants to become entrepreneurs. These conditions include lack of jobs abroad, highly competitive job markets, lack of skills in certain cases, lack of language skills, cultural differences, discrimination in workplaces, determination to grow, personal entrepreneurial spirit, knowledge of the business, and internet business skills. Therefore, quite often the decision of migrant entrepreneurs to start their own business is based on necessity.

However, according to the expat-preneurial definition by Vance et al. (2016) expat-preneurs move from developed to developed countries. Therefore, we suppose that they should be less necessity-driven entrepreneurs. Usually, these expatriates are educated, and do not face any issues with language or discrimination. Factors that are important for them in starting their own business include a lack of career possibilities, a wish for independence and self-development, and finding a suitable business environment. We propose that some differences in pre-departure and transitioned expat-entrepreneurs might be revealed by looking at gender, age, and educational background.

The Demographic Characteristics of Expat-Preneurs

Concerning the gender issue, until the 20th century, men predominated in moving to another country in order to pursue business opportunities. The scientific literature reflected this reality. Based on liberal feminist theory, men and women are essentially similar (Harding, 1987) and are seen as equally able to think rationally. Therefore, males and females and any subordination of females is connected with discrimination or structural barriers, such as unequal access to education. Bruni et al. (2004) noted three main barriers against female entrepreneurship. The first one could be described as the socio-cultural status of women, which is connected to the role of women with respect to responsibilities toward family, children, and housing. The second barrier is associated with the access to networks of information and assistance. Finally, the third highlighted barrier is access to capital. Women face problems searching for financial support and this is associated with a stereotype that 'women can't handle money' and is connected to the two previous barriers. This corresponds with the mixed embeddedness theory (Girling and Bamwenda, 2018). Empirical evidence from the study of Azmat and Fujimoto (2016) on Indian female entrepreneurs in Australia highlighted that their success massively depended on their family embeddedness and cultural heritage.

According to the Global Entrepreneurship Monitor (2015), the phenomenon of entrepreneurship is growing among women, although they are still less involved in entrepreneurial activities in comparison to men. This can be seen in both developed and developing countries (Patil and Deshpande, 2019). Figures taken in 2014 for Lithuania show that 59,700 (8.9 percent) of females and 83,300 (12.9 percent) of males were self-employed. In 2015, the number for women slightly increased but the percentage slightly decreased: 58, 600 (8.6 percent), with both figures for men decreasing 59,900 (9.3 percent) (Department of Statistics, 2017).

Concerning entrepreneurial age and gender, studies by Brockhaus (1982) and Hisrich and Peters (1996) demonstrated that entrepreneurial decisions in general are taken between the ages of 25 and 40. However, some differences in relation to females could be noted. Langowitz and Minniti (2007) highlighted the most entrepreneurially active age of females was between 25 and 34 years, declining thereafter, which corresponds with the findings of Hisrich and Peters (1996). However, Still and Guerin's (1987) earlier findings showed female entrepreneurs tended to be older - between the ages of 30 and 40. Also, Boden and Nucci (2000) analysed new business ventures with data on men and women from 1982 to 1987. This study pointed out differences in education and the amount of work experience, confirming a certain disadvantage in the case of female entrepreneurs. In addition, in the study by Gathenya et al. (2011) carried out in Kenya, the majority of female entrepreneurs were between 22 and 48 years. As Gathenya et al. (2011) highlight, this "age bracket is considered as the most entrepreneurially active age which contributes positively to the performance of enterprises."

However, if speaking about the situation of expatriates, the situation is a bit different. A study on expatriates by Selmer et al. (2018) showed that expat-preneurs were older than company-employed expats with an average age of 44. Speaking about the level of attainment of entrepreneurs, Brockhaus (1982) noted that managers tend to be more highly skilled than entrepreneurs, but entrepreneurs tend to have a higher level of education than the general public.

Moreover, Leonard (2010) noted that entrepreneurship is popular among SIEs and particularly for women who usually are less involved in assigned expatriation agreements. The motivation for the expatriation and careers of female SIEs are complex and varied (Muir et al., 2014). Based on the study by Vance and McNulty (2014), 34 percent of females were SIEs and self-employed as consultants or small business owners versus 25 percent for men.

With this in mind, the assumption is that expat-preneurs could be older than regular entrepreneurs and, moreover, pre-departure expat-preneurs are older too as they had their own business in their home country already formulated. In comparison to men, more females are taking expat-preneur experience. However, there is not much evidence about the demographic characteristics of expat-preneurs, especially with regard to pre-departure and transitioned expatriates. Therefore, we propose the following hypothesis H1, in relation to demographic characteristics:

H1. There are significant differences between demographic characteristics of pre-departure and transitioned expat-preneurs.

Push and Pull Factors Explaining Decision to Expatriate

The Push and Pull theory is the most popular theory explaining the process of human migration. Therefore, in order to analyse the reasons for the expatriation of pre-departure and transitioned SI expat-preneurs, push-pull factors were taken as the basis. In this sense, Kumpikaitė-Valiūnienė and Žičkutė (2017) reviewed the decision-making theories of migration and highlighted the main push-pull factors (see **Table 1**).

TABLE 1 | Highlighted push-pull factors.

Push factors	**ECONOMIC**
	• Too low wages in a home country
	• Wage differences and income inequality
	• Low level of country's economic development
	• Price politics of products
	• Person's unemployment
	• Too few employment opportunities in a country
	• Not enough new workplaces in a country
	• Non-supportive tax system
	NON-ECONOMIC/SOCIAL
	• Personal life conditions
	• Study and education system
	• Not enough cultural centres, such as museums
	• Social conditions
	• The level of health care
	• Environmental conditions
	• Family reasons
	• Political corruption
	• Intolerance of personal attitudes/discrimination
	• Intention to spread your culture and religion
	• Wish for changes
Pull factors	**ECONOMIC**
	• Better opportunities to get a job
	• Lower cost of living
	• Higher income
	• Lower taxes
	NON-ECONOMIC/SOCIAL
	• A large number of home citizens in host country
	• Relatives living in this host country
	• The distance from the homeland
	• Language
	• Possibility for self-development
	• Political stability
	• More attractive weather
	• Better conditions of health care
	• Higher tolerance
	• The country's prestige
	• Higher possibility for self-realisation

According to Kumpikaitė-Valiūnienė and Žičkutė (2017).

Economic or non-economic determinants can be attributed to "demand-pull" in the destination country, "supply-push" in the homeland, and network factors as the linkage between these two (Kumpikaitė-Valiūnienė and Žičkutė, 2017; Mihi-Ramirez et al., 2017). In conjunction with the SIE concept and the traditional migration theories, push and pull factors in the context of expatriation were applied.

Looking at the rationality that pre-departure and transitioned expat-preneurs moved abroad with different previous entrepreneurship experiences and, therefore, different primary intentions, we suppose their decisions to expatriate differ and so we propose the hypothesis H2.

H2: There are significant differences on push and pull factors between pre-departure and transitioned expat-preneurs.

To summarize, a theoretical model of study is presented in **Figure 1**.

METHODOLOGY

Context of the Research

Lithuania is a small EU country situated along the south eastern shore of the Baltic Sea, to the east of Sweden and Denmark. Its population is just 2.7 million, which has steadily decreased because of low birth rate and high expatriation. This decline started back in 1990 when Lithuania's independence was restored after 50 years of Soviet occupation. The whole period after independence can be divided into four emigration waves (Kumpikaitė-Valiūnienė, 2019). The first wave includes the period of independence from1990 to 2003, the second wave started after joining the EU in 2004, the third wave started in 2009 with the economic crisis and Lithuania joining the Schengen Area, and the last wave started after joining the Euro zone in 2015. Most Lithuanians moved to more developed European countries and to the United States. Historically, Lithuanians used to migrate to the United States, with large numbers doing so from the end of the 19th century, and it remained the most attractive country to move abroad to until 2004 when Lithuania joined the EU. At this time, the United Kingdom, Ireland, Germany, and Spain became more popular and later, after the economic crises, Norway joined the list of favourite countries.

Although Lithuania is a developed country, it is economically weaker than the majority of older EU member states. Comparing information about the purchase power standard (PPS) and the average salary among EU countries, in 2015 the EU PPS average was 1.0, in the United Kingdom 1.7, Germany 1.6, Ireland 1.4, Spain 0.9, and in Lithuania 0.6 (Statistical office of the European Union Eurostat, 2016). At similar or lower levels were Slovakia, Latvia, Hungary, Czechia, Romania, and Bulgaria. Average salaries in 2014 were 2,690 EUR in Sweden, 2,597 EUR in the United Kingdom, 2,160 EUR in Ireland, 2,054 EUR in Germany, and 524 EUR in Lithuania (Fischer, 2018). In Lithuania, more than 80 percent of all companies are small and have up to only nine employees (Versli Lietuva, 2017). Therefore, career perspectives are very limited in Lithuania. In summary, Lithuanians move to foreign countries for better work, career, and economic perspectives and therefore provides a good example to analyse its expat-preneurs.

Sample and Procedure

The survey method was selected for the research. Data gathering was completed online for several reasons: Shaffer et al. (2006) note that the response rate for expatriates is low, averaging 15 percent. In addition, it is difficult to access expat-preneur information as there is no available statistical data about Lithuanian expat-preneurs. Therefore, a decision was taken to separate expat-preneurs from the general group of expatriates.

An invitation to participate in the survey with a link to an online questionnaire was delivered to Lithuanian expatriates abroad through social media and websites. A call to participate in the study was also listed in Lithuanian expatriates' webpages in different countries. The data was collected in October 2015 and from October to December 2016. Of course, the verification of the answers and their analysis also took much more time. In total, 1,586 respondents completed the questionnaire in October 2015 and 3,946 respondents participated in the survey from October to December 2016. Of the total participants, 308 respondents according to their current occupation were selected as the sample for this study. The sample was taken only from those respondents who had their own business outside of the home country, i.e., SI expat-preneurs. The status of SI expatriation was checked with the question 'Who initiated your expatriation?' and with a selection of multiple answers. In addition, all respondents did not have citizenship in the host country and, therefore, based on the approach we apply in this paper taken from Al Ariss and Özbilgin (2010) and McNulty and Brewster (2016), they could not be called migrants.

The sample consisted of two particular groups: pre-departure expat-preneurs and transitioned SI expat-preneurs. Of this, a total of 250 respondents (81.2 percent of the sample) started their businesses abroad with previous experience of being employed by others, studying, or being unemployed in Lithuania. These were attributed as being transitioned expat-preneurs. The remaining 58 respondents (18.8 percent of the sample) were self-employed entrepreneurs in Lithuania before leaving and represented pre-departure expat-preneurs in the sample. The demographic characteristics of pre-departure and transitioned expat-preneurs in the sample are presented in **Table 2**.

In general, expat-preneurs from 24 countries participated in this study. The most attractive destination countries for the sample participants were the same as for the total Lithuanian population of expatriates, i.e., the United Kingdom, Norway, and the United States. Almost half of the respondents (46.4 percent) were 30–39 years old, with two additional groups having similar percentages: 40–49 years and 20–29 years old (respectively, 23.7 and 21.1 percent). Additionally, 67.9 percent of the sample were females (209 respondents), and 68.8 percent of the sample had a degree of higher education (212 respondents).

Respondents were divided into four groups based on the period of their departure. This grouping was done according to the four emigration waves in Lithuania, highlighted by Kumpikaitė-Valiūnienė (2019).

Measures

The study had an exploratory nature with single question items for several key concepts and their constructs (Wanous et al., 1997). Push and pull factors of an economic and non-economic nature (respectively, 8 and 4 of push, 11 each of pull) were measured as independent variables for pre-departure or transitioned SI expat-preneurs' paths. The list of factors provided and tested by Kumpikaitė-Valiūnienė and Žičkutė (2017) were used in the questionnaire. A general question about the reasons for initiating self-expatriation was given to respondents, along with the list of factors, unlimited choices, and including an open answer to provide any other factors not in the list that might come

out of the expat-preneur's experience. Each factor was coded as a separate variable (0 = not selected, 1 = selected).

The occupation of respondents was measured by two questions, asking for identification of the last occupation in their home country and the current occupation in their host country. The same list of 14 occupations (army officers, managers, specialists, technicians and younger specialists, office employees, services' employees and sellers, qualified specialists of agriculture, qualified workers and masters, plant and machine operators and assemblers, unskilled workers, self-employed, students, unemployed, and housewives) was used for both questions with one open answer for other options, taken from Kumpikaitė-Valiūnienė and Žičkutė (2017). This measurement allowed for the selection of expat-preneurs only, composing the sample of 308 respondents, and affiliated them into a particular group of pre-departure or transitioned. A dummy variable for groups of pre-departure (1) and transitioned (0) expat-preneurs was created. In addition to demographic characteristics, such as gender, age, and education, another two characteristics related to Lithuania as the research context, such as the departure period and host country of respondents, were included. The departure period reflects the four Lithuanian migration waves (Kumpikaitė-Valiūnienė, 2019) and was measured by a question with five ranges for an answer (from 1 = until 1990, to 5 = since 2015 and later). The list of countries was provided for the host country, used for analysis as a nominal variable. Other demographic characteristics of respondents, like their gender, age, or education, were measured by a single question

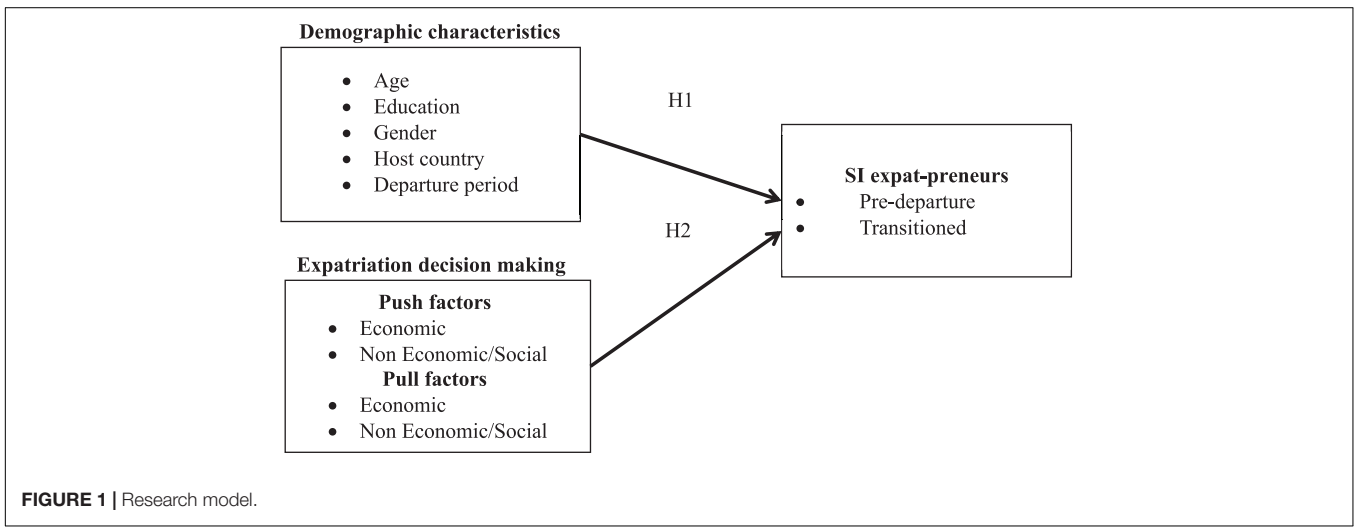


FIGURE 1 | Research model.

TABLE 2 | Demographic characteristics of the sample.

		Pre-departure expat-preneurs	Transitioned expat-preneurs	Total sample
Respondents (*N*)		58	250	308
Gender (female: *N*, %)		30 (51.7)	179 (71.6)	209 (67.9)
Education (higher: *N*, %)		33 (56.9)	179 (71.6)	212 (68.8)
Age (*N*, %)	19 and less	0 (0.0)	1 (0.4)	1 (0.3)
	20–29	11 (19.0)	54 (21.7)	65 (21.2)
	30–39	10 (17.2)	133 (53.4)	143 (46.6)
	40–49	29 (50.0)	44 (17.7)	73 (23.8)
	50 and more	8 (13.8)	17 (6.8)	25 (8.1)
Host countries (*N*, %)	United Kingdom	11 (19.0)	61 (24.4)	72 (23.4)
	Norway	8 (13.8)	43 (17.2)	51 (16.6)
	United States	8 (13.8)	40 (16.0)	48 (15.6)
	Sweden	7 (12.1)	17 (6.8)	24 (7.8)
	Spain	7 (12.1)	11 (4.4)	18 (5.8)
	Ireland	4 (6.9)	12 (4.8)	16 (5.2)
	Germany	4 (6.9)	10 (4.0)	14 (4.5)
	Denmark	2 (3.4)	11 (4.4)	13 (4.2)
	**Others*	7 (12.1)	45 (18.0)	52 (16.9)

**15 other countries (Belgium, Holland, Iceland, Australia, Switzerland, Austria, Italy, Canada, New Zealand, Greece, France, Cyprus, Finland, Mexico, and Ukraine) with less than 2 percent (total sample) of respondents each.*

each. Age was recorded in five ranges (from 1 = 19 years and less, to 5 = 50 years and more) and used for further analysis. Education was measured in several levels and coded later into dummy variables (1 = secondary and professional, 2 = higher education).

Methods of Analysis

A comparison of pre-departure and transitioned expat-preneurs' demographic characteristics and push-pull factors was conducted using the Mann–Whitney *U* rank test. Logistic regression was used for measuring the impact of push and pull factors (independent variables), departure period and host country (control variables from the research context), and demographic characteristics like gender, age, and education (control variables) on pre-departure or transitioned SI expat-preneurs' paths (dependent variable).

Results

Comparison Analysis

Two independent groups of pre-departure and transitioned expat-preneurs were analysed according to demographic characteristics and push and pull factors of expatriation. Differences between the two groups were found in cases of gender, age, and education but not in the departure period (see **Table 3**), confirming the Hypothesis 1 (H1).

Comparative analysis results show that pre-departure expat-preneurs were older and less educated than transitioned expat-preneurs, and there were more males than females among them. Looking at the work positions, 15.8 percent of transitioned expat-preneurs worked in the services sector, 14.5 percent studied, and 11.2 percent were specialists in Lithuania before they expatriated. The biggest amount (more than 40 percent) within both groups left Lithuania during the third emigration wave. Of the pre-departure expat-preneurs, 90.7 percent were satisfied with their career, compared to 80.5 percent of transitioned expat-preneurs.

The analysis of all push and pull factors for expat-preneurs' groups (pre-departure and transitioned expat-preneurs) revealed significant differences only for six single factors (see **Table 4**).

We found differences in these economic push factors between expat-preneurs (pre-departure and transitioned). Our results show that a significant pushing effect from expat-preneurs is a non-supportive tax system. This was more important for pre-departure expat-preneurs than for transitioned expat-preneurs. However, having too few employment opportunities was a more important push factor for transitioned expat-preneurs. Similar effects were found in non-economic push factors. Political corruption in Lithuania was a more common non-economic push factor for pre-departure expat-preneurs, while family reasons played a more important role for transitioned expat-preneurs.

Only two non-economic pull factors from the whole group revealed differences between pre-departure and transitioned expat-preneurs, with differences being of the same direction. The higher possibility of self-realisation, as well as host country prestige, revealed a stronger pull effect to pre-departure expat-preneurs than to transitioned ones.

Comparing results in the profiles of pre-departure and transitioned expat-preneurs (see **Figure 2**), differences existed, but in general, they appeared only in the case of six factors from 34, so it confirmed Hypothesis H2, but just for these factors.

Regression Analysis

According to the theoretical model, three models were tested using logistic regression (see **Table 5**). The results showed that push and pull factors (model 1) that differ between pre-departure and transitioned expat-preneurs correctly predicted 81.8 percent of the expat-preneurs' type. Adding demographic variables to the models (model 2 and model 3) raised the prediction up to 86.3 percent with an R square of 0.375.

In all three models, too low employment played an important economic push role on the path of pre-departure and transitioned expat-preneurs. In the first and second models the additional impact of a non-supportive tax system can be seen. The first model also included the impact of political corruption in Lithuania. Hereafter, age and education were significant in the third model, but not gender, improving the R square even more. In summary, all three models represented a good fit and confirmed the impact of tested variables on the types of expat-preneurs.

DISCUSSION

Traditionally, most theories and studies describe foreign entrepreneurs as people who migrate to more developed countries out of necessity. Our results highlight how entrepreneurs from developed countries deepen their motivations, and the differences between pre-departure and transitional expat-preneurs, through a focus on expatriation reasons and demographic characteristics.

Theories about international entrepreneurship, such as the cultural approach and the mixed embeddedness theory, have had a limited empirical evidence so far. Our results support them confirming the relevance of a demographic profile for different types of expat-preneurs. Thus, the analysis of international business activity should include differences between traditional ethnic migrants and new expatriate pre-departure and transitioned entrepreneurs, broadening the scope of the analysis of such theories.

In this line, our results highlight the existence of discrepancies between international ethnic entrepreneurs (South to North) and expat-entrepreneurs (from developed countries), thus contributing to research calling for space to include expat-preneurs in entrepreneurship theories (Andresen et al., 2014, 2020; Vance et al., 2016; Girling and Bamwenda, 2018; Meuer et al., 2019). Some new insights about gender issues were revealed in the study.

The gender issue matters when studying global entrepreneurs. Thus, any overseas venture is a process experienced differently by males and females and therefore could be considered to be sex-selective. Males especially dominate among assigned expatriates. Tendencies have been changing in the last 20 years, and the gender approach in international entrepreneurship processes has become very important. Besides this fact, the data analysis of this study found that more females who were not self-employed

TABLE 3 | Comparative analysis matrix for demographic variables.

	M	*SD*	Mean rank		Mann–Whitney *U*	*Z*
			Transitioned expat-preneurs	Pre-departure expat-preneurs		
Expat-preneurs (0 = transitioned)	0.19	0.39				
Gender (1 = male)	1.68	0.47	160.26	129.66	5809	−2.915**
Education (1 = secondary and professional)	1.69	0.46	158.76	136.12	6184	−2.175*
Age (1 = 19 and less)	3.18	0.87	144.70	193.93	4905	−4.066**
Departure period (1 = until 1990)	3.33	0.95	144.73	156.20	6281.5	−0.977

*$p < 0.05$, **$p < 0.01$.

TABLE 4 | Comparative analysis matrix for expatriation factors.

Expatriation factor	*M*	*SD*	Mean rank		Mann–Whitney *U*	*Z*
			Transitioned expat-preneurs	Pre-departure expat-preneurs		
Non-supportive tax system	0.29	0.45	147.46	184.84	5490	−3.681**
Too few employment opportunities	0.15	0.36	158.10	138.97	6349	−2.367**
Political corruption in Lithuania	0.32	0.47	145.66	192.62	5039	−4.473**
Family reasons	0.22	0.41	157.96	139.59	6385	−1.981*
Higher possibility for self-realisation	0.45	0.50	149.68	175.28	6045	−2.288*
Prestige of host country	0.11	0.32	151.78	166.21	6571	−2.021*

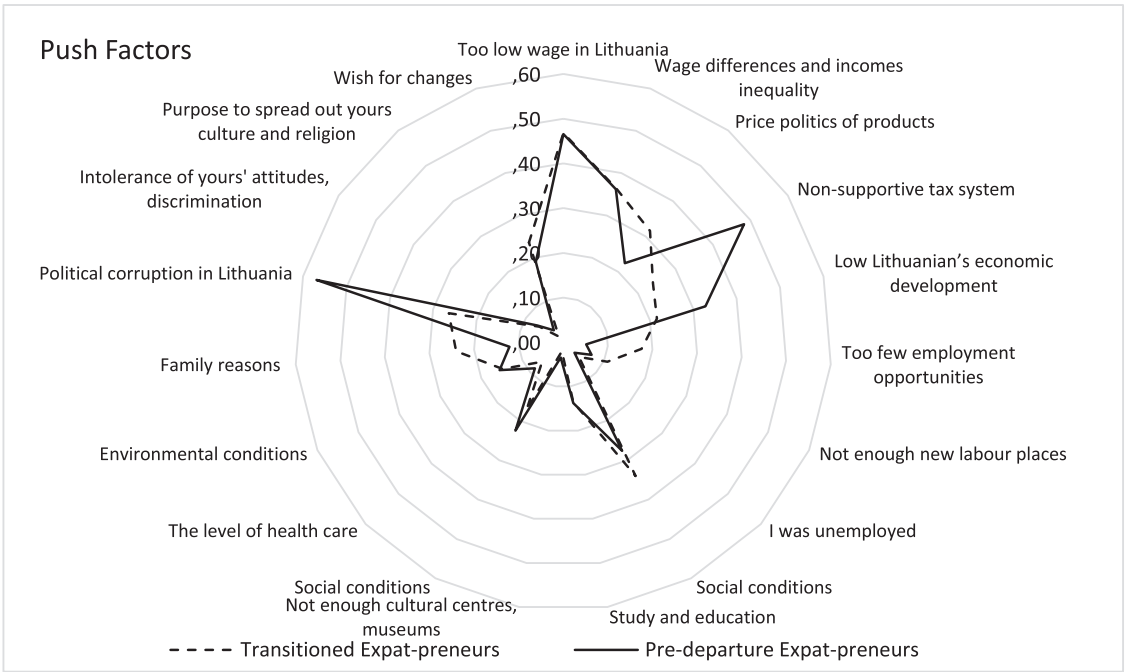
*$p < 0.05$, **$p < 0.01$.

in Lithuania became expat-preneurs in their host countries. This could be explained by the fact that more females left their home country due to family reasons and therefore came to entrepreneurial activities later (Leonard, 2010). Our study revealed that more females are transitioned expat-preneurs. It is probable that after some time spent abroad, females see expat-preneurship as an opportunity to be employed (Lewin, 1998) and/or to take up and follow activities that they have always wanted to do.

No statistical inference was found in education according to gender in our sample. This did not correspond with the findings of Boden and Nucci (2000), who highlight that females are seen as having insufficient education or experience. Such findings provided new insights into expat-preneurs that, based on their nature, they are less necessity-driven entrepreneurs than migrant entrepreneurs are. Expat-preneurs come from developed countries and their education does not depend on gender, and the majority of them have reached a level of higher education. However, these results based on a one country case provided only a few insights and they need deeper analysis and comparison with other developed and developing countries.

Looking at other demographic characteristics, results show that pre-departure expat-preneurs are older and less educated than transitioned expat-preneurs. It partly corresponds with the study of Selmer et al. (2018), which showed that expat-preneurs were older than company-employed expatriates. According to the study, some respondents who graduated from high school abroad and decided to start their own business were younger and more highly educated.

As previously mentioned, the business environment is an important factor for entrepreneurship (Kirkwood, 2009; Patil and Deshpande, 2019). Due to the specifics of our study, analysis was based on expatriation push-pull factors and economic indicators of the home and the main host countries. Political corruption in the home country and a non-supportive tax system were identified as the most important expatriation factors for pre-departure expat-preneurs. This showed that people were looking for better business opportunities abroad. As an example, the 2015 corruption perception index (where 0 means highly corrupt and 100 very clean) was 81 in the United Kingdom, 76 in the United States, 89 in Sweden, 88 in Norway, 75 in Ireland, 81 in Germany, 91 in Denmark, and 58 in Spain in comparison to 59 in Lithuania (Transparency International, 2018). Based on this data, we saw that the main destinations for Lithuanians were less corrupt than Lithuania. It was more complicated to compare tax systems in different countries as they depend on types, size of business, and various regulations in each country. In terms of corporate tax in these destination countries, this varied from the lowest of 12.5 percent in Ireland, up to 40 percent in the United States, with Lithuania having 15 percent (KPMG, 2018). Comparing the ranking of 80 countries in 2019 in terms of where best to start a business, Lithuania was #53, the United States #11, the United Kingdom #13, Sweden #18, Germany #25, and Spain #33 (U.S. News, 2020). However, the business environment is even more important in order to be successful in starting a business. Forbes (2015) provided the list of Best Countries for Business by grading 144 nations on 11 different factors which encourage entrepreneurship [property rights, innovation, taxes, technology, corruption, freedom (personal, trade, and monetary), red tape, investor protection, and stock market performance]. According to these factors, Denmark was #1, Norway #3, Ireland #4, Sweden #5, United Kingdom #10, Germany #18, and the



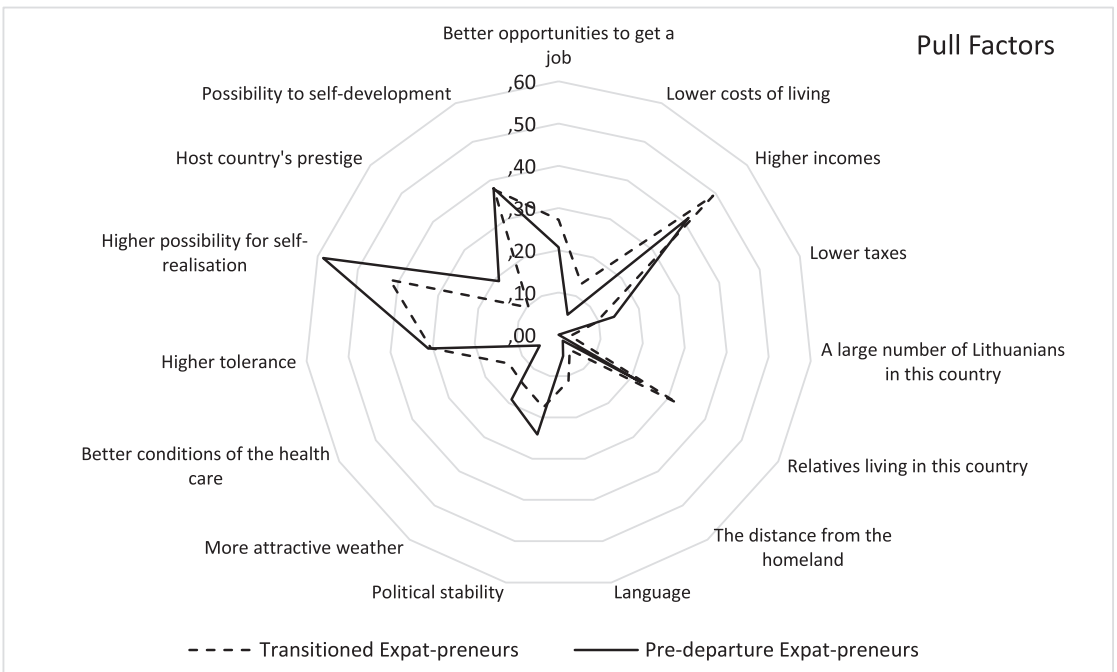


FIGURE 2 | Profiles of pre-departure and transitioned expat-preneurs according to expatriation factors.

United States #22 in 2015. Summing up, based on reviewed factors and the conducted study, Lithuania's general business environment was not very attractive and was the reason for pre-departure entrepreneurship.

The most important non-economic pull factors are a higher possibility for self-realisation and the possibility of self-development. This shows that the sample of analysed self-employed respondents truly represents expat-preneurs, as they left their country of origin for reasons connected with better job opportunities. This could be related to the classical Schumpeter Theory (Girling and Bamwenda, 2018), meaning that pre-departure expat-preneurs pursue better opportunities by establishing themselves in other countries, as does the traditional ethnic migrant. However, research by Stone and Stubbs (2007) on

TABLE 5 | Results of logistic regression.

	Model 1			Model 2			Model 3		
	β	*SE*	Wald	β	*SE*	Wald	β	*SE*	Wald
Constant	−2.093	0.287	53.297**	−1.637	0.597	7.529**	1.009	1.150	0.770
Expatriation (independent) variables									
Non-supportive tax system	0.871	0.351	6.151*	0.864	0.357	5.851*	0.392	0.419	0.878
Too low employment opportunities	−1.954	0.655	8.896**	−2.044	0.662	9.541**	−2.083	0.740	7.925**
Political corruption in Lithuania	0.873	0.353	6.098*	0.799	0.358	4.985	0.668	0.420	2.533
Family reasons	−0.420	0.459	0.839	−0.477	0.465	1.052	−0.635	0.524	1.470
Prestige of host country	0.187	0.440	0.180	0.076	0.455	0.028	0.156	0.505	0.096
Higher possibility for self-realisation	0.561	0.329	2.897	0.603	0.339	3.174	0.687	0.380	3.265
Demographic (control) variables									
Departure period (L)						3.489			4.817
				−18.885	27957.878	0.000	−19.988	27770.198	0.000
				−0.057	0.621	0.008	−1.199	0.703	2.906
				−0.870	0.648	1.803	−1.312	0.720	3.324
				−0.114	0.569	0.040	−0.499	0.587	0.722
Host country				−0.018	0.025	0.494	−0.045	0.030	2.193
Gender							−0.531	0.393	1.822
Age(L)									27.532**
Age(1)							−20.864	40192.970	0.000
Age(2)							−1.904	0.727	6.853**
Age(3)							−2.290	0.644	12.630**
Age(4)							0.072	0.589	0.015
Education							0.889	0.407	4.777*
Nagelkerke R^2		0.192			0.213			0.375	

L, Last category is used as an indicator, i.e., departure period 5, Age 5.
**p < 0.05, **p < 0.01.*

the motivations of 41 British expatriate entrepreneurs managing 71 family businesses in other countries, such as Spain and France, found that, rather than profit, they settled in those countries to improve their lifestyle. According to Schumpeter, all expat-entrepreneurs would have the advantage of possessing innovative and risk-taking skills that enable them to achieve success.

Our results allow us to qualify the assumptions of Schumpeter' Theory and Stone and Stubbs (2007), so that in the case of pre-departure entrepreneurs, they would use their skills to take advantage of the best opportunities that exist in other countries, such as a more favourable tax system, less corruption, and better labour market conditions. But also, in the case of transitioned entrepreneurs (already established in the destination country and without the pressure of home country circumstances), entrepreneurship is motivated by improved lifestyle, greater prestige, and self-realisation.

Implications for Managerial Practice

A deeper understanding of expat-preneur phenomena is useful for both the home and host countries. Received results could be useful for Lithuania, as policy makers should consider the main push factors behind moving business abroad, like political corruption and taxes and their burden. Possible solutions to prevent other entrepreneurs expatriating to other countries as well as how to motivate expat-preneurs to start transnational business and expanding it into home countries might be elaborated. This would help to bring financial and human capital into countries that lose valuable employees, such as Lithuania. In addition, countries in Central and Eastern Europe that experience similar flows and tendencies of expatriation might also benefit from the findings of this research.

In addition, according to Vance et al. (2016, p. 212), 'expat-preneurs can further contribute to the long-term economic health and growth of a host country through knowledge transfer.' They contribute not only knowledge and human capital, but also physical capital, and they pay taxes and contribute toward the development of the host country. According to human capital theory (Chorny et al., 2007), expatriates are young and qualified individuals and, in addition, our study revealed that transitioned expat-preneurs are younger that pre-departure ones. Therefore, the decision to move abroad is an investment because an individual increases his or her employment perspectives (Sjaastad, 1962). Not only countries, but also organisations in Lithuania and CEE countries, need to encourage changes in the areas that influence the factors of expatriation.

CONCLUSION

It should be noted that expatriation is a growing phenomenon in developed countries. People expatriate to where they see better possibilities for employment, self-realisation, and

personal development. Often, these expatriates become self-employed and turn into expat-preneurs. The Lithuanian case presented here, studying the similarities and differences of expat-preneurs, contributes to the exploration of the expatriation process and provides a profile of an expat-preneur. Introducing demographic characteristics helps to forecast the type of expat-preneur. Differences are found in the cases of gender, age, and education. Pre-departure expat-preneurs are older and less educated than transitioned ones. According to the results, more males are pre-departure expat-preneurs and more females are transitioned expat-preneurs.

There are more similarities than differences between the expatriation factors of pre-departure and transitioned expat-preneurs, bridging them more than dividing them. With regard to differences, the results show that pre-departure expat-preneurs are pushed to move abroad because of a better business environment, while they are pulled by the higher possibility of self-realisation as well as the prestige of the host country. At the same time, transitioned expat-preneurs are pushed more by family reasons, along with too few employment/career opportunities.

The present study contributes to the expatriation research field by empirically tested pre-departure and transitioned expat-preneur phenomenon based on their demographic characteristics and decision to leave their home country. Our results extend the scope of traditional theories of entrepreneurship, such as the cultural approach and the mixed embeddedness theory, as well as Schumpeter's theory of the case of expat-preneurs.

Limitations and Guidelines for Future Research

Due to difficulties in directly accessing expat-preneurs, and instead taking them as a sample from a general group of expatriates, not all the questions were connected with their entrepreneurial activities, but this is a very small number among a large number of questions which did not affect the purpose of the research. In addition to a quantitative nature of the research, the majority of respondents had not indicated what kind of business they were in. Therefore, we propose as a future research line to study the diversity and popularity of business types among Lithuanian expat-preneurs. Furthermore, respondents were from 24 different countries. Such a limited geographic spread did not allow an analysis in accordance with countries that might be valuable in exploring the impact of the host country on expatriation decision making. However, this also means some advantages in the study of their demographic characteristics, such as belonging to the same culture. In addition, as indicated in Section "Sample and Procedure," focusing on a small country with high migration rates is convenient for our analysis of push-pull factors and migration. In any case, we would like to extend and replicate this research in the future by including a sample of more countries with similar characteristics, or groups of countries with differences between them.

Decisions to locate businesses in the host and/or home countries usually depend on different tax rates, growth prospects, laws, and attitudes toward foreign businesses (Vemuri, 2014). However, in this case, due to the shortage of time to access expat-preneurs, the push-pull factors were analysed as the reason to expatriate but not in the context of the decision to establish a business abroad. However, we propose as a future line of research the perspective of the destination country. In addition, the time when transitioned expat-preneurs started their business abroad after they moved to the host country was not controlled. Such data would contribute to the exploration of expatriates' entrepreneurship field.

One of the main shortages was a lack of questions about marital status and children. Without this, it was not possible to complete an analysis of the family's impact on the decision of respondents to move and to become entrepreneurs. Gender issues are already partly covered, but they are important in developing this research further as the majority of our expat-preneurs were females. In addition, the gender issue should be studied further in terms of 'entrepreneurial intentions' (Díaz-García and Jiménez-Moreno, 2010) and 'accidental entrepreneur' (Lewin, 1998) differences because females, as previously mentioned according to Bruni et al. (2004), face three main barriers in becoming entrepreneurs. Moreover, there is still a lack of studies into what extent pre-departure and transitioned expat-preneurship in their various forms are influenced by gender.

As for the motivations for expatriation, even taking into account the above limitations, it would be interesting to continue this research by delving into the similarities and differences between different ethnic expatriates, and also expand the sample to other nationalities. For example, corresponding to a cultural approach, Andrejuk (2017) in studying a unique case of EU-15 and the EU-12 entrepreneurs in Poland, revealed that cultural differences play an important role in entrepreneurial success. Also, entrepreneurs from the EU-12 succeeded in their business when they fully integrated into the host communities but expatriates from the United Kingdom and Spain were successful when they employed their cultural heritage. Therefore, more studies on ethnic expat-entrepreneurs would allow the scope of entrepreneurship theories to be extended.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements. Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements.

AUTHOR CONTRIBUTIONS

VK-V, JD, and AMR contributed to the design and implementation of the research, to the analysis of the results, and to the writing of the manuscript. All authors contributed to the article and approved the submitted version.

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The Influence of Quality on eWOM: A Digital Transformation in Hotel Management

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There is no doubt that the use of Internet for purchasing products and services has constituted a crucial change in how people go about buying them. In the era of digital transformation, the possibility of accessing information provided by other users about their personal experiences has taken on more weight in the selection and buying processes. On these lines, traditional word-of-mouth (WOM) has given way to electronic word-of-mouth (eWOM), which constitutes a major social change. This behavior is particularly relevant in the services area, where potential users cannot in advance assess what is on offer. There is an abundant literature analyzing the effects of eWOM on different variables of interest in this sector. However, little is known about the factors that determine eWOM. Thus, the main objective of the present paper is to analyze the impact of two variables (objective quality and perceived quality) on eWOM. Both of them are crucial for potential customers in the process of finding hotel accommodations and they can motivate people to make such comments. The results demonstrate that these variables truly have a significant impact on whether or not users make comments on line. Moreover, it proved possible to observe certain differences according to the profile of the tourist involved and the destination where the hotel is located. In the current changing environment, this information is of great use for hotel managers in order to design strategies according to the type of guest they wish to attract.

Keywords: eWOM, objective quality, perceived quality, on-line comments, digital transformation, management, hotel sector

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INTRODUCTION

Over the last several decades, the Internet has consolidated itself as a world-wide basic means of communication, both for individuals and for businesses. Over time, the growing use of the Internet has implied that more and more customers are becoming hyper-connected across multiple channels, formats and device types, which in turn has meant an important digital transformation. The way people purchase products and services has changed, as they have access to abundant on-line shopping possibilities and a huge amount of information about the personal opinions of previous consumers. Through the Internet, people inform others about their personal experiences relating to certain products or services, information that the latter then use in taking decisions to make a purchase, whether on or off line.

This means of communication has become of particular value in the services area (Voyer and Ranaweera, 2015), with the hotel sector being among those most strongly affected

(Serra-Cantallops and Salvi, 2014). The inseparability of the provision of a service and its consumption makes it particularly difficult to assess a service before making use of it (Litvin et al., 2008; Papathanassis and Knolle, 2011). Hence, having access to on-line messages significantly reduces uncertainty during the decision-making process in these circumstances (Yan et al., 2016; Hussain et al., 2020).

Taking advantage of this situation, a large number of tourist web pages allow their users to generate content in a simple, easy way, giving them control over the information itself, the manner in which it is distributed and the use that web surfers can make of it (Erdem and Cobanoglu, 2010; O'Connor, 2010). This brings with it easy access for potential customers to make comparisons of the quality of tourism services on offer.

As an outcome of this digital transformation, electronic word-of-mouth, termed eWOM, expands the possibilities for communication and the effects already present in traditional word-of-mouth during the purchasing process. Consequently, it has become an increasingly interesting field of study (Breazeale, 2009; Huete-Alcocer, 2017).

In the specific case of tourist accommodations, there are many pieces of work analyzing the effects of eWOM on different variables such as sales or profits (Gu et al., 2012; Yang et al., 2012a; Nguyen and Coudounaris, 2015), willingness to pay (Wu and Ayala-Gaytán, 2013), attitudes toward brands and products (Lee and Youn, 2009; Gavilán et al., 2018), or guests' choice of accommodations (Noone and McGuire, 2014), among other topics. However, few studies have examined the factors that drive consumers' eWOM behavior (Balasubramanian and Mahajan, 2001; Hennig-Thurau et al., 2004) and even fewer have done so with regard to the hotel sector (Hu and Kim, 2018; Yen and Tang, 2019), so there is ample space for more research.

Among the various determinants, service quality has proved to be an important factor in the marketing literature. Potential guests use these data during their decision-making process (Chan and Ngai, 2011), which justifies a more in-depth analysis of their effects on eWOM. Nonetheless, only two previous studies have analyzed its impact on eWOM activities in the hospitality industry (Yen and Tang, 2019; Serra-Cantallops et al., 2020) with no conclusive results. Hence, this paper has as its main aim to contribute to the pool of knowledge about the determinants of eWOM in this sector by investigating the influence of two kinds of quality: (a) objective quality and (b) perceived quality.

Previous research shows that the varied range of customers and hotels present makes it hard to reach generalizable conclusions (Chintagunta et al., 2010; Ghose et al., 2012; Gu et al., 2012; Blal and Sturman, 2014). Thus, these effects were additionally analyzed in relation to the profile of tourists. This has been demonstrated to be an important variable, for example, when modeling on-line review scores (Fang et al., 2016). In this case, travel companions were considered as the differentiating profile characteristic. Furthermore, as in Phillips et al. (2015), hotel location was also taken into account, with four European regions (Northern, Western, Southern and Central) being distinguished.

These features, as well as the use of a high-quality, reliable Europe-wide database, constitute a major contribution of the present paper in comparison to the vast majority of previous work which was in the form of location-based studies (Moro et al., 2017). All this favors generalization of the results and implies an advance in academic knowledge of eWOM. Likewise, from a managerial point of view, the results will be useful in designing strategies that improve the image of hotels and increase room bookings. Being constantly aware of factors that determine customers' opinions and their preferences for hotel services can be the key to surviving in this digital era.

LITERATURE REVIEW

As Internet became established and generalized, and e-commerce grew, there was a striking increase in its use when purchasing goods or services. This behavior has given rise to a new vehicle for exchanging information and opinions among consumers, so that traditional word-of-mouth (WOM), which has demonstrated to be more effective than other marketing techniques (Reichelt et al., 2014), has given way to electronic word-of-mouth (eWOM). It can be defined as "informal communication directed at consumers through Internet-based technology related to the usage or characteristics of particular goods and services, or their sellers. This includes communication between producers and consumers as well as those between consumers themselves" (Litvin et al., 2008, p. 461).

The specific nature of the Internet offers a huge variety of possibilities for communication, which has constituted a disruptive change relative to classic ways of buying (Cheung and Thadani, 2012; Yan et al., 2016). It allows access to information without limitations in time, as it can be synchronous or asynchronous (Litvin et al., 2008). Another characteristic relates to the number of individuals it connects: one-to-one (such as e-mails or instant messages), one-to-many (for example, websites), or many-to-many, as in the case of forums, blogs, virtual communities, and similar (Chan and Ngai, 2011; Moliner et al., 2015). Furthermore, this communication is no longer just among friends and acquaintances (Chan and Ngai, 2011), but can include contacts with numerous individuals, who may even be anonymous. On these lines, various marketing researchers have investigated the impact of such social ties in relation to consumers' decision-making processes (Pasternak, 2017; Hussain et al., 2020). As a result of this communication, the way in which a decision to buy is made has changed considerably. Potential customers can access information about the features and uses of given products or services. Even more interesting, they can find out the opinions and assessments of people who have already bought and made use of them. Consequently, much more information is available to potential customers, which can be very useful to them in establishing their own perceptions of a business and its products (Li and Bernoff, 2008).

Specifically, in the tourism sector, this digital transformation has led to the sharing of opinions about personal experiences over the Internet as a widespread practice and eWOM has proven to be of great importance when the aim is to search for information about such experiences (Bronner and de Hoog, 2010). Since the early 2000s, a number of pieces of work concerning tourism

services have highlighted the influence that recommendations from other consumers have over the making of a purchase decision by potential tourists (Litvin et al., 2005, 2008). In the particular case of hotel services, eWOM is a key aspect that requires great attention from managers, in order to carry out continuous improvements and develop a good reputation in the market (Park and Allen, 2013; Reyes-Menéndez et al., 2019). According to Bronner and de Hoog (2013), the importance of this type of information channel will increase when a product or service is characterized by three aspects: accessibility, relevance and experience, which is a perfectly fit in the case of hotel services.

From an academic perspective, studies have focused primarily on two dimensions of eWOM activities: eWOM volume and eWOM valence. On these lines, both the number of comments made by consumers and their ratings or feelings incorporated in their comments are key aspects. For example, Nieto et al. (2014, 2017) discovered that ratings and the number of reviews affected consumers' decisions to purchase in tourism. They demonstrably improved profitability, satisfaction and business performance (Nieto et al., 2014) and affected the consumer's willingness to pay for hotel services (Nieto et al., 2017).

With regard to the effects of the valence, there are no conclusive results so far. On the one hand, positive comments do improve attitudes toward hotels (Vermeulen and Seegers, 2009; Gavilán et al., 2018), and increase the number of reservations made (Torres et al., 2015), market share (Duverger, 2013), and sales (Duverger, 2013; Nguyen and Coudounaris, 2015). On the other hand, a hotel's reputation becomes worse the greater the relative weight of negative comments, as against positive (Rose and Blodgett, 2016). Negative comments have a more persuasive effect than positive or neutral (Park and Nicolau, 2015). They seem more credible and impactful than positive views and this negative impact is stronger in the case of services than of physical goods. However, other authors conclude that complaints or negative comments are almost never used and the majority of the comments posted are recommendations (Bronner and de Hoog, 2010, 2013). Furthermore, a third possibility for eWOM can be considered, occurring when both positive and negative comments are present at the same time (Liang and Corkindale, 2019; Roy et al., 2019).

In respect of their number, prior research results seem to be clearer. It has been demonstrated that in general the volume of comments positively affects the sales of products, their popularity and awareness of them (Duan et al., 2008). In the case of hotels, the larger the total of on-line comments made about a hotel, the more positive views there are (Melián-González et al., 2013), the greater is preference for that hotel (Vermeulen and Seegers, 2009; Viglia et al., 2014) and the larger is the improvement in credibility (O'Connor, 2010). In consequence, the number of comments about hotels is an eWOM indicator that managers must keep strongly in mind. Its noteworthy influence on potential consumers' opinions, especially in the case of products requiring information about previous experiences to ascertain their value (Yang et al., 2012a), merits a deeper understanding. For these reasons, this is the central variable of our study.

Research that addresses user-generated product reviews follows two major lines of investigation (Serra-Cantallops and Salvi, 2014): (a) the perspective of information senders, so as to analyze the motivations for generating and posting reviews (Cheung and Lee, 2012), and (b) the perspective of information receivers, so as to examine the adoption of such messages and the consequences for consumers and companies (Senecal and Nantel, 2004; Cheung et al., 2008). In marketing and communication literature, much has been written about the effects of eWOM. However, just a few studies have examined factors that drive consumers' eWOM behavior (Balasubramanian and Mahajan, 2001; Hennig-Thurau et al., 2004). In this way, many authors have pointed out that despite its practical relevance, the antecedents of eWOM have received much less attention than its effects (Yang, 2013; Fu et al., 2015; Chu and Kim, 2018; Hussain et al., 2020). In the field of tourism, there are recent studies that go into the background of eWOM (Yang, 2013; Munar and Jacobsen, 2014; Lee and Oh, 2017; Dixit et al., 2019). Nevertheless, very few have done so specifically in the context of hotel services (Hu and Kim, 2018; Yen and Tang, 2019). Hence, the present paper attempts to address this research gap by focusing on the factors that lead to eWOM behavior in this sector.

The prior literature on motivations for eWOM examines the underlying personal determinants of individuals' willingness to make such comments (*personal factors*). Regardless of the industry involved, the most important motives are entertainment, social ties, information, trust, social interaction, desire for economic incentives, interpersonal influence, concern for other consumers, and the potential usefulness of approval, among others (Hennig-Thurau et al., 2004; Chu and Kim, 2011; Lien and Cao, 2014). In the hospitality industry, factors such as altruism (Munar and Jacobsen, 2014; Bilgihan et al., 2016), enjoyment and economic incentives (Park et al., 2011; Dixit et al., 2019), sociodemographic characteristics (Nusair et al., 2011), social characteristics of the person (Kim and Tussyadiah, 2013), a sense of belonging to a community, social identity and a feeling of helping other consumers or enterprises (Serra-Cantallops and Salvi, 2014), have been identified.

However, little is known about the possible influence of other sorts of variables that might be called *specific service-related factors* (Serra-Cantallops et al., 2020). These determinants can differ, depending on the sector in question, because eWOM motivations are industry based (Harrison-Walker, 2001). According to Hofacker and Belanche (2016), it is important to analyze the antecedents and effects of eWOM, but it is also crucial to pay attention to those factors that may assist managerial efforts to encourage consumers to create content. Hence, in the hospitality sector, the characteristics of the hotel, which are specific service-related factors, may be more relevant than personal aspects from the point of view of hotel managers, because they control these factors (Serra-Cantallops et al., 2020).

In this way, one key aspect that should be considered is the quality of the service offered by the hotel (Serra-Cantallops et al., 2020). Service quality is a central marketing concept that has attracted continual research interest in the field of hospitality. It can be defined as "an overall judgment or an attitude relative to the superiority of a service" (Parasuraman et al., 1988, p. 16). On the one hand, many consumers resort to on-line comments to reduce risk and uncertainty when selecting a hotel and

validating its quality (Kim et al., 2011). On the other hand, the quality of the service can also determine tourists' opinions and their level of contentment. Parasuraman et al. (1985) believed that service quality is a result of comparisons between consumers' expectations and the actual services provided. In accordance with the theory of expectancy disconfirmation, a comparison between prior expectations and the perceived level of service received during consumption constitutes the degree of satisfaction of customer (Parasuraman, 1997). In marketing literature, it is widely accepted that satisfaction and perceived quality are strongly interlinked and various previous studies demonstrate that quality has a significant impact on the degree of satisfaction and on consumer loyalty (Moliner et al., 2015; Ziqiong et al., 2015; Serra-Cantallops et al., 2018). In turn, these variables are related to an intention to make recommendations through inter-personal communication after a virtual purchase (Godes and Mayzlin, 2004; Moliner et al., 2015). Businesses fully understand this prime role for quality as a determining factor for making suggestions and comments on the Internet (eWOM). Firms in the tourist sector are putting great efforts into designing communication strategies for improving the quality of the services offered. However, academic research in this area is still far from extensive, as most of the studies have focused on restaurants and have hitherto yielded no conclusive results (Jeong and Jang, 2011; Zhang et al., 2014; Kim D. et al., 2015).

It would appear that only just two previous studies have analyzed the influence of service quality on eWOM behavior in the specific context of hotels. Yen and Tang (2019) deduced that a good performance of hotel's attributes, as indicators of service quality, had a positive effect on eWOM. On the other hand, Serra-Cantallops et al. (2020), in the context of upper-class hotels, found no positive relationship between these two constructs. Their results showed that, although service quality is crucial for consumer satisfaction, it is not a determinant of positive eWOM. This lack of conclusive results makes the topic very interesting.

The present study builds on this literature stream. Following the recommendations of Serra-Cantallops et al. (2020) it is proposed to take a step forward in the analysis of the relationship between a hotel's quality and eWOM by distinguishing between objective quality and perceived quality. In respect of the former, in the hotel sector the category or "star rating" assigned reflects this kind of quality, so that all potential tourists are likely to use it as an objective indicator for this feature. The existence of a standard classification of hotels gives potential customers an idea about the intrinsic quality of establishments, and allows managers to design different strategies based on the higher or lower category of their hotels (Öğüt and Tas, 2012). This variable is important from the eWOM viewpoint because there are differences in consumer behavior as an outcome of the objective quality assigned to the hotel. From the angle of eWOM adopters, previous studies have demonstrated that customers of top-category hotels (high objective quality) mostly select accommodations on the basis of strongly positive assessments, while for medium and low category hotels the overall number of on-line comments is more important (Blal and Sturman, 2014). However, little is known about the effects of this variable upon the decision to make online comments.

Various authors accept that European hotel classification constitute a measure of objective quality (Abrate et al., 2011). However, the process of standardizing categories for accommodations around the world is proving to be an arduous task. There are efforts to control and standardize the quality of hotels through a star rating. However, failures to review and update the category assigned to a given hotel make this assessment difficult. Thus, star ratings sometimes become an ambiguous signal of quality for tourists, which may cause differences between customers' expectations and the star rating assigned to a hotel. For this reason, it is also crucial to take into account the quality perceived by customers.

It is possible to define perceived quality as the personal assessment made by a customer of the overall quality of the product or service received (Zeithaml, 1988). This is an important element determining consumer decisions (Susilowati and Sugandini, 2018), especially in the case of services. In these circumstances, the provider knows the real quality of the service while potential customers do not (Öğüt and Tas, 2012; Bronner and de Hoog, 2013), so they use this information as a benchmark for the hotel's quality perceived by those who have already been guests (Bansal and Voyer, 2000). For this reason, on-line comments have become one of the most influential variables affecting brands (Rose and Blodgett, 2016). They come from customers who have previously made use of a service and voluntarily decide to express their opinions about it, which confers great credibility on their views (Sparks and Browning, 2011; Ye et al., 2011).

In this context, the attributes classically used as indicators of a hotel's quality are cleanliness, location, services, characteristics of the room and the hotel in general, security, reputation, and the attentiveness of staff, among others (McCleary et al., 1993; Lockyer, 2005; Wilkins et al., 2010). All of these are important for tourist perceptions of quality, since they have an impact on brand value, their overall experience, their willingness to pay a given price, and on the process of building customer loyalty (Berry, 2000; O'Connor, 2010). One way of getting to know the quality perceived by guests relative to these attributes of a hotel is sentiment analysis. This methodology involves analyzing unstructured contents generated by users (Schuckert et al., 2015; Pelsmacker et al., 2018; Al-Natour and Turetken, 2020). It concentrates on a review of the text of comments made by tourists so as to identify the sense of their feelings toward the hotel involved (positive, neutral or negative), as also the intensity of these feelings (Kirilenko et al., 2018). From this analysis it is possible to identify their degree of satisfaction and the value they set on their experiences (Xiang et al., 2015; Berezina et al., 2016; Geetha et al., 2017). Similarly, it makes it feasible to learn their opinions on the specific characteristics of the hotel that give rise to that level of satisfaction or dissatisfaction (Sparks et al., 2016; Luo et al., 2020). This to some extent reflects the results of comparing their prior expectations about the hotel with their real experiences.

In academic circles there is growing interest in attempts to demonstrate a positive correlation between text comments

and numerical ratings (Kim H.-S. et al., 2015; Lee et al., 2017; Yoon et al., 2019). This would allow unstructured qualitative data about users' opinions to be transformed into quantitative scores. In the context of hotels, López Barbosa et al. (2015) used sentiment analysis to investigate the presence of correlations between numerical ratings and textual comments. The results they obtained confirmed there was such a relationship. In similar fashion, Geetha et al. (2017) examined the connections between the feelings expressed in text-based reviews and the number scores for two categories of hotels: premium and economy. Their results also showed that there was consistency between the scores given and clients' actual feelings.

On this point, it is worth noting that on-line booking systems also allow access to the scores given and the comments made by former guests on the Internet about various aspects of hotels (Vermeulen and Seegers, 2009; Öğüt and Tas, 2012). It is therefore possible to make use of these scores as a good indicator of guests' perceptions about a hotel's quality when textual comments are not available, as is the present case. Ratings represent a guest's level of satisfaction (Reichheld, 2003; Ganjalyan, 2018; Shen et al., 2018) and researchers in marketing agree that satisfaction and perceived quality are highly interconnected (Serra-Cantallops et al., 2020). These data can thus be used as indicators of this kind of quality. On similar lines, some previous studies have concluded that eWOM has a significant effect on perceived quality (Susilowati and Sugandini, 2018). However, there do not appear to be any previous studies considering the inverse relationship.

In view of the above, it seems clear that quality, whether objective or perceived, is a key element in the degree of satisfaction of tourists. Consequently, it may be surmised that it will have an impact on their intention to record their happiness or unhappiness with regard to these aspects through online comments. Hence, it is to be expected that both types of quality would influence the decision to take part in eWOM. On this assumption, the following may be hypothesized:

H1: The objective quality of a hotel has a significant influence on eWOM relating to it.

H2: The perceived quality of a hotel has a significant influence on eWOM relating to it.

Figure 1 shows our research model:

As previously indicated, the expectations of hotel users may vary as a function of customer segment, hotel characteristics or both (Chintagunta et al., 2010; Gu et al., 2012; Blal and Sturman, 2014), so that is of some importance to take account of these aspects. Hence, analyses complementary to the two hypotheses quoted above were carried out. The aim was to investigate whether results differed as an outcome of the tourist profile (according to the travel companions) and a hotel's geographical location within the European Union as North, West, South or Center, in accordance with the pattern of regions and sub-regions that the World Tourist Organization uses to divide up the map of world tourism (UNWTO, 2018).

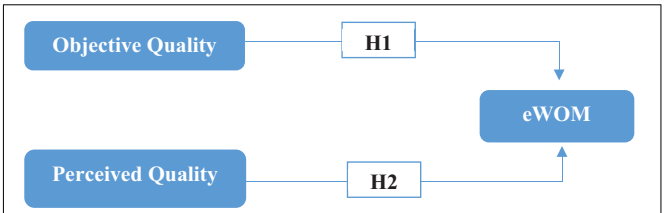

FIGURE 1 | Hypothesized research model.

DATA AND METHODOLOGY

Sample

There are currently a good number of on-line intermediaries that allow users to make hotel reservations directly in any part of the world. Among these websites, Booking.com was chosen for this study, as it is the world leader in on-line hotel reservations. It is a reliable, high-quality database, two important aspects when it comes to adopting information (Erkan and Evans, 2016). The site is available in forty-three languages and offers more than five million hotels, apartments and other types of accommodations, located in more than 120,000 destinations and 229 countries.

The website provides information both on an aggregate basis for all tourists having visited a given hotel, and by customers segments according to accompaniment. This latter distinguishes between people traveling alone, with friends, as a couple, or with children. Additionally, the site gives details of other variables, such as price, star rating and location of the hotel.

Figure 2 shows schematically the process used to obtain data. The data collecting process took place in May 2018 and the services of a specialized company were hired to obtain the necessary data to carry out the present study. This company developed a software solution tailor-made for the project, a web-crawler[1]. This software made possible automatic extraction of the relevant details from each webpage and the creation of a database to organize the information gathered. The crawler was developed using *Ruby onRails* technology that receives the identity (*id*) of a capital city from Booking.com as a seed and simulates a search for it. The search results page directly yielded the necessary data. A MySQL database, created specifically for the task, stored all the information obtained.

The criteria indicated here were used to obtain the final sample. Since Booking.com permits reservations at hotels in any country in the world, the first criterion was to select hotels located in countries in the European Union. The next was to identify those situated in the capital cities of each of these countries[2]. Thereafter, STATA 14 was used to eliminate any hotels not

[1]A web-crawler is a system capable of running in a planned way through a set of resources (including videos, tables, and other items). These resources may be local or remote, for instance URLs. In general, the crawler downloads contents only if they appear relevant to its objective. Moreover, by definition, a web-crawler is able to discover resources that are related and relevant to its application.

[2]These were Northern Europe (London, Dublin, Stockholm, Helsinki, and Copenhagen), Western Europe (Paris, Luxemburg, Brussels, Amsterdam, Berlin, and Vienna), Southern Europe (Madrid, Lisbon, Rome, Athens, Ljubljana, and

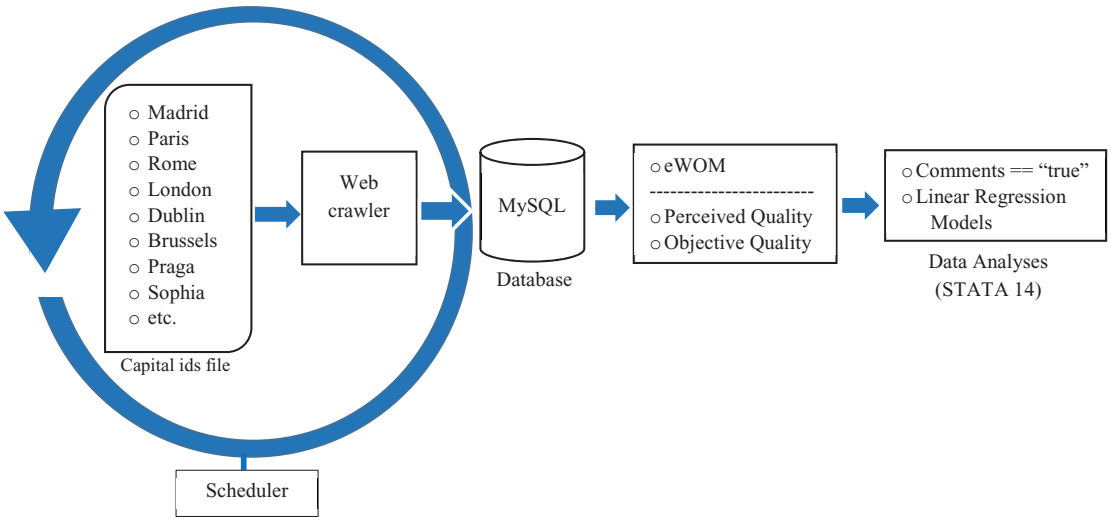

FIGURE 2 | Data collection process.

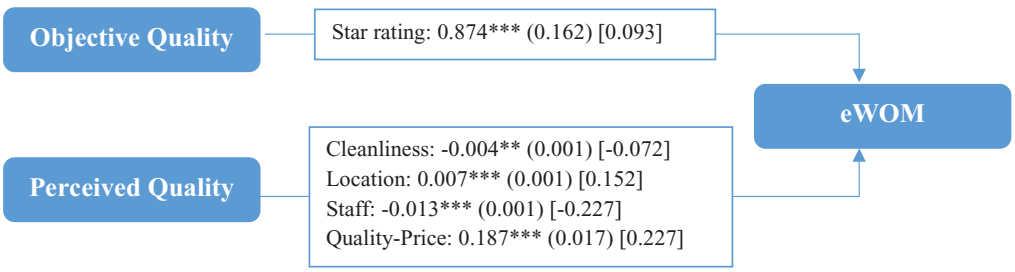

FIGURE 3 | Regression model for factors determining eWOM. Results of the hypothesized model. ***$p < 0.001$; **$p < 0.05$. The values outside the brackets are unstandardized coefficients, those in parentheses are standard errors, and those in brackets are standardized coefficients.

providing data on all of the variables of interest. In this way, a final sample was compiled of 1,718,779 individuals who had posted a comment after a stay in a hotel reserved through Booking.com. The outcome was that in total 5,509 hotels were analyzed.

Variables and Model

The aim was to determine the effects of different variables on eWOM. Consequently, in measuring the variables chosen, account was taken of the following criteria[3]. A discrete quantitative variable, the number of comments made for each of the hotels in European capital cities available through Booking.com, gave a value for the dependent variable, eWOM.

With regard to the explanatory variables, objective quality was measured by using a discrete quantitative variable reflecting the category of the hotel in terms of the number of stars (values from 1 to 5). This categorization is widely accepted in the European Union, with no major differences between the schemes for awarding stars used in the various countries (Arcarons i Simón et al., 2008). Secondly, it is widely accepted the use of online customer ratings as a signal of quality (Öğüt and Tas, 2012). Therefore, four indicators of perceived quality were utilized, these being: cleanliness, location, staff and the relationship between quality and price. These are continuous quantitative variables showing the scores given by customers on a scale from 0 to 10 (0 being the lowest score and 10 the highest).

In addition, the model included a series of control variables, one referring to price, four to the location of the hotel, and six relating to the profile of the customer. No previous studies analyzing the influence of these variables on eWOM appear to exist. Nevertheless, there is no doubt that they are key variables in the process of selecting a hotel, so that the model should include them. The price refers to the cost of a double room, and it is a continuous quantitative variable expressed in euros. With regard to the location of the hotel by sub-region of the European Union, four dummy variables were used (Central, Southern, Northern and Western), taking the value 1 when the hotel was located in the given sub-region and 0 when it was not. Finally, the model also included six variables representing the percentage of each

Valletta) and Central Europe (Warsaw, Prague, Bratislava, Bucharest, Budapest, Sophia, Vilna, Riga, and Tallinn).

[3]Certain variables were normalized using the following transformations: (1) the square root of the variables: number of comments, price, families with small children, families with older children, mature couples, young couples and tourists traveling alone, (2) the cube of: cleanliness, location and staff, (3) the square of: quality-price relation, and (4) the logarithm of groups of friends.

type of customer relative to the total sample according to the profile of tourist[4].

In the light of this information, the intention was to check the hypotheses put forward, using a linear regression model to determine the effects of the different variables on eWOM. Additionally, a second series of linear regression models is presented, taking into account the various segments of tourists and sub-regions of the European Union, with an eye to complementing the results obtained from the main analysis. All the statistical analyses were carried out using STATA 14.

RESULTS

The first linear regression model shown in **Table 1** reflects the effects of the variables considered on the number of comments made (eWOM) for the sample of hotels in the European Union. This **Table 1** includes both standardized Beta coefficients, and non-standardized coefficients, as well as Student's *t*-values and levels of significance. In addition, robust standard errors were also calculated in order to control for heteroscedasticity in the model and ensure its robustness. In respect of the quality of the regression model, corrected R^2 showed that the variables selected explained 21.6% of the variance of the dependent variable. The Snedecor F statistic had a value of 107.95. This demonstrates that there is a significant linear relationship between the dependent variable and the group of independent variables. Thus, the model proposed does serve to explain participation in eWOM by means of the variables chosen. Additionally, even though all variables were standardized, the variance inflation factors (VIFs) were checked in each of the regression equations. The data gave no evidence of multicollinearity, the highest Variance Inflation Factor (VIF) having a value of 4.62 (mean 4.55e + 12) for the pooled sample.

The results obtained confirmed both of the hypotheses proposed in relation to objective quality and perceived quality, as shown in **Figure 3**. With regard to objective quality measured in terms of the star rating, a significant positive relationship was seen to exist between this quality and eWOM, bearing out hypothesis H1. This result indicates that the higher the objective quality of the hotel, the more comments customers make, which leads to the conclusion that tourists of this kind are more demanding. In respect of the second hypothesis, all the variables proved to be statistically significant, even if their signs varied, which would also confirm hypothesis H2. It is possible to see how some variables representing the quality perceived by tourists, such as scores for location and the price to quality relationship, had a significant positive influence. This implies that higher scores for these variables increased the number of comments, favoring eWOM. In contrast, higher ratings for cleanliness and staff had a significant negative impact on eWOM. In these cases, the higher the perceived quality in respect of these variables, the smaller the number of comments made by tourists. Thus, all of these variables are of importance for tourists when selecting hotels, since they have a significant influence on the number of comments, in some cases when the customer is satisfied and in others when the hotel fails to come up to expectations with regard to particular features.

The values for standardized Beta coefficients, which permit comparisons of the relative impact of the different variables included in the model independently of their measurement units, show that the variable representing the relationship between quality and price had the greatest influence on eWOM, followed by staff. The results indicate that customers were particularly interested in stressing their favorable opinions about the relationship between quality and price. In contrast, tourists made more comments if they were unhappy with the service or the treatment they received from the hotel's staff.

With regard to the control variables, the first point of interest is that price has a significant negative influence on the number of comments. The higher the price, the fewer comments customers make. For its part, when the destination where the hotel was located lay in Northern or Western Europe, as against Central Europe, this had a significant positive influence over whether comments were made about it. Moreover, young couples were the most highly involved in eWOM activities, an unsurprising result because their age would make them more accustomed to using new technologies. The comments made in the following section go deeper into all these aspects.

In order to take into account the possible effects of tourist profile and to ensure if our main findings are robust, we estimate our model using several different subsamples according to travel companions. **Table 2** shows the regression models taking into account the different profiles of travelers. In this case, the R^2-values indicate that the variables selected explain 14.4, 17.1, 18.6, 11.2, 11.8, and 12.2% of the variance of the dependent variable for each type of tourist profile, respectively. In all the models Snedecor's F statistic indicates the existence of a linear relationship between the dependent variable and the explanatory variables taken together. Hence, the six models proposed serve to explain the influence of the chosen variables over the number of comments (eWOM), according to the tourist profile.

These analyses also confirm the two proposed hypotheses, which guarantees the robustness of our results. As can be observed, the two explanatory variables have a significant effect on eWOM and their corresponding positive or negative effect remains the same as in the general model, independently of the tourist profile. By type of tourist, consideration of the standardized Beta coefficients indicates that, regardless of whether tourists were traveling alone or in company, the explanatory variable with greatest influence on the eWOM, and moreover with a positive impact, continued to be the relationship between quality and price.

However, it is possible to note some differences with regard to the second weightiest variable by tourist profile. For families with small children, young couples, groups of friends and people traveling alone, the second most important variable was staff, with a negative impact. Such guests made fewer comments the happier they were with the treatment they receive from hotel's staff. In contrast, for families with older children, location became

[4](a) Families with small children, (b) families with older children, (c) mature couples, (d) young couples, (e) groups of friends, and (f) tourists traveling alone.

TABLE 1 | Regression model for factors determining eWOM.

	Non-standardized coefficients		Beta standardized coefficients	Parametric tests	
	B	Robust standard errors		*t*	Sig.
Constant	−16.624	1.267	–	−13.26	0.000
Star rating	0.874	0.162	0.093	5.545	0.000
Cleanliness	−0.004	0.001	−0.072	−2.82	0.005
Location	0.007	0.001	0.152	11.41	0.000
Staff	−0.013	0.001	−0.227	−10.98	0.000
Quality-price	0.187	0.017	0.277	12.02	0.000
Price	−0.193	0.037	−0.108	−6.15	0.000
Southern	3.296	0.318	0.162	9.84	0.000
Northern	7.127	0.409	0.364	20.09	0.000
Western	6.616	0.359	0.366	18.98	0.000
Fam. small children	0.481	0.115	0.064	4.25	0.000
Fam. older children	1.410	0.120	0.177	11.81	0.000
Mature couples	1.038	0.102	0.145	9.79	0.000
Young couples	1.557	0.087	0.222	16.94	0.000
Groups of friends	1.734	0.255	0.101	7.20	0.000
	N	R^2	$R^2{}_a$	*F*	Sig.
	5,509	0.216	0.214	107.95	0.000

The variables "Central" and "Tourists traveling alone" acted as reference variables.

TABLE 2 | Regression model for factors determining eWOM by tourist profile.

	Families small children	Families older children	Mature couples	Young couples	Groups of friends	Tourists alone
Constant	–	–	–	–	–	–
Star rating	0.095***	0.056***	0.224***	0.121***	0.040*	0.094***
Cleanliness	−0.094***	−0.143***	−0.026	−0.102***	−0.150**	−0.061**
Location	0.116***	0.183***	0.198***	0.108***	0.158***	0.148***
Staff	−0.142***	−0.127***	−0.125***	−0.163***	−0.217***	−0.198***
Quality-price	0.383***	0.340***	0.249***	0.371***	0.295***	0.214***
Price	0.006	−0.015	−0.082***	−0.058**	−0.094***	−0.142***
Southern	0.194***	0.187***	0.239***	0.272***	0.131***	0.153***
Northern	0.289***	0.394***	0.385***	0.307***	0.330***	0.365***
Western	0.221***	0.242***	0.363***	0.334***	0.208***	0.412***
N = 5,509	R^2	R^2	R^2	R^2	R^2	R^2
R^2	0.144	0.171	0.186	0.112	0.118	0.122
F- Snedecor	122.8***	148.4***	158.1***	86.4***	64.0***	83.7***

*** $p < 0.001$; ** $p < 0.05$: * $p < 0.1$. *Beta standardized coefficients are presented. The models were calculated using robust standard errors.*

the second most influential variable, with a positive impact on the number of comments. The same was true for star ratings in the case of older couples, with a positive impact on eWOM, as these guests can be more demanding because of their personal status and the higher categories of the hotels they tend to use. However, it is striking that cleanliness was not a significant variable for this group of tourists. The explanation for this is likely that they were staying at hotels in the higher categories, where this aspect would be guaranteed.

With regard to the control variables, it should be noted that the absolute price was also not significant for families with children, whatever their ages, while the relationship between quality and price was of significance. With regard to location, it is possible to observe that tourists traveling to capital cities in Northern and Western Europe were those who made the largest number of comments. All categories of tourists shared this trend.

Finally, **Table 3** shows the various models that take into account the sub-regions of Europe in which the hotels assessed were located. Because of the volume of information provided in this table, **Table 4** offers a summary of the main results from these models to assist in interpreting them.

This is a preliminary analysis that will likely lead to future research. It is a first approach to studying the influence that may be exercised by profile characteristics of tourists and hotels over participation in eWOM. The results show that even if these market segmentations are incorporated, the two hypotheses put forward continue to be confirmed. In addition, the most striking result is that the relationship between quality and price was

TABLE 3 | Regression models for factors determining eWOM by tourist profile and hotel location.

	Central						Southern					
	SC	**OC**	**MC**	**YC**	**GF**	**TA**	**SC**	**OC**	**MC**	**YC**	**GF**	**TA**
Constant	–	–	–	–	–	–	–	–	–	–	–	–
Star rating	0.016	−0.022	0.219***	0.155***	0.027	0.109**	0.349***	0.263***	0.346***	0.277***	0.212***	0.308***
Cleanliness	−0.107**	−0.207***	−0.113**	−0.146***	−0.153***	0.026	−0.016	−0.083*	0.096**	0.007	−0.060	−0.010
Location	0.067*	0.212***	0.216***	0.093**	0.166***	0.157***	0.132***	0.235***	0.258***	0.144***	0.234***	0.163***
Staff	−0.090**	−0.053	−0.059	−0.090**	−0.203***	−0.169***	−0.170***	−0.122**	−0.242***	−0.225***	−0.289***	−0.251***
Quality-price	0.538***	0.459***	0.283***	0.359***	0.274***	0.142**	0.313***	0.324***	0.246***	0.365***	0.317***	0.298***
Price	0.105**	0.120**	0.074*	0.079**	0.094**	−0.029	−0.137***	−0.094**	−0.117**	−0.140***	−0.180***	−0.238***
N	1,267	1,267	1,267	1,267	1,267	1,267	1,261	1,261	1,261	1,261	1,261	1,261
R^2	0.216	0.209	0.212	0.132	0.081	0.049	0.178	0.174	0.214	0.142	0.153	0.137
	Western						**Northern**					
	SC	**OC**	**MC**	**YC**	**GF**	**TA**	**SC**	**OC**	**MC**	**YC**	**GF**	**TA**
Constant	–	–	–	–	–	–	–	–	–	–	–	–
Star rating	0.019	0.0147	0.184***	0.006	−0.025	−0.015	−0.062*	−0.087**	0.091**	0.023	−0.102**	−0.022
Cleanliness	−0.132***	−0.160***	−0.065	−0.105**	−0.215***	−0.120**	−0.044	−0.067	−0.016	−0.123**	−0.101*	−0.28
Location	0.085**	0.143***	0.173***	0.067**	0.080**	0.133***	0.213***	0.213***	0.192***	0.172***	0.212***	0.211***
Staff	−0.100**	−0.097**	−0.066*	−0.133***	−0.128***	−0.200***	−0.250***	−0.284***	−0.136**	−0.251***	−0.283***	−0.216***
Quality-price	0.363***	0.357***	0.252***	0.354***	0.331***	0.235***	0.316***	0.249***	0.228***	0.366***	0.192***	0.116**
Price	0.111***	0.021	−0.040	0.046	−0.030	−0.082**	0.009	−0.016	−0.112*	−0.109**	−0.110**	−0.127***
N	1,856	1,856	1,856	1,856	1,856	1,856	1,125	1,125	1,125	1,125	1,125	1,125
R^2	0.087	0.086	0.109	0.063	0.069	0.056	0.091	0.083	0.077	0.095	0.136	0.073

****$p < 0.001$; **$p < 0.05$; *$p < 0.1$. Beta standardized coefficients are presented. The models were calculated using robust standard errors. SC, Families with Small Children; OC, Families with Older Children; MC, Mature Couples; YC, Young Couples; GF, Groups of Friends; TA, Tourists traveling alone.*

TABLE 4 | Summary of the most influential variables by tourist profile and hotel location.

	Europe			
	Central	**Southern**	**Western**	**Northern**
Fam. small children	Quality-price (+)	Star rating (+)	Quality-price (+)	Quality-price (+)
Fam. older children	Quality-price (+)	Quality-price (+)	Quality-price (+)	Staff (–)
Mature couples	Quality-price (+)	Star rating (+)	Quality-price (+)	Quality-price (+)
Young couples	Quality-price (+)	Quality-price (+)	Quality-price (+)	Quality-price (+)
Groups of friends	Quality-price (+)	Quality-price (+)	Quality-price (+)	Staff (–)
Tourists traveling alone	Staff (–)	Star rating (+)	Quality-price (+)	Staff (–)

generally the variable with the greatest influence over the number of comments, having a positive effect, regardless of the sub-region in which the hotel evaluated was located and of the tourist profile. However, consideration of the second most influential variable for eWOM shows a greater number of differences (see **Tables 3**, **4**).

In the case of Western Europe, the second most important variable for families with children, whatever their ages, and for groups of friends, was cleanliness, which exerts a negative effect on eWOM. Likewise, the staff variable had a negative influence on eWOM for young couples and people traveling alone. For mature couples, the objective quality (star rating) was the second most important variable, with a positive sign. In the case of Central Europe, the quality-price relation was also the most influential in all cases except for people traveling alone, for whom it was staff, with a negative impact. Additionally, there were clear differences by tourist profile in respect of the second most important variable.

In Southern and Northern Europe, the results were not so homogeneous, which prevents the drawing of general conclusions. In the first area, the South, quality-price relation and star rating came in the first two positions, varying between first and second by type of customer profile. For families with young children, older couples and people traveling alone, the variable star rating was the most influential. However, for all other groups, the relationship between quality and price held this position. In Northern Europe, the prime position went to the quality-price relation for families with small children, mature couples and young couples, with a positive effect here too. In the case of families with older children, groups of friends and people traveling alone, the first place fell to the variable staff, with a negative impact.

In view of the differences noted, it would be of great interest to investigate at some future point the effects on eWOM from other variables related to the profiles of tourists and characteristics of hotels. For example, it would be possible to consider any or all of the age, gender, educational level, and even country of origin of tourists, as also the age, number of rooms and location of hotels in countries in other continents. In this way, the door would be opened to undertake comparative analyses offering more precise and exhaustive results regarding the differences in preferences and behaviors of tourists.

DISCUSSION AND CONCLUSION

The changing environment fostered by an increasing use of the Internet has implied huge numbers of changes in many aspects of people's lives. One of the most visible is the way in which they buy products and services. Especially with regard to services, the Internet has made it possible to have access to information that would have been unimaginable just a few decades ago. On these lines, tourism is one of the sectors most affected by this situation. The main characteristics of tourism, the inseparability of provision from consumption and its intangibility, make it particularly difficult to assess such a service in advance (Grönroos, 2000). This brings with it a high perceived risk for potential customers during the decision-making process (Litvin et al., 2008). However, the use of the Internet and the communication possibilities that it offers is triggering noteworthy changes in the way in which people consume and plan journeys (Erdem and Cobanoglu, 2010; Papathanassis and Knolle, 2011). In this new era, electronic word-of-mouth (eWOM) has become a key element in the process of selecting and booking tourism services. Previous literature on this topic concentrated fundamentally on studying the effects that eWOM has on different variables of interest (Litvin et al., 2008; Ye et al., 2011; Öğüt and Tas, 2012; Melián-González et al., 2013; Viglia et al., 2014). Nonetheless, little research has investigated the factors influencing the making of on-line comments by customers.

Therefore, the present piece of work aims to contribute to existing knowledge in this field by studying the variables that promote participation by consumers in this sort of communication in the context of travel accommodations. In this sense, service quality has proved to be an important factor from the marketing point of view. However, just two previous studies have analyzed its influence as an eWOM determinant in the hospitality sector (Yen and Tang, 2019; Serra-Cantallops et al., 2020). Consequently, the present paper attempts to address this research gap by extending the analysis made by Serra-Cantallops et al. (2020) in that we consider the distinction between objective quality and perceived quality. These two variables are under the control of the hotel's managers, which is crucial to develop more suitable marketing strategies according to the type of tourist that they are aimed to attract.

To accomplish this aim, the Booking.com website was used to create a European Union database corresponding to 5,509

hotels and covering all categories (star ratings). This in turn allows generalization of the results and constitutes a major new contribution to the literature published to date.

The study concentrated on analyzing a range of variables that can influence the number of comments made by customers as a function of their personal experience. Although the use of quantitative scores is an objective measure of on-line reviews, few previous studies have researched the scores when compared with textual comments (Moro et al., 2017). This aspect can also be considered a further contribution by the present paper.

Additionally, these effects were analyzed taking into account the profile of tourists (as a function of the people with whom they traveled), and of the geographical location of the hotels by European region (North, West, South, and Center). These two facts, in their turn, constitute a third contribution from this work, since previous studies have stressed that the great differences between hotels and types of tourist make it hard to achieve conclusive results (Chintagunta et al., 2010; Ghose et al., 2012; Gu et al., 2012; Blal and Sturman, 2014; Phillips et al., 2015; Fang et al., 2016).

The results obtained lead to three main ideas. The first is that both the objective and the perceived quality of the hotel have a significant influence on eWOM. The second is that it is possible to observe that customers are motivated to make comments more as an outcome of their own perceptions with regard to different aspects of the hotel (perceived quality) than on the basis of objective features. Finally, the third conclusion is that, regardless of the tourist profile and the location of the hotel, the quality-price relation variable generally has the greatest impact on the making of on-line comments, and its effect is positive in all cases.

With regard to the first conclusion, two issues arise. On the one hand, the significant positive effect exerted by objective quality on the number of comments leads to the conclusion that customers will be more or less demanding in accordance with the quality attributed to the hotel by its star rating. Thus, the higher the category of the hotel, the greater will be guests' motivation to make comments about it. Thus, managers of top-category hotels should pay more attention to this subject, as their guests are more prone to make on-line comments about their hotel experience. On the other hand, when it comes to perceived quality, all the variables representing it have a significant impact on the number of comments. While better assessments of location and quality-price relation have a positive effect on eWOM, better assessments of cleanliness and staff have a negative impact, reducing eWOM. Thus, these are crucial variables for tourists when choosing hotels. No information is available about the sense of these comments because they are numerical scores, so it is not possible to make definitive claims in this respect. However, the logical expectation would be that higher ratings would lead to more positive comments, and lower ratings to more negative. Hence, an interpretation of these results might therefore be an assumption that high scores for location and the price-to-quality relationship not only would give rise to more comments but additionally that these would be favorable to the hotel. These results are in accord with those claiming that participation in eWOM grows when opinions are more extreme (Bansal and Voyer, 2000), in this instance when they are strongly positive. In contrast, cleanliness and staff exert a significant negative effect on the numbers of comments, which could mean that hotel guests would record on the Internet any deficiencies regarding these aspects.

Concerning the second conclusion, the previous statement is true whatever the tourist profile and the location of the hotel may be. This result is of especial value in the hotel context. It shows that subjective matters, such as perceptions about different features, motivate people to take part in eWOM more than do aspects of an objective nature, like star rating and price (information easily available to anyone interested in the hotel). Taking into account the difficulty of judging the quality of hotel service in advance, this study highlights the fact that this kind of information is what is of most interest to potential customers and what is crucial in their choice of a hotel.

The third conclusion is particularly true for young couples and tourists traveling as a family with children, whatever their ages, these results being in line with previous studies (Campo et al., 2010). However, two key aspects should be stressed. First, on the basis of tourist profile, there are certain differences in respect of other influential variables that can be interpreted better by considering the ages of the tourists, whether they are traveling with children or not, and what outlay per family unit is involved. For example, those traveling with older children are aware of the difficulties of getting around with this sort of family group. Therefore, it is not surprising that for this type of tourist the place where the hotel is sited turns out to be one of the features with the greatest influence over their opinion of a hotel and hence on the number of comments they make. A good location in relation to activities feasible with children in the destination chosen by this type of tourist seems to have a positive influence on the making of comments. However, whatever their ages may be, the absolute price is not significant for families with children. This leads to the conclusion that in such cases, the amount of money spent on accommodations is normally large because of the number of individuals in the family unit so, in these cases, the important feature is the quality-price relationship rather than the price in itself. Secondly, in the case of elderly couples, star rating becomes the second most influential variable, with a positive impact on eWOM. This type of customer may be expected to be particularly demanding, in view of their greater age and likely greater wealth. For this reason, the probability would be that the more a hotel matches up to their expectations as a function of its category, or indeed exceeds them, the more motivated they will be to record this fact in the form of on-line comments.

All these results can be of great use when hotels face intense competition due to a saturated market. Thus, a better understanding of the specific determining factors for eWOM will help hotel managers improve successful marketing strategies and enhance the attractiveness of their hotels (Chaochang et al., 2015; Serra-Cantallops et al., 2020). It is essential that management should constantly monitor and assess on-line customer reviews and scores, so as to identify what attributes generate customers' positive or negative attitudes toward their hotel. Customers' scores are a relatively simple and objective measure of guests' opinions that can be easily accessed by potential customers as a

first criterion for selecting a hotel. Thus, it would be advisable to pay special attention to low scores and negative comments, in order to improve or solve the deficiencies found by hotel guests. One choice for tackling this question might be to show that managers are concerned about customers' opinions, for example, by trying to provide them with appropriate answers, or even more, by inviting customers to give additional information about their level of satisfaction with the hotel's services (Del Chiappa et al., 2018). This might encourage customer loyalty, increasing hotel profits (Öğüt and Tas, 2012). The very fact of giving an answer shows an image of concern about the opinions of guests and enhances a hotel's credibility (Rose and Blodgett, 2016). This point is crucial because credibility reduces perceived risk and the cost of information, increasing perceived quality.

Thus, in view of the information given above, the general recommendation to managers of any type of hotel would be to concentrate their efforts on improving features related to the quality perceived by customers and designing strategies differentiated by segments (for example, as a function of the stage in family life or the number of people traveling together as a group). This may aid in limiting the number of negative comments or scores and enhancing the number of positive ones by taking into account the type of variables most relevant for a given tourist profile. This recommendation is particularly important if comments or scores are negative (Guerreiro and Moro, 2017) and related to variables that are under management control (Rose and Blodgett, 2016), as is the present case. This is because positive or negative assessments made by customers about features controllable by a hotel's managers have a considerable impact on reputation (Min et al., 2015) and thus on the possibilities of attracting future guests. An adequate response could mitigate negative effects. Even more, hotels do not necessarily lose customers who post a negative review. If they give a proper answer to negative comments from customers, perhaps through personal contact with them, they may turn them into satisfied future guests.

However, answering all customer reviews is time-consuming and costly, especially if they are negative reviews (Nguyen and Coudounaris, 2015). Thus, taking into account that not all users are equally important, the profile of the user could also be used as a discriminating factor. As Moro et al. (2017) suggest, it is crucial to frame the responses on the basis of user profiles and focus hotel managers' attention on those specific users who are more likely to give lower scores. Making the effort to turn those negative scores into positive could lead to affirmative eWOM.

Another strategy might be to try to attract opinion leaders who would be favorable toward a hotel's services, and encouraging them to post positive feedback (Yang et al., 2012b). Those recommendations could be of particular value for hotelsin the higher categories, since their customers are clearly more demanding. In the case of lower-range hotels, managers should pay extra attention to aspects relating to price, hygiene or cleanliness, and to living up to standards in relation to rooms (Brotherton, 2004). On these lines, previous research has demonstrated that for hotels in the lower categories, customers are more sensitive to the number of on-line comments, whilst for those in the higher categories the most influential point is the positive or negative valence of the comment (Blal and Sturman, 2014). Thus, in accordance with the kind of hotel, management actions for the first type of hotel (lower categories) should aim at getting more comments (logically, positive as far as possible). In the case of higher-category hotels, they should aim to increase satisfaction levels among customers. Because these guests make fewer comments, any they do make should be evidence for a high degree of satisfaction. This will yield a certain image of exclusivity, which is what customers are looking for in this sort of accommodations (Blal and Sturman, 2014).

Moreover, it is vital to be aware of different aspects of a hotel according to customer profiles. In view of the fact that in all instances these are variables controllable by the hotel management, a good match to requirements according to tourist type will result in more bookings. Additionally, a hotel's location is also a point to take into account, as it may aid in identifying the most important aspects in accordance with the sort of tourists it is intended to attract.

Some limitations of this study have already been mentioned, but they should still be listed, alongside other points that may in themselves constitute new lines of research. It would be desirable to increase the number of explanatory variables for eWOM, so as to include the valence of the comments and to have more information about tourist profiles in order to provide more complete results and to be able to offer a more exhaustive interpretation of them. With regard to this last limitation, it would be advisable to have more data about the tourist profile relating to characteristics such as gender, age, level of studies, or even home country. This would allow interesting comparative analyses to be made by customer segment, the results of which would be very useful for hotel managements when designing more specific strategies on the basis of the sociodemographic profiles of the tourists they wish to attract. Likewise, it would also be advisable to expand the number of hotels considered, looking not only at the European Union, but also hotels located in other continents. A worldwide comparison might also yield interesting results on differences in tourist behavior. Similarly, it might also be useful to analyze the moderating effects of star rating and tourist profile on the results presented here. Finally, account should be taken of the fact that potential tourists may use different types of website, depending on the types of sub-decision they want to make, whether search-determined or experience-determined (Bronner and de Hoog, 2013). Moreover, they are also free to post their comments on domain-independent social media, like Twitter or Facebook. The present research is based on data derived from a domain-specific medium (Booking.com). Future lines of research could take into account, not only other sources of domain-specific media such as Hotels.com or Travelocity.com, but also information from domain-independent social media. This would make it possible to analyze whether the online channel might be an important variable in the degree of guest satisfaction.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

GS-G contributed to the present manuscript in its conceptualization, methodology, formal analysis, investigation, writing – original draft, and funding acquisition. AG-F participated in its conceptualization, investigation, and writing – original draft. Both authors contributed to the article and approved the submitted version.

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A Digital Capabilities Dataset From Small- and Medium-Sized Enterprises in the Basque Country (Spain)

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INTRODUCTION

Sustainable competitiveness and growth of small- and medium-sized enterprises (SMEs) are increasingly determined by their capability to make use of digital technologies [EU (European Commission), 2018b] and tie into a digital ecosystem (Pelletier and Cloutier, 2019). Surveys (Tarutea and Gatautis, 2014; Bouwman et al., 2019; Shettima and Sharma, 2020) prove that the digitalization has a positive effect on the performance of SMEs. This includes dimensions such as growth, market value, and profitability as well as social and environmental performance and satisfaction; 46% of firms that participated in a survey of the European Digital Transformation Scoreboard report a medium-to-large increase in their annual turnover over the last 3 years following the adoption of technology [EU (European Commission), 2018a]. Many SMEs, however, are lagging behind in digital transition (OECD, 2017). According to a report by the Digital Innovation Hubs Working Group (2018), only 17% of SMEs have successfully integrated digital technologies into their businesses, compared with 54% of large companies. They lack resources and capabilities or suffer from inertia, which hampers opportunities (Cenamora et al., 2019). In the emerging highly interconnected and collaborative forms of value creation, the capacity to connect better to an integrated business network will be important to stay competitive (Rehm and Goel, 2017; EU (European Commission), 2014).

SMEs comprise three different categories of enterprises, namely, micro-enterprises, small enterprises, and medium-sized enterprises (see **Table 1**). To classify firms, the official European definition of SMEs considers three different factors: level of employment, level of turnover, and size of balance sheet.

According to the EU (European Commission) (2018b) overall, in 2017, SMEs in the EU accounted for 99.8% of all EU-28 nonfinancial business sector enterprises, two–thirds of total EU-28 employment (66.4%), and slightly less than three–fifths (56.8%) of the value added generated by the nonfinancial business sector. Micro-SMEs are by far the most common type of SME, accounting for 93.1% of all enterprises.

SMEs are a highly diverse group of enterprises that also condition how they approach digitalization (OECD/UN ECLAC, 2012; Neirotti et al., 2018). For example, approaches differ in case of Industry 4.0 adoption (Matt and Rauch, 2020) or the integration in platform ecologies (Gierlich-Joas et al., 2019). A common denominator, however, is the need to integrate, build, and reconfigure internal and external resources in order to adapt to rapidly changing environments (North and Varvakis, 2016). These dynamic capabilities take the form of skills, processes, procedures, organizational structures, and decisions that motivate and promote the

TABLE 1 | Definition of SMEs.

Company Category	Employees	Turnover	Balance sheet total
Micro	<10	<€2 million	<€2 million
Small	<50	<€10 million	<€10 million
Medium sized	<250	<€50 million	<€43 million

Source: European Commission Recommendation dated 6 May 2003 regarding the definition of micro-enterprises, small-sized enterprises, and medium-sized enterprises (2003/361/EC), Official Journal of the European Union, L 124/36, 20 May 2003.

detection (sensing) and capture (seizing) of opportunities in order to reconfigure (transform) their capabilities (Teece, 2007). As several studies show, the development of dynamic capabilities impacts SME performance and growth (He and Wong, 2004; Lubatkin et al., 2006; Macpherson and Holt, 2007; Protogerou et al., 2008; Sunday and Vera, 2018) and is vital for implementing Industry 4.0 approaches (Garbellano and Da Veiga, 2019) and digitalization (Matarazzo et al., 2021).

However, currently, there is a limited understanding of how SMEs are approaching digitalization from a dynamic capabilities perspective. Garzoni et al. (2020) introduce a four-level approach of engagement of SMEs in the adoption of digital technologies, namely, digital awareness, digital enquirement, digital collaboration, and digital transformation, hence the need to map adoption and learning paths of these firms. For this mapping, digital maturity models or frameworks can provide guidance (Valdez de Leon, 2016, Williams et al., 2019). The DIGROW digital maturity framework (North et al., 2020) is grounded on the microfoundations of dynamic capabilities (Teece, 2007) and therefore allows to link digitalization to organizational capabilities. Based on this framework, a questionnaire has been built and applied to a sample of 380 SMEs from the Basque region (Spain). In the following section, we describe the framework, the structure of the questionnaire, the data collection process, and the content of the database built as a result of this process.

METHOD

The DIGROW Framework of Digital Maturity

The DIGROW framework of digital maturity (North et al., 2020) aims at companies to assess their digital maturity level, and the capabilities associated with each level of maturity, which could support their digitally enabled growth. The framework is grounded in dynamic capabilities theory. In the explanation of microfoundations of dynamic capabilities, Teece (2007) described his constituent capacities: "For analytical purposes, dynamic capabilities can be disaggregated into the capacity (1) to sense and shape opportunities and threats, (2) to seize opportunities, and (3) to maintain competitiveness through enhancing, combining, protecting and, when necessary, reconfiguring the business enterprise's intangible and tangible assets" (Teece, 2007: 1319). Pavlou and El Sawy (2011), based on their empirical research, proposed four steps of dynamic capabilities development—sensing, learning, integration, and coordination—thus highlighting the importance of managing knowledge and learning to cope with turbulent and disruptive environments (North and Varvakis, 2016).

A particular shortcoming in SMEs is that owners and managers are aware of growth potentials; however, they tend to lack an explicit strategy, and if they have one, they do not communicate that strategy to employees (North et al., 2016). Therefore, in the DIGROW framework, an intermediate step is inserted between Teece's "sensing" and "seizing," the step of strategy development and communication, which is related to Pavlou and El Sawy's (2011) learning and integration. Thus, the "DIGROW" framework considers four capacities:

1. *Sensing digitally enabled growth potentials:* searching for digitally enabled growth opportunities, understanding and developing digital customer needs, sensing technology-driven opportunities, and use of external sources for digital innovation.
2. *Developing a digitally enabled growth strategy and mindset:* Digitally enabled growth strategy, digital leadership, digital mindset (attitudes and behaviors), and empowered employees.
3. *Seizing digitally enabled growth potentials:* Digitally enabled business models, digital market presence, digital customer experience, and agile implementation/deployment of digitalization initiatives.
4. *Managing resources for digital transformation:* Digital skills and learning, digital processes, digital technology and security, and digital investments.

Each of these capacities is assessed at six levels described by an anchor statement. A pretest in selected firms (North et al., 2019) revealed that these six levels would allow a sufficient degree of differentiation. As mentioned above, a self-assessment questionnaire has been developed based on this framework. This is shown in the **Appendix**.

Data Collection

The companies subject to study are small- and medium-sized enterprises (SMEs) from the Basque region in Northern Spain, which, according to the definition of SME proposed by the European Union, comprise between 10 and 249 employees.

The questionnaire has been addressed to 7,040 firms in cooperation with regional business associations between July and November 2018 and was answered by the chief executive officer (CEO) or the information technology (IT) manager in each firm. The number of SMEs that responded to the survey amounted to 540 (response rate 7.67%). After only partially completed or invalid questionnaires were eliminated, the final sample consisted of 427 companies. As for company size, 47 firms were micro-enterprises (i.e., <10 employees), 220 were small firms (i.e., between 10 and 49 employees), and 160 were medium-sized firms (i.e., between 50 and 249 employees).

Regarding composition of the sample according to industries, 133 firms belong to the manufacturing sector and 24 to commerce, 198 companies are distributed among different types of services (i.e., education, health services, insurance,

information services, transport, and professional services), and 25 companies belong to the building sector.

Database Content

Based on the data collected, we built a database in which the structure and content are described in this section.

The database is structured in rows and columns. Each row contains the information related to each firm (in total, 427 firms). On the other hand, the columns include the following information:

- Industry where the company operates. Industries are codified according to NACE (A21) classification.
- Range of employees per company. We consider these data to categorize the firm as a micro-enterprise (range = 0–9 employees), a small company (range = 10–49 employees), or a medium-sized company (range = 50–249 employees).
- The level of maturity reported by each firm regarding each question referred to firm's digital capacities (16 questions/capacities in total). We distinguish six maturity levels. Levels 0 and 1 correspond to a low degree of a firm's digital maturity; levels 2 and 3 correspond to a medium degree of a firms' digital maturity; and levels 4 and 5 refer to a high degree of a firm's digital maturity (see the **Appendix**). These level values are reported in the database and ranged from 0 to 5.

DATA USAGE

The data contained in this database can be analyzed for different purposes.

The main purpose is to assess the level of digital maturity of each company. In order to obtain an overall picture of the level of digital maturity, we have carried out a descriptive analysis, in particular, a frequencies analysis. We used the software IBM SPSS (version 26.0).

First, a frequency analysis for the whole sample allows us to obtain the number and percentage of companies that rated each one of the levels of digital maturity for each one of the capacities considered. In other words, for each capacity, we could know how many firms attain a particular level of maturity. Based on this, we could conclude if the maturity level achieved by each company regarding each capacity was low, medium, or high. The results of the frequency analysis are as follows: Regarding sensing potential opportunities for digital growth, a high number of companies are able to search and identify growth opportunities (77%), and 28.2% of firms work actively on their identification. Nevertheless, only 24% identify growth opportunities systematically.

As far as developing a digitally based growth strategy and mindset is concerned, while many companies understand the relevance of digitalization, they are not able to develop strategies aimed at taking advantage of the growth opportunities opened by digital technologies. Only 18% of companies define a digitally enabled growth strategy, and 15% update their strategy, taking into account different facets of digitally enabled growth.

In terms of seizing digitally enabled growth potentials, 31.6% of companies do not have a digitally based business model, while 22% of firms claim to have started to change some components of their business models. Finally, only 14.4% of companies systematically adapt their business models or create new business models to promote a digitally enabled growth.

With regard to managing resources for digital transformation, approximately a quarter of firms (26%) consider that investment to develop digital skills is low. And only 6.7% of companies claim to possess the necessary digital skills. On the other hand, almost a quarter of firms (24%) claim to achieve a medium level of investment in digital transformation initiatives, while only 9.5% of companies consider they invest a lot in digitalization.

Second, we also run a correlation analysis. Observing the correlation matrix, we find that the highest correlated variables are the following: digitally enabled growth strategy highly correlates with digital leadership (0.76) and a digitally based business model (0.70). Moreover, a digitally based business model correlates with digital market presence (0.70) and digital customer experience (0.72). Digital customer experience also highly correlates with digital skills and learning (0.74). Finally, there is a high correlation between digital skills and learning and agile implementation of digital initiatives (0.72). On the other hand, we run a factor analysis, but this does not show relevant results, since it only discriminates one factor, probably due to the high extant correlation among most of variables (i.e., capacities).

Third, we carried out a regression model analysis to explore the relationship between a digitally enabled growth strategy as the dependent variable and digital mindset, digital leadership, and empowered employees as the independent variables (Aramburu et al., 2020). The results of the regression model test show that the relationship between each independent variable and the dependent one is significant in all cases at a significance level of 95% ($p < 0.05$; see **Table 2**). Therefore, digital leadership, digital mindset, and the fact of having empowered employees who deploy digital initiatives have a positive and significant influence on digitally enabled growth strategy. In addition, digital leadership is the most relevant capacity influencing digitally enabled growth strategy ($\beta = 0.533$), followed by digital mindset ($\beta = 0.287$) and empowered employees ($\beta = 0.151$).

Finally, further analyses have been carried out with the aim of testing the role of firm's size. With this purpose, a mean comparative analysis has been carried out comparing small- and medium-sized companies (i.e., between 50 and 249 employees) and big firms (i.e., between 250 and 500 employees), showing that there is a significant difference according to the size of the firm only in the case of eight capacities included in the framework over a total of 16 (i.e., use of external sources for digital innovation, digital leadership, empowered employees, digitally enabled business models, digital market presence, digital customer experience, agile implementation/deployment of digitalization initiatives, and digital skills and learning). Therefore, we conclude that the firm's size affects digital maturity, but this effect is not extremely relevant.

TABLE 2 | Regression model (coefficients and significance).

Model	Non-standardized coefficients		Standardized coefficients	*t*	Sig.
	B	Standard error	Beta		
(Constant)	0.418	0.183		2.288	0.023
Your company has a digital leadership	0.533	0.051	0.522	10.522	0.000
Your company has developed a digital mindset	0.287	0.066	0.201	4.343	0.000
Your company empowers employees to experiment with digital initiatives	0.151	0.049	0.144	3.107	0.002

Note: Dependent variable: Your company has a digitally enabled growth strategy.

LIMITATIONS AND FUTURE RESEARCH AVENUES

Additional types of data analysis could be carried out. For instance, and considering the data contained in the database, further regression analyses might be carried out in order to explore the relationships among different sets or combinations of capacities. One potential area of interest to explore would be to analyze which factors can influence the digitalization processes, such as digital skills, digital investments, and digitally enabled growth strategy. Another future avenue could be to explore how digitally enabled business models are influenced by the digitally enabled growth strategy, digital investments, and the digital mindset. Finally, a future relevant path for research is opened regarding the impact of coronavirus disease 2019 (Covid-19) in digital transformation of SMEs, in terms of both firms' capabilities and also firms' characteristics (e.g., size and industry). The pandemia is catalyzing digitalization processes in many companies; thus, it would be interesting to explore what is happening in SMEs.

To conclude, the database has some limitations, such as it only includes data of SMEs from a particular geographical setting (i.e., Basque region in Spain). Moreover, it only refers to SMEs, not including data of big companies. Regarding the industries represented, the dataset is quite complete since it contains data of SMEs belonging to all industries in the region. Finally, another limitation is that the database does not contain data regarding the companies' performance (i.e., revenues or growth rate). This might be completed in the future collecting additional data about performance.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found in the article/**supplementary material**. The dataset is available here: http://data.orkestra.deusto.es/es/dataset/digrow-basque-sme.

AUTHOR CONTRIBUTIONS

NA has led the writing process of this manuscript. KN has led the development of the digital maturity framework referred to in this paper (i.e., DIGROW framework). AZ has led the data collection process and database building. MPS has contributed to the writing of a part of the article. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2020.587949/full#supplementary-material

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The Transformation of Higher Education After the COVID Disruption: Emerging Challenges in an Online Learning Scenario

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Crisis requires society to renew itself, albeit in a disruptive way. The current Covid-19 pandemic is transforming ways of working, living, and relating to each other on a global level, suddenly and dramatically. This paper focuses on the field of education to show how higher education institutions are undergoing radical transformations driven by the need to digitalize education and training processes in record time with academics who lack innate technological capabilities for online teaching. The university system must strive to overcome this situation to be competitive and provide high-quality education in a scenario of digital transformation, disruptive technological innovations, and accelerated change. To achieve these goals, this paper explains some barriers and challenges that universities encounter, as well as technological resources and methodologies they have used in the current scenario to transform higher education to face Covid-19 disruption. The discussion and conclusion synthesize significant insights that can be applied to the digitalization of education in the foreseeable future.

Keywords: higher education, innovation, COVID-19, digital transformation, online learning

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INTRODUCTION

The disruption caused by the current Covid-19 pandemic is unprecedented, and the resulting economic and social measures have brought massive change (Krishnamurthy, 2020). To mitigate the spread of the virus, governments around the world have imposed social distancing measures, lockdowns, and cessation of personal contact outside immediate households. The pandemic is thus having a massive impact on educational activity. In a matter of weeks, entire education systems from elementary to higher education had to completely transform activity to evolve to an online teaching-learning scenario (Mishra et al., 2020). According to UNESCO, higher education institutions (HEIs) were closed completely in 185 countries in April 2020, affecting more than 1,000 million learners around the globe (Marinoni et al., 2020).

The reality of the new normal, disrupted by COVID effects, has involved a radical transformation of education and training, and one of the sectors undergoing dramatic digital transformation is global higher education (Dwivedi et al., 2020). The sudden forced closure of face-to-face teaching has led academics and students into "unfamiliar terrain" due to the need to adapt swiftly to total e-learning settings (Carolan et al., 2020). This sudden change has required universities to evolve toward online teaching in record time, implementing and adapting the technological resources available and involving professors and researchers who lack

innate technological capacities for online teaching. The university system must be able to provide quality education in a scenario of digital transformation, disruptive technological innovation, and accelerated change in the educational framework. The emergence of disruptive innovation is a time of risk and uncertainty, but it is also a time of opportunities, bringing talent and innovation to the education system.

By definition, a disruption implies a sudden break or interruption. When applied to education, disruption involves a break from traditional, established educational models of knowledge transmission (Carolan et al., 2020; Mishra et al., 2020). Innovations that change the direction of education replace or displace existing models. They interrupt the functioning of established educational models in unexpected ways, first improving the model and then affording new ways of understanding its ongoing development. Disruptive educational innovation replaces existing methodologies and modes of knowledge transmission by opening new alternatives for learning. It also introduces new advances in education systems through information and communication technologies. This educational disruption considers both the student and the professor as engines of learning to promote an open curriculum enabled by new digital education. It also involves innovation in teaching methods; such as the development of new learning materials, mechanisms, and spaces; and the transformation of the role of students and the way they absorb and use educational knowledge. Disruptive innovations meet the needs of existing customers as well as the needs of currently available services (Christensen et al., 2006). Successful educational innovation and transformation must, however, be based on sustainability, scope, and scale (Carolan et al., 2020). The successful transformation of universities from old learning systems should foster a participatory culture, engage participants, and promote evidence-based decision making and transparent assessment of outcomes.

The new normal created by Covid disruption has accelerated the move toward online teaching. The current scenario has involved a rapid pedagogical shift from traditional to online class sessions, personal to virtual instruction, and seminars to webinars (Mishra et al., 2020). The impact of the pandemic will bring an era of radical technological transformation, with accelerated digitalization to the worldwide higher education system (Krishnamurthy, 2020). As universities must seriously rethink and redesign their educational offerings to face this new situation, Covid-19's disruptive effects have created not only fertile opportunities for transforming HEIs but also difficulties and challenges in this process (Carolan et al., 2020).

After presenting the gaps, we will attempt to fill them by shedding light on how HEIs are radically transforming education and training, evolving to digitalization in an extremely short time. To achieve successful transformation, universities should be aware of potential barriers and recognize new tools and systems, integrating this technology into the teaching-learning process. This paper will examine some significant technological resources and methodologies that universities are using, while also discussing the main obstacles and barriers encountered both by academics and students and at an institutional level. This article's novel contribution lies in its gathering of most articles on the topic of Covid-19 in HEIs to review the most common difficulties they identify and the solutions proposed to them by different countries globally.

TRANSFORMATION OF HIGHER EDUCATION TO FACE COVID-19 DISRUPTION

Technological Resources and Methodologies Used

As a direct consequence of the social distancing efforts imposed by Covid and to maintain service during times of emergency, universities have experienced a large-scale transition to online learning (Krishnamurthy, 2020). In a short period of time, academics around the world have had to convert materials and methods rapidly to a format that is suitable for online delivery (Dwivedi et al., 2020). This transformation was hasty and compelled by circumstances. The pandemic forced a period of global experimentation with remote teaching (Govindarajan and Srivastava, 2020). Some studies refer to this new system as "emergency online education" (Marinoni et al., 2020). The system posed unprecedented challenges for students, who needed technical assistance, but also for staff and university leaders, who had to reinvent themselves in record time to keep campus operations running.

Although the process of digital transformation in higher education began years ago, the pandemic has accelerated it, leading to fundamental changes in a question of weeks. This technological transformation of education involves profound changes in teaching methodologies, essential competencies, and assessment methods, as most HEIs recognize (Jensen, 2019). In a virtual scenario, universities must evolve from a mostly "lecture-based learning" system toward "problem-based learning" methodologies, that engage students more actively (Marinoni et al., 2020). This transition from "in-person" to virtual education will have significant implications for the entire learning process, not only extensively modifying methods for assessing learning outcomes but also requiring reconsideration of the skills and competencies required of students in this new setting (Jensen, 2019).

As current social distancing measures will last for some time, education institutions must thoroughly redesign their service to face the new environment. To construct a well-designed online learning experience, universities should develop digital learning methodologies and provide digital learning contexts, tools, and support systems (Krishnamurthy, 2020).

Digital education requires appropriate infrastructure and technological platforms (e.g., Blackboard, Moodle, Microsoft teams), solid servers that can sustain the virtual workload, and methodological training of professors and students for online delivery using all the technical and educational resources available. Numerous webinars and guides are available for professors, and most universities have signed contracts with companies such as Microsoft that provide Office or Teams resources or technological platforms to strengthen virtual

communication. At a global level, a wide variety of online communication platforms and solutions are available to help digitalize the entire teaching-learning process in the Covid-19 scenario (Mishra et al., 2020). In a recent empirical study conducted in a university context, these authors observed that the technologies most used to support teaching during the lockdown period were the university web platform; instant messaging tools (WhatsApp, Telegram); video-conferencing tools (Zoom, Skype, Google Hangouts, Google Meet); and educational apps (Google Classroom); combined with email and telephone conversations to maintain individualized contact with students. Other technologies were also generally useful (Cisco WebEx, GoToMeeting, Microsoft Teams, Monosnap, Loom, OBS).

The technological resources available provide multiple options for teaching, such as giving lectures by videoconference, sharing material (e.g., slides, videos, presentations), interacting through chats, creating debate forums or workgroups, supervising practical activities, evaluating and tutoring students, recording explanations and making them available to students, etc. Furthermore, these tools can be used synchronously or asynchronously and integrated. All of these resources must be supported, however, by an educational methodology to maintain students' attention and keep them involved in the course. To ensure clarity of the educational objective of each activity, instructors must design the audiovisual material, plan students' work time, and use the right tools for each activity—for example, for tutoring, videoconferencing activities, or student assessment. It is important to make sessions dynamic by introducing collaborative and formative tools. It thus also seems essential to introduce active methodologies for the interaction of students and professors, and that engage students in peer collaboration.

Various methodologies for online teaching and evaluation have emerged and proven useful in the current pandemic (the authors used some of these in remote teaching). The assessment process is very important, as it represents the culmination of the entire learning process. **Table 1** provides a summary description of some of the main online assessment strategies and supporting digital technologies available. In addition to learning assessment, this article addresses other issues that should be borne in mind. **Table 2** includes the main difficulties and breakthroughs different countries have encountered in the teaching-learning process during lockdowns, as they have made the massive migration or shift from traditional in-class face-to-face education to online education.

Emerging Barriers and Challenges in the Current Scenario

Covid-19's disruptive impact led to a rapid transformation of educational activity. As explained above, the rapid suspension of face-to-face teaching forced both students and professors to adapt to a wholesale shift in the teaching-learning process (Carolan et al., 2020). This adaptation was not obstacle-free, and some barriers and challenges emerged in this process (Marinoni et al., 2020; Mishra et al., 2020). To enable safe transition and achieve a successful transformation, universities must be aware of these potential obstacles and establish appropriate mechanisms to overcome them. Drawing on specific studies, we describe these barriers from the perspective of the main agents involved in the learning process: students, professors, and institutions (universities).

Students report that the major challenge in adapting to online learning was technical problems (Mishra et al., 2020). Some authors highlight the ways online education can amplify the digital divide (Govindarajan and Srivastava, 2020). To mitigate this barrier, institutions should mobilize resources to ensure that all students have access to a proper IT infrastructure and bandwidth connection, as well as specific support to solve technical problems (Carolan et al., 2020). To ensure an equitable student experience in this new scenario, universities must guarantee that students from less privileged socioeconomic backgrounds are not disadvantaged. Students also found it difficult to maintain attention in a purely online context, reporting the following significant barriers (among others) (Liang et al., 2020; Mishra et al., 2020): boredom, sense of isolation, lack of time to follow the different subjects, and lack of self-organizing capabilities. Professors also noted that isolation was a significant problem in designing the courses, indicating the need to find the optimum balance of individual student-centered learning and collaborative learning, fostering virtual communities of practice to enhance student peer engagement and collaboration (Carolan et al., 2020).

From the professors' perspective, this forced transformation was also stressful, as professors had to adapt quickly to new online techniques, with little or no training in some cases and in record time (Dwivedi et al., 2020). The sudden transition from face-to-face to distance teaching also required a teaching staff with diverse levels of readiness to use different pedagogies with specific competencies (Marinoni et al., 2020). The digital divide can also be applied to academics. Not all faculty members are comfortable in an online setting, and a generational divide may separate those who have relied on classical methods and never used technology tools from the younger faculty who may be more adept with newer technologies (Govindarajan and Srivastava, 2020). The main difficulties professors highlighted were the high demand for specific skills such as proficient computer knowledge, specific communication abilities for an online setting, proper handling of various teaching-learning tools, and the need to solve specific problems quickly during learning sessions. After an initial period of adaptation-experimentation to convert rapidly to remote teaching, however, academics highlighted some interesting lessons for overcoming barriers (Dwivedi et al., 2020). First, instructors should create an appropriate physical setting for online teaching, including lighting and sound. The specific content of class sessions should be thoroughly redesigned to adjust timing to online delivery and introduce group activities to motivate and engage students and encourage collaborative learning. As most universities will opt for a hybrid system in the near future that combines small face-to-face groups with online sessions, the challenge for academics will be to ensure that students in both situations experience high-quality learning (Dwivedi et al., 2020).

At the institutional level in universities, the move to emergency remote teaching in the Covid-19 pandemic involved

TABLE 1 | Various resources/methodologies for student assessment in online teaching.

Assessment methodologies	Description	Supportive technologies
Diagnostic evaluation	Exercises, questionnaires, or tests that assess students' preconceptions, competences, information, etc., regarding the new topic	• Concept map • Questionnaires on Web platform • Online questionnaires • Interactive and gamified presentations
Evaluations using video tags	Students answer different questions by adding tags to a YouTube video. The professor can review students' answers by examining the labels. This process can be performed in groups or individually (as individual tests where students do not share their annotations)	• Videos on YouTube or published on the Web platform • Video annotations • Questionnaires on Web platform • Online questionnaires
Group and collaborative analysis	When not all exercises can be evaluated due to large number of students, one or more can work together. Evaluation may be anonymous or voluntary, and sequenced so all students are evaluated. At the time of evaluation, the exercises are shared so that the students better understand the quality criteria and their application to specific cases	• Videoconference platforms • Text and video annotations
Self-assessments	The student analyzes the work presented and evaluates it	• Online questionnaires • Rubrics • Questionnaire on Web platform
Co-evaluation or peer evaluation	Students evaluate the work of classmates in the group (intergroup) or work team (intragroup)	• Online questionnaires • Rubrics • Workshops on Web platform
360° evaluation	Contrasts evaluations of an individual or team exercise or tasks from different points of view: professor (hetero-evaluation) and/or students (co-evaluation or peer evaluation and self-evaluation)	• All tools available on Web platform that allow sharing of this evaluation, e.g., chat, digital rubrics, etc.
Objective tests	Exercises where students must select the correct answer or explanation to a problem from among several options	• Multiple response questionnaires on Web platform
Interviews	Interviews allow individual or group monitoring of a topic or topics, and can be considered as a continuous or final diagnostic evaluation	• Videoconference platforms
Ipsative assessment	Assessment that measures different moments of the process to assess progress. Students can observe their progress and achievements through repeated exercises and graphical representation of their evaluations	• Rubrics • Tools on Web platform
Oral partial or final exams	Review of learning achievement at the end of a process. Enables validation of learning achieved during the process Final or partial exams (need weighting) administered to students and graded or evaluated by the professor (hetero-evaluation) and the other students (co-evaluation)	• Online presentations • Videoconference platforms • Self-recorded videos by the student • Tests, reports, etc. included in tasks, plus anti-plagiarism tool on Web platform
Final evaluation	Tests that students must take	• Tests, reports, etc. that professors can publish on Web platform and that can be combined with the anti-plagiarism tool and resolved through Videoconference platforms

a total disruption of business as usual (Krishnamurthy, 2020). To move toward a sustainable model for online learning, universities should use technology to re-invent teaching processes, transform assessment activities, change the use and roles of traditional Faculties and Schools (providing specific training), and focus on value through the reinvention and self-renewal of the service model. Promoting this digital transformation requires the cultivation of participatory culture, and students, professors, and administrators must work together to support and examine the changes implemented (Carolan et al., 2020). Universities also face additional barriers to this transformation, including financial constraints and the limits imposed by the current IT infrastructure (Krishnamurthy, 2020). Public universities will have to deal with diminishing budgets due to reduced government funds, and universities are experiencing a decrease in student enrollment due to the current uncertain economic situation. The IT-infrastructure available to universities will also limit opportunities to embrace full digital transformation, and some investments will be needed to enhance these technical capabilities. Despite all of these challenges, universities are quite positive about this transformation. In a recent survey conducted of institutions in all countries in the European Higher Education

TABLE 2 | Difficulties and breakthroughs in online learning-teaching.

Authors	Difficulties encountered in massive "migration" from traditional in-class face-to-face education to online education	Breakthroughs	Country analyzed
Aguilera-Hermida (2020)	• Situational and environmental challenges • Online educational challenges • Emotional challenges	• Technology Acceptance models: Attitudes, affect, and motivation Perceived behavioral control Cognitive engagement • Family time • New activities	• United States.
Bao (2020)	• Ambiguous future career goals • Lack of active academic involvement • More time spent in in-class study than in out-of-class study depending on students' study time	• 5 principles: Appropriate relevance Effective delivery Sufficient support High-quality participation Contingency plan preparation	• China.
Carolan et al. (2020)	• Prevailing institutional attitudes toward e-learning and pedagogy • Existing IT infrastructure • Availability of learning technology support • Staff digital literacy • Redeployment of academics	• Participatory culture • Distributed leadership • Engaged participants, shared and evidence-based decision-making • Transparent assessment of outcomes	• United States, • United Kingdom, • Australia.
European University Association (2020)	• Absence of economic and budgetary implications for higher education • Exacerbation of socially vulnerable stakeholders • Disguised learning and teaching practices • Internationalization programs • Learning difficulties for students • Socially disadvantaged students • Student stress	• Fostering of international mobility and cooperation • Major European networks and associations • Projects and mobility implementation • Stakeholder collaboration	• Europe.
Govindarajan and Srivastava (2020)	• Hybrid model?	• Face-to-face courses: Educational support on the ground: Instructional designers, trainers, and coaches to ensure student learning and course completion Which students will remain on campus? • Online courses: Anonymized discussions about complementary technology issues, course design, course delivery, and evaluation methods	• United States.
Krishnamurthy (2020)	• Mental health of students • Mental health of employees • Short-term unbudgeted financial costs • Accelerated rates of student attrition and physical health of employees	• Transformation of university: • Technology Acceptance Model • Unbundle and re-invent teaching, learning, assessment, and certification • Focus on value, not just quality • Change in use and roles of faculty, mentors, and peer-to-peer learning • Transform business model	• United States.
Mishra et al. (2020)	• Time-bound online teaching-learning: Unstable network connection	• Use of e-teaching-learning tools available, such as Zoom, Google Meet, Facebook, and YouTube streaming • Use of Social Media, such as WhatsApp	• India.

Source: The authors.

Area, most universities have confirmed that they have plans to explore new ways of teaching (92%) and enhance digital capacity (75%) beyond the crisis (European University Association, 2020).

We conclude this section by drawing on recent literature and a proactive approach to summarize some key insights for higher education's transformation toward online education. First, institutions need to improve their technological infrastructures, while at the same time ensuring that all students have equal access to the technological resources needed. This step requires a financial investment to enable a real digital transformation (Jensen, 2019). Another major obstacle to technological transformation is the human factor. There is a strong need for institutional leadership and support, involving the different stakeholders (faculty, students, technical staff) in the change process. The successful transformation of higher education requires faculty development and specific

policies to improve crisis management readiness and increase institutional resilience to address new challenges in the near future (Marinoni et al., 2020). Finally, the increase in digitalization and available information leads to new ethical questions regarding online security and rights to data privacy. Universities must also address these issues by developing codes of conduct to ensure transparency and create a safe, trustworthy environment for online learning (Jensen, 2019).

DISCUSSION AND CONCLUSION

The disruptive impact of Covid-19 and the availability of digital technologies that can support online learning present an unprecedented opportunity for the transformation of higher education at a global level. We are all involved in a digital world, and the phenomenon of online learning is here to stay. After some months of online experiences, a paradigm shift has occurred in university education. Online teaching has gained relevance and ensured its continuance even after the Covid-19 pandemic. Our examination reveals the use of a plethora of technological tools and platforms to support online learning: web-based learning platforms, video-conferencing tools, Massive Open Online Courses (MOOCs), streaming conferences, instant messaging tools, and educational apps, among others, to support new methodologies to enable learning processes. As this transition to online learning was hasty and forced by circumstances, however, the various actors in the learning processes (students, professors, universities) encountered several barriers in adapting to this new setting. Universities must be aware of these barriers and mobilize resources to overcome them in the short term, paying special attention to the digitalization of learning processes and offering specific technical training to professors, administrative staff, and students. We do not yet know what the shift to virtual learning will mean for the future of higher education at global level, but it is clear in the current scenario that universities should develop a sophisticated combination of face-to-face and online learning to harness the potential of the technological tools available to meet students' expectations and enhance their learning experience in the current digital environment. The main contribution of this paper is thus to observe online teaching from different perspectives, with a primary focus on connectivism (Millwood, 2011), based on Bandura's theory of constructivism, while taking into account both assessment problems and the main difficulties in online teaching and learning caused by Sars-Covid-2 outbreaks throughout the world.

AUTHOR CONTRIBUTIONS

All authors contributed equally to the manuscript and approved the version submitted.

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METHODS
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Orde ab Chao Method for Disruptive Innovations Creation (With COVID-19 Pandemic Case Application)

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This paper introduces a novel method for the creation of ideas for disruptive innovations. It provides an application of innovation management techniques to specifics of disruptive technologies, which stand behind the Industry 4.0 (and Society 4.0) changes that are taking place at present. Centered around the Ordo ab Chao technique, the paper presents how contemporary disruptive technologies can attain reflections in the complex creative process that has to lead to disruptive ideas and innovations. Quite some innovative thinking techniques already exist. However, they fail to place emphasis on creation of ideas that are tied to emerging disruptive technologies so as to further deploy them in a focused, yet innovative manner. Hence, this paper presents an effective technique that facilitates creation of disruptive ideas with a focused potential for real-life implementations. Practical application of the method related to challenges in higher education processes amid the COVID-19 pandemic is also demonstrated. Based on the understanding of existing disruptive technologies, the technique is used for the adaptation and improvements of distance-learning processes to further add value for students and our society in general. In brief, the Ordo ab Chao technique is a promising tool for systematic development of disruptive solutions, representing a creative synergy between cutting-edge technologies and innovation management approaches.

Keywords: innovations management, disruptive technologies, forced connections, methodological adaptation, products and services, disruptive innovations

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INTRODUCTION

It is widely recognized that successful disruptive innovations lead to the highest business performance outputs. Based on the work of Christensen (Christensen, 1997; Schmidt and Druehl, 2008; Christensen et al., 2011), a disruptive innovation is defined as something that creates a new value by disrupting the existing value network(s), resulting in displaced dominating market-leading organizations, or dominating products and services. Clearly, such innovations are more often than not generated by newcomers or even complete outsiders, rather than existing market-leading entities. However, the obvious challenge is how to manage disruptive ideas creation processes. Although planning great discoveries and breakthrough ideas is not an easy task, we believe that it is possible to intentionally create conditions that can lead to disruptive solutions. Hence, this paper proposes a new method for achieving disruptive ideas in a "creatively organized" manner. This means that there is a systematically organized base and methodology with simultaneous integration

of creative concepts at the core. This is what the *Ordo ab Chao* (i.e., Order from Chaos) method is about—a disruptive ideas creation method.

The paper is structured as follows. In the first section, the *Ordo ab Chao* conceptualization is presented. It starts with the state-of-the-art disruptive technologies properties [e.g., Blockchains (BCs), Internet of Things (IoT)] to clearly understand our starting point. Then, the Forced Connections Technique is presented, which is a well-known creative thinking technique aimed at generating new ideas and solutions to a concrete problem. Following this, the aforementioned disruptive technologies and the technique of Forced Connections are integrated into the *Ordo ab Chao* method that is focused on the development of disruptive ideas for problem solving. In parallel, the action research background of Orde ab Chao is elaborated. In the second section, the development and the application of the method are demonstrated (i.e., distance learning process improvements amid the COVID-19 pandemic). Before the *Conclusions* section, we validate the Orde ab Chao method as a scientific contribution in the field of theory related to disruptive innovations, as well as an applicable tool for practical use. The paper ends with references.

OVERVIEW OF THE AREA

This section first provides background information on technologies, then an overview of relevant existing creative thinking methods followed by COVID pandemic stimulus for this new action research approach that has led to the Orde ab Chao method, described in the third section.

Understanding Disruptive Technologies

The discovery of the steam machine proved to be an impetus for the First Industrial Revolution. Within it, a few discoveries and business models may be identified (Wiki, 2020), which stand out as crucial driving factors of further developments, e.g., a transition from hand production methods to machines, new chemical manufacturing, iron production processes, potential of water power, development of machine tools, and the rise of mechanized factories. Those researchers and entrepreneurs who were able to find efficient solutions related to these areas had huge prospects for success. Clearly, crucial "elements" of actual technologies have to be identified and applied in a new way to find solutions to current problems and challenges.

When talking about the fourth technological revolution (Industry 4.0), core and enabling technologies, which are driving forces of these developments, can already be identified. Key representatives are BCs, IoT devices, Big Data, Artificial Intelligence (AI), Cloud Computing, Virtual Reality, Additive Technologies, and Security. These key technologies have to be well understood at their core:

- Massive storage and processing are enabled by Cloud Computing, mostly as a result of recent computer communications technologies developments. This way, servers' farms may be formed anywhere in the internet and offered for deployment where needed as if they were available locally.
- On the other side, the cyberspace is getting densely populated with various small computing devices, IoT, which typically lack computational resources, while mostly performing sensor-like functionalities toward physical world. IoT can be considered as a kind of sensorics layer of the internet, which is becoming the main source of data globally (Gagliordi, 2018).
- Data (including those generated by the IoT) gradually require a storage with a ledger-like functionality that ensures their integrity and reliable provisioning. BCs play a pivotal role here with their deployments of cryptographic mechanisms and consensus protocols, which result in a distributed, incorruptible, and tamper-resistant database.
- Processing of all these data requires appropriate technological means. Storage and processing power described above enable ubiquitous implementations of AI. These run over Big Data and find solutions for various decision-making problems. The more data there are, the better AI solutions become.
- When bridging the above processes, which are mainly taking place in the digital world, toward the physical world, robots and 3D technologies come into play. Clearly, most often their deployment is in advanced tangible output production processes due to the very nature of robots and 3D technologies.
- Overlapping physical and digital realms are virtual and augmented reality technologies that use cyberspace resources to create completely new (virtual) realities or to create outputs that are "implanted" into the physical world and perceived by users as being an integral part of this physical world.
- The systemic "glue" of all the aforementioned technologies is Security Technologies, as without Security (and often also privacy), the above technologies are vulnerable at their core. Their functionalities and functioning can be subverted to an extent that would make them unusable not only for businesses but also for private life deployments.

The main lessons learnt with the aforementioned Industry 4.0 technologies are the following:

- Raw power does make a difference. Many AI principles like (deep) neural networks have been known for a long time, but there has not been sufficient processing power to make them serviceable. This could be referred to as a foreseen disruptive scenario. Many organizations have in fact already been playing with this technology and waiting for its boom to come.
- With the invention of Bitcoin, its BC structure was created as a necessary kind of infrastructure for this digital currency to make it operationally usable. However, it soon turned out that BC can live a life on its own, providing "just" a ledger kind of functionality for numerous purposes not possible so far, including smart contracts. This could be referred to as an unforeseen disruptive scenario. No organization

has been playing with this technology, as it was simply unavailable.

Forced Connections Technique Principles

The purpose of creativity techniques is to avoid established ways of thinking and to find solutions within the known. The longer we deal with one problem, the more stereotypical our thinking is (Likar et al., 2006). Theory of creative thinking encompasses more than a hundred methods, which have different starting points (known vs. unknown problem to participants), goals (useful vs. extremely original ideas), numbers of participants (group vs. individual), ways of performing the creative process (ideas based on creativity of participants, ideas based on solutions from nature, and creativity originating from forced associations), etc. Such techniques are, for example, brainstorming, Gordon's technique, morphological analysis, bionics, Forced Connections, and others (Likar, 2007). There are also lateral thinking techniques, see e.g., De Bono and Zimbalist (1970). In addition, there are many other approaches and techniques, which can be fruitfully applied for idea creation (Zendejas and Chiasson, 2008; Košmrlj et al., 2015). Due to more and more in-depth knowledge, solutions often become more complex, which is not necessarily effective. The Forced Connections Technique, which is based on Morphological Forced Connections, presented by Koberg and Bagnall in the early 1970s (Putri et al., 2019), is one of those techniques that address the aforementioned problems. Moreover, we can also find "random" combinations, which have led to many discoveries in the past, e.g., vulcanization process, or discovery of penicillin.

Hence, the Forced Connections Technique is based on our ability to generate associations between disparate items, e.g., constructs, ideas, pictures, physical objects, or words. Its aim is to make a link between problems and challenges on one side, and randomly selected words and constructions on the other. It relies on random external triggers that force people to make a connection between the problem at hand and the triggers, which cause people to broaden their perspective and thus create original ideas that can represent the base for disruptive ones. The first step is to find random words. We look for them in dictionaries, lexicons, professional books, indexes, and suchlike. It is important not to choose only the words that we find interesting—they have to be chosen randomly. In its simplest form, we can place our finger on an index, find the word, and write it down on a paper.

The Forced Connections Technique addresses four types of connections. However, in a case where we apply it to a concrete problem, i.e., our challenge, and look for new solutions, we have two basic possibilities presented in **Table 1**.

By connecting a random word with a concrete problem, solutions may be found beyond known frameworks. One such example is the car rust problem. Random words can be window, plastic, water, and crocodile. To begin with, the conjunction "and" is omitted from the chosen words.

*The direct link method (cell A in **Table 1**) gives the following answers:*

TABLE 1 | Typology of connections (associations) within Forced Connections Technique.

Connections	Random word—a concrete problem
Direct	A
Indirect	B

- Window: A car should have more windows to minimize rust.
- Plastic: A car should be made of plastic.
- Plastic: A car is plasticized or made of plastic.
- Water: We have no direct association.
- Crocodile: We have no direct association.

*The indirect link (cell B in **Table 1**) offers several options:*

- Window: We use a computer with MS Windows to make it easier to solve the problem of rust, so we do a computer simulation of rust.
- Plastic: We look for some kind of plastic with mechanical properties of steel.
- Water: It causes rusting, but it is facilitated by chemical elements found in the atmosphere and thus air pollution should be reduced air pollution.
- Crocodile: It lives in water with various fish like electric stingray. Continuing with electricity, we come to cathodic protection, which nowadays successfully protects cars' metal parts, bridge structures, etc.

The most important "asset" of the idea creation process is a team—building an appropriate team is one of the key success factors. There are many useful concepts and methodologies, e.g., the VICTORY model proposed by Tang (2019), which addresses non-cognitive, cognitive, and environmental enablers of team creativity.

Distance Learning Challenges

The development of a method for creation of ideas for disruptive innovations follows. Using a pilot study, it will be applied to current pandemic distance learning challenges. Therefore, this section deals with theoretical background related to distance learning.

We start with a wider picture related to adherence of educational systems and the needs of societies and economies in 2010. So, as early as (OECD, 2010) recognized that these systems must adapt to the rapid development of the economy and enable young people to develop skills that will help them be as effective as possible at their work (Belak et al., 2017). The society and all its crucial sub-structures (economy, educational system, R&D sphere, medical system, culture, and governmental institutions) are driven by people. Besides, future development is based on new generations, so the education system is the most important pillar of their knowledge, experiences, and personal competences. Consequently, this system is crucial for our societies and countries in general. The obvious question is whether, in its current form, it is really aligned with the real needs. Sir K. Robinson, one of the best-known thinkers in the

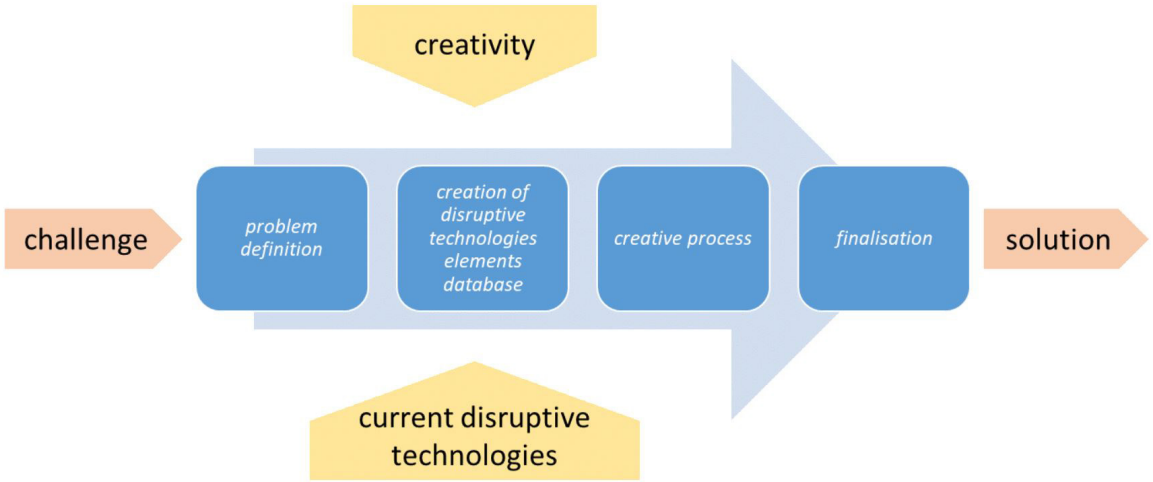

FIGURE 1 | Ordo ab Chao method structure and steps.

education sphere, has stressed many times that this system has never been seriously modified, while other areas of society, e.g., economy, culture, and personal development, have made a huge progress in the last 50 years (Robinson, 2010). The opinion of Carmody (2009), co-author of the bestseller *Disruptive Class: How Disruptive Innovation Will Change the Way the World Learns*, supports this thesis. He explains that the current form of teaching "is unable to provide today's pupils with the skills they need to master in order to interact with and within the digital society". He highlights the need for a disruptive education that approaches learning in a somewhat different way.

During the COVID-19 outbreak, UNESCO defined a set of actual challenges (UNESCO, 2020). Those that are related *to our challenge, which is to make distance teaching process comparable to face-to-face lecturing*, are given below:

- Interrupted learning: Schooling provides essential learning, and when schools close, children and youth are deprived of opportunities for growth and development. The disadvantages are disproportionate for under-privileged learners who tend to have fewer educational opportunities beyond school.
- Unequal access to digital learning portals: Lack of access to technology or good internet connectivity is an obstacle to continuous learning process, especially for students from disadvantaged families.
- Social isolation: Schools are hubs of social activity and human interaction. When schools are closed, many children and youth miss out of on social contact that is essential to learning and development.

UNESCO suggests some distance learning solutions like digital learning management systems, external repositories of distance learning solutions, systems built for use with basic mobile phones (or with strong offline functionality), Massive Open Online Course Platforms, self-directed learning content, mobile reading applications, collaboration platforms with live video, and tools for teachers to create digital learning content.

McKinsey's study, although focused exclusively on higher education, showed similar results, with an additional important message. Universities and colleges are expected to be under pressure to develop and deliver online courses, which will put their budgets under even more pressure. Online programs have traditionally been cheaper (Bevins et al., 2020). However, this financial pressure threatens to significantly reduce the quality of such kind of lecturing. The authors' own experiences show that virtual lecturing can be rather effective even if "only" traditional methods are adapted. However, it is important that there is a real-time contact between a lecturer and students. It seems that what counts are the following three elements: interactivity, interactivity, and interactivity. On top of this, even the most influential and dominant massive online course platforms like Coursera have a success rate well below 10% (i.e., those who finish a course). So, the second goal is *to drive the developments in higher education sector into personalized education.*

Summing up, amid new COVID-19 reality, new models and solutions to push traditional methods to comparable levels as in ordinary settings are needed. Further, we should aim also at new ways to additionally add value and deliver enhanced education for new generations at acceptably increased costs through personalization of education processes.

Action Research Background

According to Reason and Bradbury (2008), the primary purpose of action research is to produce practical knowledge that is useful to people in the everyday conduct of their lives. Therefore, action research is about working toward practical outcomes and it is also about "creating new forms of understanding". As stressed by Koshy et al. (2010), action research creates knowledge based on enquiries conducted within specific and often practical contexts. The purpose of action research is to learn through action that then leads to personal or professional development.

The spiral model gives an opportunity to tackle a phenomenon at a higher level each time and so to progress toward a greater overall understanding.

The main idea behind the development of the Orde ab Chao method is to enable (and to enhance the probability of) producing disruptive ideas. It represents a new knowledge, with a clear practical outcome. Disruptive ideas and consequentially innovations are highly appreciated within the innovation typology, yet very difficult to create. When the basic concept of the Orde ab Chao method has been developed, we conducted a research focused on its verification and further development. We used an action research model employed by Elliot (1991 :71), which includes identification of a general idea, reconnaissance (fact-finding), planning, action, evaluation, amending plan, and taking a second action step.

ORDE AB CHAO ACTION RESEARCH METHODOLOGY

In this section, the crucial elements of action research methodology behind the Orde ab Chao method are presented, while the section *COVID-19 Pandemic Application in Higher Education* addresses concrete steps related to this methodology.

We applied a simplified methodology presented by Urquhart et al. (2012), which addresses various holistic aspects of research—for our methodology, the potentially disruptive solutions present the most important criterion. In addition, topics of fluency, i.e., number of ideas and their originality (Dixon, 1979; Ding et al., 2014), potential benefits for users (and also creative session participants' structure), and feedback from participants and from moderators, are covered as well. By doing so, we addressed some important issues in a structured way. At the conceptual level, the approach is similar to cancer treatment-related approach described by de Baca et al. (2015), where authors addressed the following: patient demographics; disease, diagnosis, and prognosis; tumor board dispositions and decisions; graphic timeline; pre-resection workup and therapy; resection workup; interpretative comment summarizing pertinent findings; biobanking data; postresection workup; and disease and patient status at follow-up. Furthermore, we wanted to create a methodology in a way that would enable us to observe, measure, and record some important properties of the *Ordo ab Chao* method. Such a concept also represents a step toward synoptic reports. Synoptic reports utilize a standardized template to record data and have emerged as an alternative to narrative reports. They have a higher degree of overall completeness compared to narrative reports: 60% vs. 45% (Eng et al., 2018). In this way, our methodology may be tested also by using other glossary databases and finding the most suitable databases related with a certain challenge.

Regarding evaluation of ideas created, there are various approaches addressing different dimensions. Dean et al. (2005) addresses novelty, workability, relevance, and specificity. A similar approach can be observed by Kudrowitz and Wallace (2013) that focuses on creativity, novelty, usefulness, product–product worthiness, and clarity. Some authors also add usefulness of the answer, with which we check how useful it is in a certain situation (Pečjak, 2001). Correa and De Moura Ferreira Danilevicz (2015) focus more on aspects related to company's strategy, feasibility, financial aspects, and others. With our research, which is not yet focused on a concrete company's strategy, we decided to evaluate two dimensions of ideas: originality and potential benefit for users.

The obvious question is why we have decided for these two criteria. Originality is a precondition for breakthrough ideas/innovations (Christensen et al., 2015). Only original ideas represent a clear distinction to already known solutions and have the potential to be disruptive. In addition, only original ideas are needed; however, they must also have potential to develop into innovations. Therefore, the next criterion is related to potential benefit for the user.

To assess originality from a qualitative point of view, the scale of Dean et al. (2005) was applied, deployed in their research on the evaluation of ideas as follows:

- 4—The idea is rare, unusual, imaginative, resourceful, and surprising; it can even be humorous.
- 3—The idea is unusual; it shows some imagination.
- 2—The idea is interesting.
- 1—The idea is ordinary, boring.

To access the potential benefit for a user, Kano's concept (Chen and Chuang, 2008; Mikulić and Prebežac, 2011; Yang and Yang, 2011) was applied.

- The must-be or basic quality: At this point, customers become dissatisfied when the performance of this product criterion is low or the product attribute is absent (such as a bicycle breaks). However, customer satisfaction does not rise above neutral with a high-performance product criterion.
- One-dimensional or performance quality: Here, customer satisfaction is a linear function of a product criterion performance. High attribute performance leads to high customer satisfaction and vice versa.
- The attractive or excitement quality: Here, customer satisfaction increases super linearly with increasing attribute performance. There is not, however, a corresponding decrease in customer satisfaction with a decrease in criterion performance (Chen and Chuang, 2008).

It is better to perform the evaluation process with a larger number of evaluators and not just one, as this ensures greater credibility and objectivity of the evaluation of ideas. Besides, most of them should not be a member of the creative team due to objectivity. It is also essential that experts for this phase are familiar with state-of-the-art solutions and have appropriate knowledge to evaluate various aspect of ideas (originality, benefits for users, etc.).

Ordo ab Chao Method

This method is based on two inputs, the Forced Connections Technique and disruptive technologies related to selected words, also referred to as *elements*. It consists of the following steps:

1. *Problem definition.* First, the problem/challenge is narrowed down and clearly defined.
2. *Creation of disruptive technologies elements database*. Instead of using random words for creating unexpected ideas, keywords from the domain of the presented eight kinds of disruptive technologies (BCs, IoT devices, Big Data, AI, Cloud Computing, Virtual Reality, Additive Technologies, and Security) are used. With this important step, the state-of-the-art disruptive technologies into our problem-solving process is applied. For each of these technologies, appropriate *elements* are sought. For example, for Virtual Reality, an appropriate source including crucial *elements* needs to be found. This can be appropriate glossary in the area of Virtual Reality. Consistent with our experience, it is very useful if the glossary has the following characteristics:
   - it includes state-of-the-art words that are narrowed down into the final set of elements;
   - it is comprehensive enough, yet not excessively long (roughly 50 elements are suggested);
   - each element has a short description, so that also a generalist can understand the meaning and use it in the creative session.
3. *Creative process* (implementation of Forced Connections). For the starting problem, a mental process looking for creative association is performed (direct or indirect), which represents a possible original solution of the defined problem.
   - Direct: either technological solutions, which are based on elements for each of the technology used can be expected, or
   - Indirect: Other types of ides may also be expected, e.g., organizational with no direct connection with the disruptive element.

On one side, a highly creative and often chaotic brain process takes place, while systematically following the identified elements. A two-phase approach is suggested:

- Each participant chooses his/her own elements for one technology and goes through possible associations. This can take 30 to 60 min not to exhaust the participant, and to get a pool of independent ideas.
- At a joint session, participants present their ideas and, with brainstorming, upgrade these ideas using the group dynamics. The aim is to upgrade their ideas with new suggestions and also to focus them on concrete problems where applicable.

4. *Finalization*. This is a final phase that is aimed at:
   - Making a selection of most original ideas with the highest potential.
   - Merging similar ideas. It often happens that ideas are overlapping, so it makes sense to merge them (overlapping ideas trigger similar or same solutions).
   - Merging ideas that address the same problem. This streamlines the diversity of generated solutions into corresponding groups.

   This phase, i.e., selection of ideas, was done by a group of four people; two of them were members of creative session (step 3) and two were new and therefore more objective. The selection process followed two criteria:

   - Originality of an idea was measured with a scale suggested by Dean et al. (2005) as presented in Literature review: Evaluation of results. As presented, a score of 4 is the highest (rare, unusual ideas, while 1 means ordinary, boring ideas).
   - The potential benefit for the user was measured with three categories as presented in Literature review (1 = basic quality, 2 = performance quality, and 3 = excitement quality).

Following the action research methodology, we also suggest guidelines for application in praxis in the section *Practical hints for Ordo ab Chao users*.

COVID-19 PANDEMIC APPLICATION IN HIGHER EDUCATION

In this section, an application of the *Ordo ab Chao* method for addressing challenges in education processes amid new worldwide reality caused by the COVID-19 virus is presented.

For the Orde ab Chao method, a pilot study was performed to test if it provides expected disruptive results, to examine the structure of participants teams related to their background knowledge, to observe the number of achieved ideas, and to evaluate their originality and potential related to expected user's experience. In addition, the feedback of participants and the moderator can provide constructive information.

Seven groups of participants, each consisting of approximately three participants, were formed. In two of the groups, the participants with mainly technical competencies (hereinafter referred to as technical team) were included. Two groups included participants with mainly social science competences (hereinafter referred to as social team), while three groups consisted of participants with blended competences (hereinafter referred to as blended team), namely, two to three participants with social science competences and approximately one member with technical competencies. Each group used one glossary element set, either IoT or VR. Besides, there was a coordinator (an expert in the Orde ab Chao methodology and glossary element support) that was of assistance to the participants.

Before the creative session (please see **Figure 1**), step 1 (Problem definition) and step 2 (Creation of disruptive technologies elements database) were already done by the authors. Otherwise, it should be done by the coordinator.

The duration of step 3 (Creative process) was approximately 15 min for presentation of the method and another 15 min for preparing for work in the Pilot Creative Session, where participants started working by themselves and the coordinator helped them to completely understand the method and their task. The pure creative session related to association took approximately 60 min.

For step 4 (Finalization), additional explanation is needed as to the selection of most original ideas. Following the Orde ab Chao concept, we wanted to achieve original ideas with the potential to become disruptive and/or breakthrough innovations. Therefore, all the ideas were evaluated following the two criteria:

- originality from a qualitative point of view (Dean's criteria 1–4; 1—The idea is ordinary. . . and 4—The idea is rare, unusual. . .),
- potential benefit for the user (Kano's concept: 1—basic, 2—performance, 3—excitement).

The evaluation process was performed after the creative session and took approximately 60 min (per group).

Problem Definition (Step 1)

Based on the described distance learning challenges, the research problem/challenge was defined, i.e., how to develop new models and solutions to push traditional methods to the same levels as in ordinary settings (goal I). Further, we should also aim at new ways to additionally add value and deliver better education for new generations at acceptably increased costs through personalization of education processes (goal II).

Creation of Disruptive Technology *Elements* Database (Step 2)

The mentioned six categories of Industry 4.0 disruptive technologies are addressed: BCs, IoT devices, Big Data, AI, Cloud Computing, Virtual Reality, Additive Technologies, and Security. For each of these six technologies, appropriate *elements* first need to be found. For the purpose of demonstration, emphasis is placed on two categories: Virtual Reality and IoT. For performing this step, two dictionaries were chosen and the terms below were obtained:

- Virtual Reality (VR) glossary encompassed 61 terms, namely (Simpson, 2020): *360, Experience*, *360 Live Streaming*, *360 Panorama*, *360 Photo*, *360 Video*, *3D Audio*, *All-In-One, Headset, ARCORE, ARKIT, Augmented Reality*, *Avatar*, *Cave Automatic Virtual, Environment*, *Computer Generated Virtual Reality*, *Computer Aided Design*, *Data/Wired Glove*, *Duck Test*, *Experiencer/User/Player*, *Extended Reality*, *Eye Tracking*, *Field Of, View*, *Foveated Rendering*, *Gaze-Activated Content*, *Gl Transmission Format*, *HAPTICS*, *Head, Mounted Display/Headset/Goggles*, *Head Tracking*, *Head-Up Display*, *Heatmap*, *Hotspot*, *HTC VIVE*, *Immersion*, *Immersive Reality*, *Inertial Measurement Unit*, *Latency*, *Light, Field Technology*, *Locomotion*, *Mesh*, *Mixed Reality*, *Mobile Headset, Oculus Rift*, *Perambulation (Locomotion)*, *Positional Sensor*, *Presence*, *Real Life*, *Reticle*, *Room-Scale*, *Six, Degrees-Of-Freedom*, *Spatial Mapping*, *Spherical Panorama*, *Stitching*, *Surface Detection*, *Teleportation, Telestration*, *Tethered Headset*, *Transportation*, *Unity, 3D*, *Virtual Reality (VR)*, *Virtual Reality Sickness*, *VR Marketing*, *Vuforia*, *WebVR.*
- IoT Glossary encompassed 55 terms, namely (VR, 2020): *Actuator, Advanced Message Queuing Protocol, Application Agents, Bluetooth Low Energy, Chirps, Competing Consumers, Connected Devices, Connectivity Protection, Constrained, Application Protocol, Data Filtration, Device-Agnostic Control, Direct Messaging, Edge Gateway, Edge Layer, Embedded Device/Systems, Endpoint Device, Flow-Based Programming, Geofencing, Haze Computing, Home Automation, iBeacon, Industrial Internet, Integrator, Internet of Things*, *Internet Protocol Suite*, *IoT Cloud Platform, IoT Development Board, Lightweight Protocol, Long Range Communication Protocols, Low-Power Devices, Machine-to-Machine, Mesh Network, Microcontroller, Messaging Protocols, Message Queuing, Telemetry Transport, Multi-Agent System, Near-Field Communication, Operability, Personal Area Network, Propagator, Radio Frequency Identification, Real-Time Operating, System, Releasability, Sensor, Sensor Network, Single-Board Computer, Site-Level, Management, Store and Forward, System on a Chip, Transmission Control Protocol/Internet Protocol, Ubiquitous Computing, Wearables, Wi-Fi, ZigBee, Z-Wave.*

The above two dictionaries have also been used for description and better understanding of the *elements*.

Creative Process and Finalization (Steps 3 and 4)

Due to too many possible associations, and not to extend the length of the paper, only those ideas with the highest potential are partially merged together and presented (steps 3 and 4 of the presented method are merged).

Glossary Element: VR—

Hotspot, Avatar—for a Detailed Explanation of Element, See IoT (2020) and Simpson (2020)

Problem

A class discussion is extremely important for a successful education process. However, there are relatively few verbal questions from students when using distance learning tools. Students seem to be more reserved to expose themselves by raising questions. So, typing in a chat window is often preferred, which is mainly done impulsively. Consequently, a question is often not well articulated, also because of required extensive typing performed in a short period of time.

From an idea to solution

The idea is that students connect to an artificial agent anonymously. This agent leads students to articulate their questions well, and once their question is well articulated, the lecturer is stopped and the agent tells the question to the whole virtual audience. In addition, the chat channel can be proxied to enable anonymity, when such articulation can be sacrificed, or is not so important.

Glossary Element: VR—
Eye Tracking, Field of View, Head Tracking, Heatmap, Latency. Additional Word, Pupils Dilation

Problem
Problem of "talking to the wall". During distance lecturing, one of the crucial problems is that a lecturer has an impaired "real-life" feedback from students compared to face-to-face lectures. Nevertheless, this feedback is important, as it enables good lecturers to immediately react. Practical experiences show that, with distance learning, students often lose concentration and may also engage in other activities (e.g., browsing web pages, texting, and having all kinds of other distractions in their own environments). For a lecturer, it is almost impossible to check faces of tens or hundreds of students to get visual feedback on their concentration, not to mention that such feedback on face-to-face lecturing includes also body language. In addition to limited camera captured area, online lecturing also often provides poor quality video, causing additional problems.

From an idea to solution
The telemetry is used to analyze the data gathered by the student's computer and to give feedback to the lecturer; namely, which student has lost concentration or is not following the lecture. This information would be shown as a colored bar (going from red to green) in the (sub)window of each participant and would enable the lecturer to react accordingly. Certainly, this should not be an element that leads to a "punishment", but a sign to include additional dynamics, start a discussion, suggest a break, and suchlike. The base for telemetry can also be smart glasses with sensors for eye tracking, field of view analysis, head tracking, and dilation of the pupil. Additional sensors may be placed on glass holders so as to measure skin conductance, oxygenation levels, etc. As these types of information raise privacy issues, an appropriate intermediate service (like a proxy-avatar) can regulate this info, so only the aforementioned color bar indicator is obtained in each student's sub-window, while the rest of the data are destroyed in real time. This way, privacy is preserved.

Glossary Element: VR—
Environment, Augmented Reality

Problem
Video platforms are technically well prepared, yet participants do not have the same feeling as in the classroom.

From an idea to solution
Participants' photos are not presented in separated frames but are elements in a virtual classroom. It can be done in a simple or a more sophisticated way, using the Augmented Reality principles.

Glossary Element: VR—
Experiencer/User/Player

Problem
Students are often less motivated to cooperate in comparison with the classical classroom (they report the energy in the class is different). Therefore, additional elements of motivation should be applied.

From an idea to solution
Students get bonus points for their active cooperation within the discussion, e.g., time of discussion. An additional element is optional, i.e., that a lecturer after the students' discussion "weights" the relevance of student's discussion.

Glossary Element: VR—
Head Tracking

Problem
Presenters do not have the impression of the whole auditory and their agreement/disagreement with the content in case of many participants or if they do not want to share their photo on video platform.

From an idea to solution
Detecting students either nodding/shaking their heads, and as a next step, the system would send the lecturer only aggregate information from the audience (or individual) about non-verbal communication.

Glossary Element: VR—
Heatmap, Head Tracking, Eye Tracking

Problem
When the lecturer asks the audience to read the text, he/she does not know when students finished reading.

From an idea to solution
The computer video system recognizes eye/face movement patterns when participants are reading. Identifying how many people have already read the text (via Heatmap, Head Tracking, or Eye Tracking), a professor receives the info on percentage of those who have already finished. Thus, he/she can move the text forward.

Action Research Methodology Implementation

In the previous section, the basics for action research were presented. As it will be explained, the whole method was being developed step by step, cycle by cycle. These cycles, following the action research paradigm, will be presented as follows: reconnaissance (fact-finding), planning, action, evaluation, measuring/evaluating results (ideas), feedback from moderator (observation) and feedback from participants, and amending plan.

Cycle 1

The starting point is based on literature review and authors' ideas. First, we selected participants (technical team) for the Orde ab Chao creative session. They received brief instructions regarding methodology. In this cycle, there was no moderator. At the end of the creative session, we provided evaluation of ideas (independent team of two to three people) and prepared a brief open question interview for the participants of the technical team. The first group (one technical team) performed the Orde ab Chao method. A creative process was based on two glossary element sets. During the evaluation phase, evaluators assessed ideas—the only criterion was their disruptive potential. Based on the

interview with the team, we realized that brief instructions were not sufficient and part of created ideas was not clearly focused into searching solutions of the basic challenge. The evaluators also reported that ideas were "very technical". There was also a remark that the number of ideas was quite low compared to other creativity techniques, e.g., brainstorming or Forced Connections, where 30–50 or more ideas can be expected (Likar, 2007). Based on these experiences, we prepared an improved methodology for Cycle 2. It included more detailed personal instructions for creative session implementation. In addition, a more detailed and comprehensive evaluation methodology was introduced (see the section "ORDE AB CHAO ACTION RESEARCH METHODOLOGY"). We also wanted to test how another structure of participants—not only technical team—would perform. We decided to test a social sciences team and a technical team.

Cycle 2

Based on the amending plan, we performed the second cycle with social teams (two groups) and a technical team (one group). When all the Orde ab Chao steps were done, evaluators did their work following the more detailed and comprehensive evaluation methodology already presented in section Orde ab Chao conceptualization and action research evaluation methodology. First, we evaluated the creative session results: number of ideas, their originality, and potential benefits for users. We also performed interviews with participants. The observations showed some interesting differences in results between both groups. Social groups had more ideas, but originality and potential benefit for users seemed to be lower. The interviews showed that participants who were familiar with the Forced connection method had no problems. Yet, the other group faced problems, especially in developing indirect connections (see **Table 1**). In addition, we realized that with the present quantitative (number/evaluation of ideas) and qualitative instruments (interview with team members), we do not have a sufficient insight into the creative session of the teams. Based on these experiences, we prepared additional improvements in the method. We first upgraded the introduction of the Pilot Creative Session. After the ex-cathedra presentation, participants started working by themselves and the coordinator helped them to completely understand the method and their task. The coordinator was also a part of the method and participated in the creative session. Though we developed a system, which was composed of humans engaged in interaction, using gestures and language resulted in the creation of impressions and the transmission of information as suggested by Koshy et al. (2010). In addition, we upgraded the evaluation toolkit with an interview with the coordinator and received an insight into the Orde ab Chao process. We also wanted to test the idea of blended teams, including participants with social and technical skills.

Cycle 3

Based on the amending plan, we performed the third cycle with social teams (three groups). There was a coordinator, who firstly performed a Pilot Creative Session, supported the session, and also observed the work. In addition, we collected participants' as well as moderators' feedback and evaluated ideas following the already presented methodology. The results of this cycle in comparison with previous cycles are presented in the next subchapter.

Overall Evaluation of Results

As mentioned, we had seven groups, which is obviously not enough for quantitative analysis. Therefore, the focus was mainly on qualitative results. Quantitative results were gathered only as indicators for further research, the main one being that each group created approximately 19 ideas (average = 18.6).

As to the rest of the criteria, the first impression is surprising. Regarding originality, 20% of them had the highest ranking 4, and regarding the criteria of potential benefit for the user, 10% of all ideas achieved the highest grade (excitement). Some differences among groups were also detected. The social team and blended team had comparable number of all ideas, while the technical team had less. However, what is more interesting is the number of most original ideas, which was approximately two times higher in the blended team and the technical team, compared to the social team. Even more fascinating is the number of "excited" ideas (potential benefit for the user criterium). The blended and technical teams had six to seven times more ideas in the mentioned "excitement" rank. When analyzing the session and the results, it was concluded that the technical team understands the glossary elements and technical solutions better. It seems that they are more critical to their own ideas (self-criticism), which is one of the problems of creativity sessions, especially by experts (Pečjak, 2001). However, at the same time, their ideas seem to be more realistic. Basic average values are presented in **Table 2**.

Evaluation of Creative Sessions

Further evaluation included feedbacks from participants and from moderators that are included in the subsection below.

Participants' feedback

- At times, it was not easy to look for associations to glossary elements that we did not understand well.
- We find the method very interesting and was helpful in creating ideas on the subject.
- The method is useful. It helps with wider problems.
- The method somewhat limits us to find solutions from one area (technology). If we did not use it, we could find another solution from another area.
- Some of the ideas are very original to us—without this technique, we would not have come up with them.
- The task seemed very instructive to us, as we were thinking for the first time about what is not good with the distance learning platform (e.g., Zoom) and how to improve it.
- A lot of cooperation was needed.

TABLE 2 | Indicative results—number of ideas.

NUMBER OF IDEAS	All seven groups	Social team	Blended team	Technical team
All ideas	19	17.0	20.3	12.5
Originality = 4 (rare)	3.6	2.0	4.3	4.0
Potential benefit for the user = 3 (excitement)	2.4	0.5	3.0	3.5

Moderators' feedback

- The methodology of the work needs to be explained first in the plenary session. Occasionally, some participants only looked for associations, but they were not focused on finding a solution to the initial challenge. It makes sense to conduct a Pilot Creative Session (3–5 min) in each group, where participants practically start working according to the methodology, and the moderator guides them while ensuring full understanding and proper implementation of the concept.
- As the participants (mainly social science participants) are often not familiar with technical glossary elements, their understanding is important for efficient idea creation process. Therefore, we suggest to create blended teams—a combination of participants with social science background and technicians, who are familiar with technical glossary terms. If such a person leads the creative session, he/she can also manage and direct the process and step by step toward original, but also realistic solutions.
- After 30–45 min of intensive creative work, participants' creativity decreased. Therefore, if 45 min is not enough for the whole session, we suggest to make a break and then to continue.

Practical Hints for Ordo ab Chao Users

Although the Ordo ab Chao method can be run individually, group dynamics plays an important role in brainstorming. To run it effectively in a group setting, it is recommended to do as follows:

- Before starting work in groups, it makes sense to conduct a Pilot Creative Session (3–5 min).
- Define the problem you want to solve in a crystal-clear way to all participants.
- Keep the session focused on the problem solving.
- Ensure that no one criticizes or evaluates ideas during the session. Criticism induces a component of risk for group members when putting forward an idea. This stifles creativity as well as most original ideas and cripples the free-running nature of a good brainstorming session.
- Encourage an enthusiastic, uncritical attitude among members of the group. Try to get everyone to contribute and develop ideas, including quiet members of the group.
- Let people have fun while brainstorming (encourage them to come up with as many ideas as possible, from solidly practical to wildly impractical ones, welcome creativity).
- Ensure that no "train of thoughts" is followed for too long.
- Encourage people to develop other people's ideas, or to use other ideas to create new ones.
- Try to keep the process running smooth and making it fast enough so it does not exceed 60 min when people typically get exhausted.
- In order to find a complete solution, it would make sense to use another technique that does not guide thinking, for example, brainstorming.
- If 45 min is not enough for the whole session, it is suggested to take a break before continuing.

It is also important to select and invite appropriate participants. Based on literature (e.g., Likar, 2007) and evaluation of our pilot study, we suggest the following structure of participants (**Table 3**). In addition, the VICTORY model elements can be useful (Tang, 2019) in synthesizing both non-cognitive (vision, openness, risk-taking, yes-I-can mindset) and cognitive (ideation, combination) antecedents of team creativity.

CONCLUSION

The current worldwide pandemic has revealed the need for many existing services to be adapted to a new normal, or even to introduce new ones, based on new paradigms. One such notable case is a higher education sector.

This situation and gained experiences in distance learning lecturing at the university level triggered the authors of this paper to look for solutions. Being specialized in innovation management techniques, it was found that there is no such technique, which would focus on a completely "disruptive scenario". Actually, the current pandemic is a disruptive scenario itself, while recent Industry 4.0 (and society 4.0 in general) disruptive technologies are already a fact. Yet, there is a missing link that would provide "disruptive scenarios and technologies" focused innovation processes. Such an approach

TABLE 3 | Optimal characteristics of participants.

Step	Structure	Type of competencies
1—Problem definition	Coordinator (in cooperation of the problem owner)	Person who understands the challenge, is familiar with technology and creativity management
2—Creation of disruptive technologies elements database	Coordinator	Person who understands the challenge, is familiar with technology and creativity management
3—Creative process	Blended team (social science, technical science background—at least one)	Creative persons with various experiences
4—Finalization	Mixed team—1–2 participants of the Creative process, the other should be new and therefore more objective	Experts familiar with state-of-the-art solutions and have appropriate knowledge to evaluate various aspect of ideas (originality, benefits for users, implementability, etc.).

would represent an important novelty compared to existing methods for idea creation.

Therefore, this paper presents a new method, called *Ordo ab Chao*, which provides the aforementioned missing link. It complements the existing innovative thinking techniques and takes them a few steps further. It focuses on disruptive ideas creation that are tied to the existing (or emerging) disruptive technologies in order to facilitate creation of disruptive ideas with a potential for real-life implementations. Stimulated by the current COVID pandemic, it has been demonstrated how the technique can be applied in practice in higher education processes so as to make virtual lecturing comparable (or better, where possible) to face-to-face lecturing conditions. The presented Orde ab Chao application also introduces a new "disruptive direction," which is a personalized study and training. This will entail additional educational and research standards for lecturers. If supported with appropriate technology changes, they are achievable. Contrary to common belief that cutting costs with technology provides grounds also for higher education system, we believe that this is one of core sectors for prosperity and well-being of every society, just like the healthcare sector. So, the costs may also rise. However, if technology is used accordingly to increase value added (in a disruptive way), the benefits may far exceed the costs. The *Ordo ab Chao* technique represents a tool for systematic development of such disruptive solutions, building on a creative synergy between cutting-edge technologies and innovation management approaches.

As to the evaluation of ideas developed by the presented method, we introduced the criteria of originality and potential benefits for users. Of course, for practical use in companies, additional criteria will include market analysis, cost–benefit analysis, capacity for implementation, time to market, intellectual property aspects, competition analysis, and others.

Finally, the Orde ab chao method can be positioned within a more generalized theoretical frame. For the starting point, we used a concept of three different methodological approaches to case research: theory generation, theory testing, and theory elaboration (Ketokivi and Choi, 2014). Following the criteria presented, the case research decision tree (Ketokivi and Choi, 2014), and results presented in this paper, it follows that the Orde ab Chao method fits into theory testing model. Most importantly, it is a promising tool for disruptive idea creation, which is among the most valuable "diamonds" in all organizations and professions, especially if they have the potential to become a real innovation.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

BL has contributed to the research on existing innovations creation techniques and their analysis (weaknesses) with relation to disruptive technologies. DT has contributed to the analysis of Industry 4.0 disruptive technologies with focus on business views (including their business models potential), BL and DT have both contributed to the creation of the new technique based on the above inputs, its refinement, including inclusion of their own experiences with distance lecturing at uni-level during recent months (due to Corona pandemics). Both authors contributed to the article and approved the submitted version.

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REVIEW
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Preparing Workplaces for Digital Transformation: An Integrative Review and Framework of Multi-Level Factors

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The rapid advancement of new digital technologies, such as smart technology, artificial intelligence (AI) and automation, robotics, cloud computing, and the Internet of Things (IoT), is fundamentally changing the nature of work and increasing concerns about the future of jobs and organizations. To keep pace with rapid disruption, companies need to update and transform business models to remain competitive. Meanwhile, the growth of advanced technologies is changing the types of skills and competencies needed in the workplace and demanded a shift in mindset among individuals, teams and organizations. The recent COVID-19 pandemic has accelerated digitalization trends, while heightening the importance of employee resilience and well-being in adapting to widespread job and technological disruption. Although digital transformation is a new and urgent imperative, there is a long trajectory of rigorous research that can readily be applied to grasp these emerging trends. Recent studies and reviews of digital transformation have primarily focused on the business and strategic levels, with only modest integration of employee-related factors. Our review article seeks to fill these critical gaps by identifying and consolidating key factors important for an organization's overarching digital transformation. We reviewed studies across multiple disciplines and integrated the findings into a multi-level framework. At the individual level, we propose five overarching factors related to effective digital transformation among employees: technology adoption; perceptions and attitudes toward technological change; skills and training; workplace resilience and adaptability, and work-related wellbeing. At the group-level, we identified three factors necessary for digital transformation: team communication and collaboration; workplace relationships and team identification, and team adaptability and resilience. Finally, at the organizational-level, we proposed three factors for digital transformation: leadership; human resources, and organizational culture/climate. Our review of the literature confirms that multi-level factors are important when planning for and embarking on digital transformation, thereby providing a framework for future research and practice.

Keywords: digital transformation, digital disruption, digital technology, workplace, organization, employee, literature review, multi-level framework

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INTRODUCTION

The rapid advancement of digital technologies such as smart technology, artificial intelligence (AI) and automation, robotics, cloud computing, and the Internet of Things (IoT) is fundamentally changing the nature of work and organizations. Collectively termed the Fourth Industrial Revolution (Schwab, 2015) or Industry 4.0, the speed and scale of current technological change are raising concerns about the extent to which new technologies will radically transform workplaces or displace workers altogether (Acemoglu and Autor, 2011; Frey and Osborne, 2013; Brynjolfsson and McAfee, 2014). The impact of digital disruption on labor markets remains contested, with some predicting substantial job losses through automation within a short time period (Frey and Osborne, 2013; McKinsey and Company, 2017). Others paint a more optimistic picture, predicting that as many new jobs will be created by new technologies as are displaced (Arntz et al., 2017). Nonetheless, the effects of digitalization are already being felt across a number of job roles and industries (Skog et al., 2018) and it is clear that organizations need to integrate new technologies and transform business models to remain competitive (Sebastian et al., 2017). Despite significant academic attention on how digital technology is disrupting job tasks and occupations (e.g., Acemoglu and Autor, 2011; Brynjolfsson and McAfee, 2014), there is less understanding of how workers and organizations can best respond to disruptive technological change. A central concern is how to bolster employee and organizational resilience to disruption from new technologies.

Although digital transformation is a new and urgent imperative, there is a long trajectory of rigorous research across multiple disciplines that can readily be applied to grasp these emerging trends. The impact of technology in the workplace has been studied for several decades (Davis, 1989; Orlikowski, 1992) and has its origins in information systems, psychology, and sociology (Venkatesh et al., 2003), alongside contributions from organizational behavior, management and communications (Huber, 1990; Dewett and Jones, 2001; Orlikowski, 2010). Recently, there has been sharp increase in studies from business and strategic information systems (Matt et al., 2015; Hess et al., 2016), human resources (Bondarouk et al., 2017; Marler and Boudreau, 2017), and healthcare (Agarwal et al., 2010; Burton-Jones et al., 2020), suggesting that digital disruption is increasing in a wider variety of industries and occupations.

In light of the scope and scale of digital transformation we are currently witnessing and the wellspring of diverse and valuable academic perspectives that have emerged to make sense of these changes, we believe that an evidence review of relevant literature is especially timely. Furthermore, we seek to lend greater coherence to our overall understanding of this fast-evolving landscape by taking an integrative approach that seeks to draw linkages across different disciplinary approaches. Hence, we have reviewed studies across disciplines and organized their findings into a holistic, multi-level framework. Our framework identifies and consolidates key factors critical for an organization's overarching digital transformation at the individual, group, and organizational levels.

Key Dimensions of Digital Transformation

There is a clear business case for digital transformation. By integrating new technologies into strategic processes, digital transformation aims to change business operations, processes, and services (Matt et al., 2015; Hess et al., 2016). In turn, these new digital capabilities can improve performance and expand products, services and customer bases (Westerman et al., 2014; Verhoef et al., 2019), leading to increased sales and profits (Warner and Wäger, 2019). There is consensus that industry-leaders in innovation and digital transformation have a greater competitive advantage and can attract a wider range of customers and employees (Berman, 2012; Chanias et al., 2019). Moreover, organizations that are more responsive to market trends and can adapt quickly to customer demands will also have the "first choice of talent, partners and resources" (Berman, 2012, p. 22). Indeed, competing for skilled employees is often cited as a key challenge to industry and workforce digital transformation (Karacay, 2018). In this way, digital transformation is not only about technology (Kane et al., 2015) but requires a focus on employee factors, alongside shifts in organizational strategy, structures, and processes (Hess et al., 2016).

Digital transformation is a more recent academic concept, although it draws on previous theories of IT-enabled change (Besson and Rowe, 2012; Wessel et al., 2020). While digital transformation is similar to other organizational change processes (e.g., Orlikowski, 1992; Weick and Quinn, 1999), it is a distinct form of organizational change (Hess et al., 2016; Vial, 2019; Wessel et al., 2020). Studies of IT-enabled transformation have identified various factors in the change process, such as organizational inertia, process, agency, and performance (Venkatesh, 2000; Kim and Kankanhalli, 2009; Besson and Rowe, 2012). While prior theory on IT-enabled change can inform the study of digital transformation, recent research suggests that digital transformation is a process of deep, structural change that occurs through the integration of multiple technologies and fundamentally redefines organizational value and identity (Besson and Rowe, 2012; Skog et al., 2018; Wessel et al., 2020).

Defined as a process that "aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies" (Vial, 2019, p. 121), digital transformation can occur at the organizational or broader entity-level. However, in contrast to other forms of technological change, digital transformation differs in terms of its scale, speed, and scope (Matt et al., 2015; Hess et al., 2016). When viewed as a process, digital transformation includes three main stages (Verhoef et al., 2019). First, organizations go through digitization, which involves transferring processes and systems, such as paper-based or non-analog systems, into digital formats (Tekic and Koroteev, 2019). Next, digitalization entails further integration and optimization of digital technologies and IT-capabilities to improve processes and add value to existing

operations and services (Verhoef et al., 2019). While the different phases of digitization, digitalization, and transformation often overlap, digital transformation is conceived as the final step in the process and is triggered by extensive digital capabilities (Verhoef et al., 2019).

Recent reviews have sought to integrate studies on digital transformation across different disciplines, contexts, and research streams (Hausberg et al., 2019; Vial, 2019) and identify different stages of digital transformation, including key strategies and requirements to facilitate transformation (Verhoef et al., 2019). Some have focused on digital work design and leadership (Cascio and Montealegre, 2016; Cortellazzo et al., 2019) as well as attention to human resource factors, such as the role of Human Resource Development (HRD) professionals in facilitating skills development due to technological change (Chuang and Graham, 2018; Ghislieri et al., 2018). Reviews of industry transformation in the context of manufacturing and Industry 4.0 have focused on process-model automation (Liao et al., 2017) although digital transformation is fast becoming a priority for many other industries. This shift is reflected in the literature, with recent studies and reviews focusing on digitalization and transformation in a range of industries (Chanias et al., 2019; Vial, 2019). Despite these helpful contributions, there has been less integration of how digital transformation impacts workers and organizations across multiple levels.

TECHNOLOGY ACCEPTANCE AND PERCEPTIONS AND ATTITUDES TOWARD TECHNOLOGICAL CHANGE

As organizations undergo digitalization and digital transformation, theories of technology acceptance provide important insights. With origins in information systems research and social psychology (Ajzen, 1985, 1991; Davis et al., 1989), several theoretical models exist to understand which factors influence a user's decision to adopt a new technology or system. The Technology Acceptance Model (TAM) (Davis, 1989) is one of the most commonly used frameworks and implies that behavioral intention (BI) and attitudes predict technology usage in two key ways: the perceived usefulness (PU) of technology (i.e., the degree to which a person believes that a technology will be useful) and perceived ease-of use (PEOU) (i.e., the degree to which a person believes that using a particular technology will be easy to use). TAM has been extended (TAM2) to include subjective norms and system-specific technology use (Venkatesh, 2000; Venkatesh and Davis, 2000).

More recently, Venkatesh et al. (2003) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT) that incorporated existing models with motivation (Davis et al., 1992; Vallerand, 1997), social cognitive theory (Bandura, 1986; Compeau and Higgins, 1995) and diffusion of innovations theory (Rogers, 1995). The UTAUT postulates that four key factors (i.e., performance expectancy, effort expectancy, social influence, and facilitating conditions) and four moderators (i.e., age, gender, experience, and voluntariness) predict technology adoption (Venkatesh et al., 2003).

While the UTAUT has been validated in various contexts and settings (Venkatesh et al., 2016), most studies have relied on student and technology-specific user populations, using generic moderators, such as age and gender (Lee et al., 2003). Research conducted in workplace settings is less extensive, although it is increasing (King and He, 2006; Chuttur, 2009; Venkatesh et al., 2016). Results also vary among settings (King and He, 2006). In general, UTAUT has been found to predict approximately 70 percent of variation in behavioral intention (Venkatesh et al., 2003) and around 50 percent in technology use (Venkatesh et al., 2016).

Alongside studies in technology adoption, research on employee perceptions and attitudes relating to technological change and digital disruption in general is growing. This is a critical factor to take into account since attitudes to discrete technologies can be shaped by overall attitudes to broader technological transformations in society and their impact on jobs. Employee attitudes to disruption have long been studied within sectors such as manufacturing and automotive engineering (Chao and Kozlowski, 1986; Haddad, 1996; Gurtoo and Tripathy, 2000) media and libraries (Jones, 1999; Karimi and Walter, 2015), which were among some of the first to undergo technological change. However, recent developments in disruptive technologies are increasingly disrupting a larger variety of sectors, including financial services (Veiga et al., 2014), health care (Blease et al., 2018), and service sectors (Di Pietro et al., 2014), among others.

THE IMPACT OF DIGITAL TRANSFORMATION ON WORK-RELATED OUTCOMES

Despite important theoretical advancements in understanding technology acceptance, there has only been modest integration of this body of research and other employee-related factors likely to influence current understanding. Instead, existing digital transformation models primarily focus on the technology process and strategy (Agarwal et al., 2010; Matt et al., 2015; Berghaus and Back, 2016) and omit integration of other factors. The impact of technology on employee-and work-related outcomes has been identified as an important direction for research (Venkatesh, 2006; Venkatesh and Bala, 2008), although until recently, few frameworks have been developed or tested. Recently, Kaasinen et al. (2018) developed a worker-centric design and evaluation framework for Industry 4.0, integrating research on technology acceptance with work-related wellbeing indicators such as job satisfaction and work engagement, drawing on prior models of work-related wellbeing (e.g., Danna and Griffin, 1999). The framework proposes antecedents at the individual, organizational and environmental levels that have immediate implications for a worker's experience with the technology or procedure (i.e., user acceptance, user experience, usability and safety). These in turn impact work-related wellbeing and organizational outcomes (Kaasinen et al., 2018). As organizations digitally transform, employers will need to pay increasing attention to employee well-being. Additional individual factors, such as workplace resilience and adaptability, are also likely to influence digital transformation

outcomes for individuals and organizations alike but have not been well studied in relation to digital transformation.

Increased uptake of advanced technology is accompanied by growing skills shortages in the labor market, where reskilling and upskilling employees is one of the most critical challenges that organizations and governments face. Leading industry reports predict that most companies will have increasing skills gaps in the years to come, with employers now seeking employees with a range of skills, such as critical thinking, analytic and problem-solving skills, alongside self-management, adaptability and resilience (World Economic Forum, 2020; McKinsey, 2021). A recent survey by McKinsey (2021) found that most companies globally (89 percent) have a skills gap or will have one in the next few years. Alongside greater demand for highly specialized skills (Chuang and Graham, 2018), employers also emphasize critical thinking, analytic and problem-solving skills, self-management, adaptability and resilience as top skills needed in today's workforce (World Economic Forum, 2020). Individuals' abilities to acquire new skills and their receptiveness to training are thus another important priority for research attention as digital transformation increases.

Group Dynamics and Organizational Factors Impacting Digital Transformation

Alongside the inclusion of employee-factors and work related outcomes, there is a need for multidisciplinary frameworks that integrate multiple factors across other levels, such as group dynamics and organizational level process and outcomes (Venkatesh, 2006; Chan, 2019). Such a multidisciplinary and multi-level research focus accords with broader trends in organizational behavior (Kozlowski and Klein, 2000; Klein et al., 2001; Ployhart, 2012; Johns, 2018), including the need for closer investigation of the intersections between individual, group and organizational factors in technological transformation (Seers et al., 1995; Avolio et al., 1999; Burton-Jones and Gallivan, 2007; Venkatesh et al., 2016). Overall, we need to better tease out the linkage between technology as a driving force underpinning digital transformation and its impact on workers and organizations as a whole.

Existing models of organizational behavior (OB) examine and predict human behavior in workplace settings and are useful for understanding factors that affect individuals and organizations at multiple levels. OB frameworks examine human behavior and organizations across three levels: (1) individuals in organizations (micro-level): (2) work groups (meso-level); (3) how organizations behave (macro-level) (Wagner and Hollenbeck, 2010). OB builds on contributions from a number of behavior disciplines, including psychology, which looks primarily at the individual or micro-level. Other disciplines such as social psychology, sociology and anthropology, contribute to understanding of meso and macro concepts such as group and organizational processes and outcomes (Robbins and Judge, 2019). Topics studied within organizational behavior commonly include employee attitudes and engagement, identification and commitment, motivation, culture and climate, leadership, group and teams relationships, and health and well-being, among others (Ployhart, 2015). Additionally, scholars have recently highlighted the importance of human capital to existing OB models. Human capital exists at the individual level, in terms of expertise, skills and competencies, but also spans other organizational levels, such as resources and support for training and talent development (Ployhart, 2015). Given rising concerns about skills gaps in the context of 4IR and the future of work, much can be learned from integrating current frameworks for Industry 4.0 (e.g., Kaasinen et al., 2018; Molino et al., 2020) with existing models of organizational behavior (Robbins and Judge, 2019).

REVIEW AIMS AND METHODS

In this paper, our aim is provide fresh theoretical understanding (Webster and Watson, 2002) of digital transformation as a topic that has received considerable attention in practice, yet lacks conceptual clarity, particularly as it relates to workplace factors rather than business or strategic processes. By reviewing literature across multiple disciplines and examining factors that may support or inhibit digital transformation across different organizational levels, we seek to extend IS and business-focused research on digital transformation by further incorporating insights from psychology, organizational behavior, and management studies. Our goal is to consolidate and synthesize current theory and empirical research into an overarching, multi-level theoretical framework for digital transformation. In turn, we aim to guide further research, practice and policy on digital transformation as a new and urgent imperative facing organizations and society as a whole.

We theorize that digital transformation is influenced by multiple factors at the individual, group and organizational level. Drawing on models of organizational behavior and management (e.g., Robbins and Judge, 2019). Through preliminary scoping of academic and gray literature (i.e., industry trends), we considered five overarching factors related to effective digital transformation at the individual level. These are technology acceptance; perception and attitudes toward technology and digital transformation; skills and training; workplace resilience and adaptability, and work-related wellbeing. At the work group-level, we theorized that effective digital transformation is supported by three main factors: team communication and collaboration; workplace relationships and team identification, and team adaptability and resilience. At the organizational level, we theorized that three overarching factors in supporting an organization's digital transformation: leadership; human resources; organizational climate, and culture.

We then conducted a targeted search of each factor, reviewing theory as well as empirical studies related to digitalization or digital transformation in workplace settings. Specifically, due to this review's broad scope and the multidisciplinary and multi-level nature of digital transformation, we have attempted to balance both the depth and breadth of existing theory and research. We conducted a title, abstract, and keyword search of the ScienceDirect database using synonyms for 1) digital, 2) workplace, and 3) transformation. To ensure that we review recent literature, we limited our search to English publications

from 2000 to August 2020. Additionally, we manually searched reference lists of reviews on digital transformation and relevant highly cited publications, and conducted "ancestry and snowballing" citation tracking (Greenhalgh et al., 2005, p. 5; Greenhalgh et al., 2017). This search strategy ensured that we searched on digital transformation more generally to understand research trends and were able to identify studies focusing on individual factors. We did not aim to be exhaustive but rather strove to highlight current research and trends to inform future research and theory development. Thus, we only included empirical studies published in high-quality journals (i.e., impact factor greater than 1) and after assessing the study's methodological rigor. We limited our pool to studies focusing on workplaces as the primary research setting and that investigated individual, group, or organizational level factors relevant to digitalizing workplaces. We excluded studies reporting on non-workplace or worker contexts and studies of digital or physical workplace design interventions (e.g., ergonomics, digital wellbeing interventions).

REVIEW FINDINGS

We organized our findings into three levels: individual, group, or organizational level. The findings are summarized in **Table 1** according to each factor and we present workplace studies conducted after 2000, with review studies shown with an asterix. Following presentation of findings, we organize the three factors into a multi-level framework, showing linkages between the three levels and possible moderating factors.

Individual-Level

At the individual level, we propose five overarching factors related to effective digital transformation among employees: technology adoption; perception and attitudes toward technology and digital transformation; skills and training; workplace resilience and adaptability, and work-related wellbeing.

Technology Acceptance and Adoption

In the workplace, technology acceptance and adoption has been studied in a range of settings, including manufacturing and construction (Venkatesh and Davis, 2000; Son et al., 2012), hotels (Lam et al., 2007; Hong et al., 2011), banking and financial services (Liao and Landry, 2000; Brown et al., 2002; Veiga et al., 2014), higher education (Talukder, 2012), IT services/consulting (Kim and Kankanhalli, 2009), government (Burton-Jones and Hubona, 2006), postal services (Dutta and Borah, 2018), and real estate (Venkatesh, 2000). Several studies also explored technology adoption across multiple settings (e.g., Venkatesh and Davis, 2000; Venkatesh et al., 2003; Burton-Jones and Hubona, 2006; Kim et al., 2007; Jones et al., 2010; Lee et al., 2013; Wang et al., 2014). The technology studied in workplaces includes general information technology (IT) (Liao and Landry, 2000; Kim et al., 2007, 2017; Lam et al., 2007; Dutta and Borah, 2018) or specific technologies, such as email and word processing software (Venkatesh and Davis, 2000; Burton-Jones and Hubona, 2006) and IS systems such as agile IS and e-learning (Hong et al., 2011; Lee et al., 2013).

In workplace settings, studies of technology adoption have found that the nature of technology matters, such as whether technology use is voluntary or mandatory (Lee et al., 2003; Chuttur, 2009). Venkatesh and Davis (2000) seminal work explains that subjective norms are more salient in mandatory systems. In voluntary settings, perceptions of the technology and subjective norms will influence adoption intentions and resultant technology use. However, in mandatory settings, technology adoption occurs regardless, but these perceptions will affect attitudes toward technology and may be more profound, with broader organizational impacts (Brown et al., 2002). Specifically, when employees perceive that the technology will be useful to their work and help them to perform, and is easy for them to learn and use, the odds of adoption increase (Burton-Jones and Hubona, 2006; Wang et al., 2014). Consistent with studies conducted in other settings on the perceived usefulness of technology and its ease-of use, notably, there is an established link between user satisfaction and IT adoption in the workplace too (Liao and Landry, 2000; Kim et al., 2007; Son et al., 2012). These findings imply that new technology and systems should ideally be useful and easy for employees to use, whether mandatory or not.

One way to resolve questions of perceived usefulness versus ease of use of technology in workplace settings is to consider how employees might experience technology adoption differently. Dutta and Borah (2018) found that IT adoption varied by gender, age and experience. In particular, male employees were more comfortable operating IT at work, while female employees were more encouraging of IT changes, especially those with longer work experience. Employees who had served longer in the organization (more than 30 years) were more anxious about working with IT but generally accepted IT due to peer and social pressure. Interestingly, older employees with longer work experience (i.e., about 20–30 years) were highly satisfied with IT usage.

Another aspect to focus on is the fit between the technology and tasks employees perform as this fit influences employees' attitudes and technology adoption (Lam et al., 2007). In a longitudinal study of the adoption of a new enterprise system software, Veiga et al. (2014) found that employees who expected the system to help them perform better at work and open the door to job opportunities or job security were more likely to use it and continue to enhance their knowledge post-adoption. In addition, the perception of organizational support for the system had polarizing effects on adoption, increasing the positive perception of the system among adopters but decreasing the usage among non-adopters. In other words, organizations must exercise care in introducing new technologies so that they win the support of adopters but without alienating the non-adopters. In a study of blue collar workers, Molino et al. (2020) found that both personal resources, such as resilience, along with organizational resource, such as opportunities for information and training, led to greater technology acceptance. The results demonstrate the value of providing all employees with knowledge and training opportunities to facilitate digital transformation without affecting the motivation of workers (Molino et al., 2020).

TABLE 1 | Summary of identified articles, with* indicating a review article.

Factor	Identified articles
Individual level	
Technology adoption	
Attitudes and perceptions relating to technological change	Blease et al. (2018); Bond et al. (2018); Brougham and Haar (2017, 2018); Cascio and Montealegre (2016)*; Cadwallader et al. (2010); Di Pietro et al. (2014); Doraiswamy et al. (2018); Hettich (2017); Li et al. (2018); Li et al. (2019); Mercader and Gairín (2020); Meske and Junglas (2020); Niedzwiecka and Pan (2017); Sarwar et al. (2019); Schraeder et al. (2006); Tasdogan (2020); Vieitez et al. (2001)
Skills and training	Bakker et al. (2012); Beer and Mulder (2020)*; Berg and Chyung (2008); Blume et al. (2010)*; Bolívar-Ramos et al. (2012); Bode and Gold (2018); Börner et al. (2018); Brown and Souto-Otero (2020); Brunetti et al. (2020); Cascio (2019)*; Chauhan et al. (2016); Ederer et al. (2015); Gamrat et al. (2014); Gorlitz and Tamm (2016); Grundke et al. (2018); Harteis and Goller (2014); Li and Herd (2017); Martín-Rojas et al. (2019); Melián-González and Bulchand-Gidumal (2017); Mercader and Gairín (2020); Noe et al. (2014)*; Oberlander et al. (2020)*; Osmundsen (2020); Sousa and Rocha (2019)*
Workplace resilience and adaptability	Baard et al. (2014)*; Badran and Youssef-Morgan (2015); Burns et al. (2013); Britt et al. (2016)*; Cameron and Brownie (2010); Cullen et al. (2014); Ferris et al. (2005); Fisher et al. (2018)*; Förster and Duchek (2017); Guo et al. (2017); Harms et al. (2017); Hartmann et al. (2020)*; Huang et al. (2014)*; Jensen et al. (2008); Jung and Yoon (2015); Kinman and Grant (2011); Kossek and Perrigino (2016); Lamb and Cogan (2016); Larson and Luthans (2006); Lounsbury et al. (2003); Luthans et al. (2005); Luthans et al. (2007); Luthar et al. (2000); Lyons et al. (2015); Mache et al. (2014); Malik and Garg (2017); McDonald et al. (2016); Ployhart and Bliese (2006); Seligman and Csikszentmihalyi, 2000; Stevenson et al. (2011); Wanberg and Banas (2000); Wei and Taormina (2014); Welbourne et al. (2015); Yang and Danes (2015); Youssef and Luthans (2007).
Work-related stress and wellbeing	Ayyagari et al. (2011); Bakker and Demerouti (2007)*; Bakker and Demerouti (2017)*; Bouckenooghe et al. (2013); Bowling et al. (2010)*; Diener et al. (2018)*; Edmans (2012); Field and Chan (2018); Fisher (2003); Jena (2015); Kazmi et al. (2008); Koys (2001); Harter et al. (2002)*; Judge et al. (2001)*; Kagan (2016); Kinicki et al. (2002)*; Krekel et al. (2019)*; Lepine et al. (2005)*; Liu et al. (2019); Nisafani et al. (2020)*; Ragu-Nathan et al. (2008); Riketta (2008)*;Schneider et al. (2003); Silvestro (2002); Tarafdar et al. (2010); Tarafdar et al. (2019)*; Tarafdar et al. (2015); Tenney et al. (2015); Tenney et al. (2016)*; Wright et al. (2002); Wright et al. (2007); Zeike et al. (2019a); Zeike et al. (2019b)
Group	
Team communication and collaboration	Alshawi and Ingirige (2003)*; Anders (2016); Banker et al. (2006); Berghaus and Back (2016); Bolstad and Endsley (2003)*; Boughzala et al., 2012; Boughzala and de Vreede (2015); Ellison et al. (2014); Faems et al. (2005); Fletcher and Major (2006); Gibson (2001); Grudin (2006)*; Guinan et al. (2019); Hur et al. (2019); Jordan et al. (2002); Kirkman and Mathieu (2005)*; Kozlowski and Ilgen (2006)*; Leonardi et al. (2013)*; Lloréns-Montes et al. (2005); Marlow et al. (2018)*; Merschbrock and Munkvold (2015); Mesmer-Magnus and DeChurch (2009)*; Nam et al. (2009)
Workplace relationships and team identification	Agarwal Upasna et al. (2012); Atitumpong and Badir (2018); Cole et al. (2002); Fay and Kline (2011); Hartmann et al. (2020)*; Huang and Liu (2017); Janssen and Huang (2008); Liao et al. (2010); Leonardi et al. (2013)*; Mukherji and Arora (2017); Sanders et al. (2010); Schlagwein and Hu (2017); Sias and Duncan (2018); Sias (2009); Sias and Perry (2004); Treem and Leonardi (2012)*; Tripsas (2009); Tyworth (2014); Utesheva et al. (2016); van Der Vegt and Bunderson (2005); Yanez Morales et al. (2020)
Resilience and adaptability	Carmeli et al. (2013); Hartmann et al. (2020)*; Marks et al. (2001); Meneghel et al. (2016a); Meneghel et al. (2016b); Stephens et al. (2013); Stoverink et al. (2018)
Organizational-level	
Leadership	Bartol and Liu (2002); Bass et al. (2003); Berson and Avolio (2004); Carreiro and Oliveira (2019); Chanias et al. (2019); Cortellazzo et al. (2019)*; Dery et al. (2017); Elenkov et al. (2005); Gemeda and Lee (2020); Haddud and McAllen (2018); Hess et al. (2016); Matt et al. (2015); Roepke et al. (2000); Yukl (2006); Zaccaro and Klimoski (2002)
Human Resources	Benson et al. (2002); Chuang and Graham (2018)*; Grant and Newell (2013); Hess et al. (2016); Li and Herd (2017); Marler and Fisher (2013)*; Marler and Boudreau, 2017*; Noe et al. (2014)*
Organizational culture and climate	Beus et al. (2020)*; Büschgens et al. (2013)*; Brunetti et al. (2020); Chanias et al. (2019); Denison et al. (2014)*; Dery et al. (2017); Hartnell et al. (2011)*; Hartl and Hess (2017); Jung et al. (2003); Mueller and Renken (2017); Osmundsen et al. (2018)*; Ostroff et al. (2003)*; Patterson et al. (2005); Schein (2004); Schneider et al. (2013)*; Zohar and Hofmann (2012)*

In the context of digital transformation today, new technologies are introduced in increasingly shorter cycles and often concurrently. This requires a different perspective on technology adoption. Notable drivers of acceptance of agile IS include an individual's level of comfort with constant changes, their innovativeness, as well as other facilitating conditions afforded by the technology and workplace (such as maintaining consistency between systems and having management support) (Jones et al., 2010; Hong et al., 2011).

Increasingly, new technologies introduced in workplaces have collaborative and social networking functions (e.g., virtual discussion rooms, forums, and chat functions) whose successful adoption is contingent on employees adopting them collectively. Talukder (2012) showed that peer social networks, including fellow employees and management, can influence attitudes toward an innovation and, ultimately, its adoption. These studies highlight the growing importance and the challenge of creating positive social norms around technology use to facilitate technology adoption.

Perceptions and Attitudes Toward Technological Change

Alongside studies in technology adoption, research on employee perceptions and attitudes relating to technological change and digital disruption in general is growing. This is a critical factor to take into account since attitudes to discrete technologies

can be shaped by overall attitudes to broader technological transformations in society and their impact on jobs. Employee perceptions and attitudes toward technological change continues to be studied within the manufacturing and automotive sectors which were among the first to automate (Vieitez et al., 2001; Kim and Kim, 2018). However, recent developments in new technologies such as AI, robotics, and cloud computing are increasingly disrupting a large variety of sectors, including health care (Blease et al., 2018; Doraiswamy et al., 2018; Sarwar et al., 2019; Tasdogan, 2020), wholesale and service sectors (Hettich, 2017; Li et al., 2018; Meske and Junglas, 2020), banking/financial services and education (Niedzwiecka and Pan, 2017; Bond et al., 2018; Mercader and Gairín, 2020).

In general, studies have shown that higher perceptions of job insecurity due to new technologies are negatively associated with organizational commitment and career satisfaction and positively associated with cynicism, depression, and turnover intentions (Vieitez et al., 2001; Brougham and Haar, 2018; Li et al., 2019). However, these findings differ across organizational settings, job roles, and other contextual factors, such as gender, age, and technology type. Importantly, studies have shown that employees who were engaged in making decisions related to the technology changes reacted more positively to the changes than individuals with lower levels of involvement (Schraeder et al., 2006).

In healthcare settings, recent surveys have found medical physicians to be both skeptical and optimistic about new digital technologies, such as AI (Blease et al., 2018; Doraiswamy et al., 2018; Sarwar et al., 2019; Tasdogan, 2020). On the whole, physicians were not overly concerned about their jobs becoming obsolete and were doubtful about the potential of technology to outperform humans and replace human clinicians in delivering care (Blease et al., 2018; Doraiswamy et al., 2018; Tasdogan, 2020). However, physicians did believe that new technologies would change their professions (Sarwar et al., 2019; Tasdogan, 2020) and were optimistic about technology's potential as a diagnostic tool (Sarwar et al., 2019) and to improve healthcare delivery and relieve administrative burdens (Blease et al., 2018). Some respondents thought documenting and updating medical records could be replaced by AI and machine learning technologies (Doraiswamy et al., 2018). In two multi-country studies, findings varied according to gender and country location. In one study, female and US-based doctors were more pessimistic about technology risks outweighing benefits (Doraiswamy et al., 2018), while in another, males and more experienced practitioners were more optimistic about the integration and adoption of AI into practice (Sarwar et al., 2019).

In the service sector, there is evidence that employees are generally motivated to support new technologies such as self-service technologies (Cadwallader et al., 2010; Di Pietro et al., 2014; Hettich, 2017). In a qualitative study, Di Pietro et al. (2014) found that employees evaluated that self-service technologies improved their productivity at work while also increasing their scope of work (e.g., hours, increased sales/clients and client satisfaction) and enhanced the quality of work (more satisfying, enhanced and faster transactions). However, Hettich (2017) found that attitudes toward self-service technologies are moderated by job type and nature of automation (e.g., automating routine tasks). Technology that is perceived as leading to future job loss or reductions is more likely to elicit negative attitudes (Brougham and Haar, 2017, 2018; Hettich, 2017).

In other studies, the mere awareness of new technologies (e.g., smart technology, AI, automation, robotics, and algorithms) by employees was generally related to perceptions of potential job redundancy, increased turnover intentions, cynicism and depression, and lower levels of organizational commitment and career satisfaction (Brougham and Haar, 2017, 2018; Hettich, 2017; Li et al., 2019). For example, Li et al. (2019) found that AI and robotics awareness were significantly associated with employee turnover intention. However, this relationship was moderated by perceived organizational support and competitive psychological climate (Li et al., 2019).

Recent reviews (Cascio and Montealegre, 2016) have highlighted the importance of job role and work-design factors in digitalizing workplaces. Vieitez et al. (2001) found a relationship between perceptions of job security and wellbeing in the process of technological change. However, perceived threats to job security were influenced by personal and situational characteristics such as formal training, type of work department, professional categories and the type of technology used. Research on attitudes toward digital transformation is more scarce. However, in a study of work design characteristics, Meske and Junglas (2020) found that employees' expectations of autonomy, competence, and connectedness in the digital workplace were linked to increased support for digital transformation.

Skills and Training

Advancements in new technologies are shifting the types of skills and competencies needed in the workplace. Individuals' abilities to acquire new skills and their receptiveness to training are thus another focus of research attention. Digital competencies are defined as a set of basic knowledge, skills, and abilities that allow workers to perform and complete their job tasks within digital work environments (Oberlander et al., 2020). Along with commonly used technologies such as document processing and email, employees are now required to use a wider range of software packages and digital tools (Harteis and Goller, 2014; Brown and Souto-Otero, 2020; Brunetti et al., 2020). Meanwhile, as more organizations undergo digital transformation, the need for highly specialized technical skills in areas such as software development, AI and data analytics, nanotechnology, robotization, IoT, and cybersecurity is increasing (Sousa and Rocha, 2019). A survey of LinkedIn professionals also found that technical skills in AI, nanotechnology, robotization, and IoT, and being proficient in digital learning contexts such as mobile technologies, tablets, and smartphones are more important among employers (Sousa and Rocha, 2019).

Alongside these trends, there is growing emphasis on the importance of soft skills such as communication, problem-solving, and creativity in technology-rich environments (Ederer et al., 2015; Börner et al., 2018; Grundke et al., 2018). Notably, Osmundsen (2020) found that cognitive competencies such as a willingness to learn and openness to change were critical in digital competencies as a prerequisite for digital

capabilities in areas such as robotization, machine learning, sensor technology, and big data.

This growing emphasis on soft skills could explain the apparent mismatch between education and training and the types of skills now required in the workplace (Börner et al., 2018; Brown and Souto-Otero, 2020). For example, recent big data analyses of job advertisements and course syllabi have found that social skills, specific technical skills, and personality traits, rather than academic qualifications, are increasingly in demand (Brown and Souto-Otero, 2020). Similarly, Börner et al. (2018) found that soft-skills such as problem-solving, organizational skills, customer service, and writing feature more prominently in job ads (Sousa and Rocha, 2019). A recent systematic review by Beer and Mulder (2020) also found that information processing enabled by technology has created increasing demands for cognitive skills (e.g., synthesizing and interpreting data) and interpersonal skills (e.g., coordinating and monitoring other people). However, the demand for manual, psychomotor skills (e.g., manual producing and precise assembling) is decreasing. Moreover, the standardization of work is positively related to interpersonal skills, but not related to cognitive and psychomotor skills, while higher task variety is positively related to the demand for cognitive and interpersonal skills, rather than psychomotor skills (Beer and Mulder, 2020).

The willingness to learn new skills is therefore a positive trait that employers seek. At the individual level, learning can be formal or informal, planned or spontaneous, and conscious or unconscious, with recent studies finding that learning is becoming more continuous, informal, and self-directed (Noe et al., 2014; Sousa and Rocha, 2019). Informal learning is defined as a cognitive activity or behavior, such as learning through self-reflection or from others, including peers, supervisors, and mentors (Noe et al., 2014). Berg and Chyung (2008) found that employees' interest in their professional field, rather than monetary rewards for good performance has more impact on informal learning engagement. Engagement in informal learning did not vary by gender or level of education but older employees showed higher levels of engagement (Berg and Chyung, 2008). In digital contexts, workplace learning has broadened from traditional in-person training to a range of online and e-learning contexts such as websites, LinkedIn, Facebook, blended learning, and massive open online courses (MOOC), among other formats (Sousa and Rocha, 2019).

Factors such as attitudes and personality also play a role in workplace learning and training transfer, defined as the extent to which the learning from training transfers to job outcomes, such as changes in work performance (Blume et al., 2010; Ford et al., 2018). A meta-review by Blume et al. (2010) found that training transfer is positively related to cognitive ability, conscientiousness, motivation, and a supportive work environment, while factors such as motivation and work environment had a stronger relationship to transfer based on the focus of training (e.g., leadership development versus computer software training).

Other reviews have found that conditions such as whether training is voluntary, co-workers' attitudes, and whether workers have input on training design and post-training opportunities impact workers' motivation and learning, such as efforts to positively transfer newly learned skills to the job (Cascio, 2019). Other studies have found that work engagement is positively related to task performance and active learning, particularly for employees high in conscientiousness (Bakker et al., 2012). Employees might also benefit from personalized learning and training within increasingly digitalized environments. The advancement of digital technology has also led to changes in workplace learning environments, such as the increasing use of platform-based technologies that allow learners "to personalize their learning space" and gain increased access to learning opportunities (Li and Herd, 2017, p. 186). For example, studies have found that personalized professional development within the education sector, such as digital badging, supported teachers in selecting their own learning goals and customizing learning activities and training (Gamrat et al., 2014). Other research within higher education found that rather than personality traits, lack of training in digital competencies (e.g., time management, training, pedagogical approaches, experience, and teaching approaches) in using digital technologies was more salient (Mercader and Gairín, 2020).

Concerning types of job and job tasks, there is evidence that adaptive and self-directed learning is more common in highly skilled workers, who are also more likely to participate in training (Gorlitz and Tamm, 2016). For example, Gorlitz and Tamm (2016) found that workers with non-routine tasks (e.g., nursing, service and healing, training, educating, planning, and negotiating) were more likely to participate in training than those doing routine tasks (e.g., fabricating and producing goods, supervising and controlling machines, repairing and patching). Harteis and Goller (2014) found that employment type (i.e., more highly skilled workers) received more support for workplace learning, regardless of age or gender. Worker personality traits such as openness to new experience and emotional stability were also found to be less susceptible to the effects of digitalization (Bode and Gold, 2018). These findings suggest that less skilled workers need more encouragement and support to upskill.

At the group level, results confirmed the importance of supervisor support in the transfer of skills and training; however, peer support was greater than that of supervisors (Chauhan et al., 2016). In firm studies, support from top management and technological skills and competencies were linked to organizational learning, corporate entrepreneurship, and firm performance (Bolívar-Ramos et al., 2012; Martín-Rojas et al., 2019). In service industries, front-office workers are increasingly using technology in their roles but because human participation is still necessary employees need training in the adoption of technologies, alongside training in non-routine and face-to-face tasks and interactions (Melián-González and Bulchand-Gidumal, 2017).

Workplace Resilience and Adaptability

Resilience is the dynamic process of adapting and coping during significant adversity (Luthar et al., 2000; Harms et al., 2017) and builds on the tenets of positive psychology (Seligman and Csikszentmihalyi, 2000). Although individual resilience is both a personality trait and a capacity that can be developed, recent

evidence suggests that resilience might be better conceptualized as a developmental process (Hartmann et al., 2020). This is because resilience may present differently across various work-life domains (Harms et al., 2017) and is influenced by resilience mechanisms (e.g., coping strategies) and resilience promoting factors (e.g., personal and environmental characteristics) (Kossek and Perrigino, 2016; Fisher et al., 2018; Hartmann et al., 2020). The potential for resilience to be cultivated can allow an individual to overcome adversity to perform as well as before, if not better, and regain "a steady state of wellbeing" (Britt et al., 2016; Hartmann et al., 2020, p. 6; Luthar et al., 2000).

In the workplace, four categories of antecedents influence individual resilience (Hartmann et al., 2020). First, certain personality traits (e.g., future-orientation, conscientiousness, openness to experience, and emotional stability (Wei and Taormina, 2014; Lyons et al., 2015) and cultural values (Wei and Taormina, 2014; Welbourne et al., 2015) are positively linked to resilience. Second, personal attributes such as self-efficacy and possessing an internal locus of control (Lyons et al., 2015; Guo et al., 2017), confidence in being able to address challenges at work (Yang and Danes, 2015), the ability to manage work demands, establish work-life balance and be reflective (Jensen et al., 2008; Kinman and Grant, 2011) are related to resilience. Third, an individual's attitude and mindset toward their job and professional development help them become resilient during adversity (Cameron and Brownie, 2010; Stevenson et al., 2011). Lastly, the work context (e.g., the presence of social support, feedback, sharing of responsibilities and work tasks (Cameron and Brownie, 2010; Burns et al., 2013; Lamb and Cogan, 2016; McDonald et al., 2016; Förster and Duchek, 2017) are related to resilience among employees.

Individual resilience is important because it is related to job performance (Luthans et al., 2005, 2007), organizational citizenship behavior (Jung and Yoon, 2015), organizational commitment (Larson and Luthans, 2006; Youssef and Luthans, 2007), work engagement (Mache et al., 2014) and openness and commitment to organizational change (Wanberg and Banas, 2000; Malik and Garg, 2017). As discussed further below, these factors are likely to contribute toward more successful digital transformation. Finally, cultivating resilience supports employee retention and is positively related to job and career satisfaction (Lounsbury et al., 2003; Youssef and Luthans, 2007; Badran and Youssef-Morgan, 2015; Lyons et al., 2015) and promotes positive mental health (Kinman and Grant, 2011) and physical well-being (Ferris et al., 2005).

Adaptability at work is a related concept to resilience and can be viewed either as the performance by a worker (i.e., the ability to adapt and perform) or as a characteristic of the individual (i.e., a determinant of work performance) (Ployhart and Bliese, 2006). However, both are important as the nature of work changes (Charbonnier-Voirin et al., 2010). At the individual level, adaptive performance includes being able to make cognitive, affective, motivational, and behavioral adaptations when tasks or work demands change (Baard et al., 2014). Individual adaptability helps workers perform better at work because adaptable workers are more proactive and take responsibility for adjusting to changing situations and are more likely to positively perceive these situations (Ployhart and Bliese, 2006; Cullen et al., 2014). There are known factors that contribute to individual adaptability. For instance, the personality traits of openness to experience, emotional stability, conscientiousness, and ambition are positively related to individuals' adaptive performance (Pulakos et al., 2006; Huang et al., 2014).

Work-Related Stress and Wellbeing

In the face of technological change and digital transformation, it is essential to consider the adverse impacts of technology on work-related stress and wellbeing since these will have bearing on employee performance and job satisfaction. In general, stress is often found to be associated with lower levels of performance (Kazmi et al., 2008). However, it depends on where the stress originates. Stress arising from good challenges (e.g., taking on a new project) is less detrimental than stress due to bureaucracy or role ambiguity (Lepine et al., 2005). Acute episodes of stress and their relationship with performance are potentially an inverted U-shape (Kazmi et al., 2008; Kagan, 2016). While the relationship between stress and performance is complex, it is clear that stress and poor mental health are related to lower levels of work performance (Tenney et al., 2016).

When implementing digital technologies, stress can result in a phenomenon called technostress, defined as stress that individuals experience due to their use of technology and the inability to cope or deal with these new digital technologies in a healthy manner (Tarafdar et al., 2015; Nisafani et al., 2020). The causes of technostress include dependency on technology when working (Liu et al., 2019), work overload (Tarafdar et al., 2010), anxiety about one's own IT capabilities amidst constantly changing technology (Ragu-Nathan et al., 2008) and work-home conflict (Ayyagari et al., 2011). For example, the adoption of digital technology has led to the fragmentation of work and produced a perpetual sense of urgency and increased blurring of work-life boundaries (Field and Chan, 2018). Similarly, the rise of email, smartphones, and new messaging software such as WhatsApp has increased communication and collaboration while creating expectations that employees need to always be available, including outside of office hours (Ayyagari et al., 2011). Consequently, workers experiencing technostress report lower productivity, wellbeing, and commitment to the organization (Jena, 2015; Nisafani et al., 2020). However, recently it has been suggested that technostress could also lead to positive outcomes at work, improving effectiveness and fostering innovation (Tarafdar et al., 2019), as digital technologies - when designed appropriately - can also mitigate technostress and create positive effects on workers (Tarafdar et al., 2019).

Subjective wellbeing is commonly referred to as happiness or satisfaction and is constituted by people's appraisals and evaluation of their own lives (Diener et al., 2018). It has been shown to be related to work performance (Judge et al., 2001; Kinicki et al., 2002; Riketta, 2008) and can be examined across life as a whole or in specific facets including at work (e.g., job satisfaction, positive affect at work, and absence of job stress or negative affect at work (Bowling et al., 2010). Employees with

higher job satisfaction perform better at work than their unhappy colleagues (Fisher, 2003; Wright et al., 2007; Bouckenooghe et al., 2013; Tenney et al., 2015, 2016). Higher subjective wellbeing may also lead to optimism and self-efficacy, which increases task persistence and enhances learning, leading to better performance over time, resilience and adaptability as digital transformation takes place (Tenney et al., 2015).

Research on work design, such as the Job Demands-Resources (JD-R) model (Bakker and Demerouti, 2007, 2017) may be particularly useful in understanding the impact of technology and digital transformation on work-related wellbeing. According to JD-R theory, two key factors influence work environments: job demands, which include physical, psychological, social, or organizational aspects of a job that require sustained effort or skills; and job resources, defined as aspects of the job that support work goals, reduce job demands, and stimulate learning and development (Bakker and Demerouti, 2007). Excessive job demands, when not accompanied by adequate resources, can lead to reduced health and a higher risk of burnout and lower levels of work engagement and wellbeing. In a study of leaders, Zeike et al. (2019b) found an association between perceived choice overload (e.g., the burden of leadership decisions and complexity of choice), pressure from digitalization (e.g., pressures to keep up with the latest technologies and prepare for digitization) and psychological wellbeing. However, in another study, leaders who were better skilled in digital leadership had higher levels of wellbeing, regardless of gender, age, and managerial experience (Zeike et al., 2019b).

There is comparatively less research exploring the relationship between subjective wellbeing and performance at the organizational level. However, the limited evidence available suggests that employee subjective wellbeing predicts an organization's performance. There is a positive relationship between employee subjective wellbeing and aggregate, organizational-level measures of performance (Koys, 2001; Schneider et al., 2003; Edmans, 2012), customer satisfaction, productivity, and absenteeism (Harter et al., 2002; Krekel et al., 2019). This relationship has been observed across different industries and is particularly strong in customer satisfaction and staff turnover, both of which drive overall profitability (Krekel et al., 2019). However, other studies have failed to find a relationship between subjective wellbeing and individual or organizational performance (Silvestro, 2002; Wright et al., 2002), which is more likely due to the effects of moderators in this relationship. Tenney et al. (2016) proposed the presence of at least seven moderators on wellbeing and organizational performance: the health of the individual, absenteeism, the ability to self-regulate, motivation, creativity, personal and social relationships, and turnovers.

Group-Level

Next, we go beyond the individual employee to consider work groups. At the group-level, we present three factors to support effective digital transformation: team communication and collaboration; workplace relationships and team identification, and team adaptability and resilience.

Team Communication and Collaboration

Team collaboration refers to the joint effort of a group of people toward common goals, whereby two or more agents share resources, skills, discoveries and are responsible for the shared outcome (Briggs et al., 2003; Boughzala et al., 2012). In the workplace, the quality of team collaboration can be assessed according to five key dimensions, namely people, process, leadership/management, information, and technology (Boughzala et al., 2012). Previous studies have revealed that team collaboration constitutes one of the essential elements of organizational functioning. The quality of collaborative work practices relates to organizational performance and productivity (Jordan et al., 2002; Banker et al., 2006; Boughzala and de Vreede, 2015). Effective collaboration among co-workers is also found to positively link to high levels of innovative performance in work teams and organizations (Faems et al., 2005; Lloréns-Montes et al., 2005).

Communication among team members is a crucial element of successful team collaboration. In the existing literature, team communication is usually measured by quality and frequency (Marlow et al., 2018). Effective team communication facilitates intra-team information flow, idea exchange and task integration and thereby serves as a support mechanism for many other team processes such as task coordination, collective decision making, clarifying misunderstandings, and so forth (Gibson, 2001; Fletcher and Major, 2006; Kozlowski and Ilgen, 2006). Team communication is also categorized as task-oriented communication, which focuses on completing tasks, achieving common goals, and relational communication, emphasizing building interpersonal relationships among team members (Nam et al., 2009; Marlow et al., 2018).

Team communication and collaboration can occur in both face-to-face encounters and mediated interactions via electronic tools (Bolstad and Endsley, 2003; Mesmer-Magnus and DeChurch, 2009). Kirkman and Mathieu (2005) propose the concept of team virtuality to capture the extent to which team members use technological tools to coordinate work tasks and the amount of informational value obtained by using such tools.

As organizations undergo digital transformation, the level of team virtuality is enhanced by implementing a variety of advanced and innovative collaboration technologies, such as video conferencing software (e.g., Skype), instant messaging (IM) platforms (e.g., WhatsApp), project management software (e.g., Slack), enterprise social media (ESM), in both geographically proximate and distributed work teams (Leonardi et al., 2013; Ellison et al., 2014; Anders, 2016). The enhanced virtuality of work team serves to facilitate both task-oriented and relational communication among team members, which in turn, engenders positive outcomes of collaborative work practices, such as efficient knowledge sharing and information flow, swift and precise task coordination, as well as increased transparency of work processes (Alshawi and Ingirige, 2003; Grudin, 2006; Ellison et al., 2014; Anders, 2016).

Based on findings from a multilevel study, Guinan et al. (2019) stressed the significance of flexible and multidisciplinary team collaboration in supporting digital transformation goals.

Specifically, cross-functional and innovative ninja teams, which enable professionals from different backgrounds to collaborate in an *ad hoc* manner and deliver digital support across multiple projects, were identified as crucial digital transformation levers. Organizations also established digital hubs to accommodate teams of top-level experts in digital technology and methods to support the continuous sharing of new ideas and facilitate collaboration on digital solutions within teams. In a similar vein, Merschbrock and Munkvold (2015) revealed that the diffusion of an innovative system required the transition to a collaborative work environment characterized by clear guidelines for information exchange, appropriate allocation of roles and responsibilities, as well as stable locations and routines for cross-disciplinary exchange. Other studies have emphasized the importance of enabling employee affinity in using digital tools to collaborate and to appoint internal digital experts (Berghaus and Back, 2016). On the contrary, digital transformation processes and outcomes are likely to be impeded by obsolete team collaboration and communication habits. In particular, inertia about the pre-existing on-site collaboration and face-to-face communication routines often results in the inadaptability or even resistance to the transformation toward digitalized work and communication processes (Alshawi and Ingirige, 2003; Hur et al., 2019). Enhancing team communication and collaboration through social and technological scaffolds is therefore vital in the face of digital transformation.

Workplace Relationships, Team Identification

Workplace relationships refer to relationships between coworkers, including vertical supervisor-subordinate relationships and peer relationships (Sias and Perry, 2004; Sias, 2009). Supervisor-subordinate relationships are referred to as leader-member exchange (LMX) and encapsulate the reciprocal interactions characterized by mutual trust, respect, and support between a supervisor and his or her subordinates (Liao et al., 2010). Relationship between peer team members is conceptualized as team-member exchange (TMX), where teams engage in an ongoing and reciprocal exchange of ideas, feedback, and emotional support (Cole et al., 2002).

In an organization's efforts toward successful digital transformation, the quality and style of workplace relationships can either propel or impede transformation progress. In particular, high-quality LMX can have positive effects on workplace innovations in terms by encouraging innovative work behaviors of employees (e.g., Sanders et al., 2010; Aarons and Sommerfeld, 2012; Agarwal Upasna et al., 2012; Atitumpong and Badir, 2018). TMX can also predict team members' innovative work behaviors and performances, with the relationships mediated by various factors such as help-seeking behaviors and psychological empowerment (Yanez Morales et al., 2020). Team identification, which emerges when an individual confirms membership of a work team, is closely related to workplace relationship since employees who form close coworker relationships tend to have a stronger sense of belonging and develop identification with their work teams (van Der Vegt and Bunderson, 2005; Janssen and Huang, 2008; Fay and Kline, 2011). According to previous studies, team identification is an essential factor during the implementation of new workplace technologies. Specifically, a misalignment between features of new technology and established collective identity often results in difficulties and resistance to technology implementation, while technologies that reinforce existing identification are inclined to be well accepted and adopted by employees and the organization as a whole (Tripsas, 2009; Tyworth, 2014; Utesheva et al., 2016).

Meanwhile, the digital transformation of an organization can also affect workplace relationships and identification. In particular, the emergence of multi-functional management and communication technologies, such as ESM and IM, provides unprecedented opportunities for social engagement and value diffusion, which serve to solidify fellowship among coworkers and enhance employees' affective attachment to their work team (Leonardi et al., 2013; Huang and Liu, 2017; Mukherji and Arora, 2017; Schlagwein and Hu, 2017; Sias and Duncan, 2018). Treem and Leonardi (2012) propose four affordances of new technologies that have considerably changed the nature of work and social networking in organizations, namely visibility, persistence, editability, and association. The persistence of an integrated flow of interaction and contextualized associations established between coworkers, in particular, play a crucial role in creating mutual understanding and accumulating social capital among team members. Such findings suggest that norms around the use of such networking technologies must be forged to promote positive communication and avoid potential misunderstanding and conflict.

Team Resilience and Adaptability

Alongside research on adaptability and resilience among individuals, there is emerging research on group-level resilience and agility. Resilience at the team-level originates from the interactions between contextual factors (e.g., type of job tasks and culture) and team members (Marks et al., 2001; Stoverink et al., 2018) as individuals collaborate over a period of time (Hartmann et al., 2020). The interpersonal relationships between individuals in a team affect emotional expression and the collective experience of positive emotions, such as shared enthusiasm, optimism, comfort, or relaxation, which foster team resilience (Carmeli et al., 2013; Stephens et al., 2013; Meneghel et al., 2016b). The structure and roles of individuals in a team also influence team resilience (Hartmann et al., 2020). Specifically, team resilience is positively related with in-role and extra-role team performance (Meneghel et al., 2016a,b), with the latter being more important as digital transformation is underway. This is because resilient teams are more likely to find flexible and effective solutions when faced with challenges and adversity.

Organizational-Level

At the organizational level, we propose three overarching factors in supporting an organization's digital transformation: leadership; human resources; and organizational culture/climate.

Leadership

Leadership is another essential factor that is likely to shape digital transformation processes and outcomes in work teams and organizations and describes a leader's ability to motivate and

influence others to engage in collective activities and accomplish shared goals (Zaccaro and Klimoski, 2002; Yukl, 2006). In general, leadership is found to play a crucial role in organizational functioning and employee performance (Cortellazzo et al., 2019; Gemeda and Lee, 2020).

In an organization's drive toward digitalization and transformation, leadership, and technological innovations mutually affect each other on an ongoing basis (Cortellazzo et al., 2019). On the one hand, technological advancement poses new challenges and requires leaders to take up new responsibilities and enhance leadership skills according to the changing contexts (Cortellazzo et al., 2019). Specifically, the adoption and implementation of new technologies have been identified as key drivers for initiating disruptive changes in work teams and organizations, which often results in the reconfiguration of established management routines and resistance from members (Bartol and Liu, 2002; Cortellazzo et al., 2019).

In the face of these challenges, leaders are entrusted with a range of emerging responsibilities, including but not limited to creating positive digital cultures, motivating employees to embrace transformation and upskill, and attracting digital experts, among other roles (Roepke et al., 2000; Elenkov et al., 2005; Haddud and McAllen, 2018). In a recent review, Cortellazzo et al. (2019) identified five main skills that characterize effective leadership in the digital era: communicating through digital media, high-speed decision-making, managing disruptive change, managing connectivity, and the renaissance of technical skills. Similarly, responsive leadership, characterized by leaders' responsiveness to employees' feedback and continuous leader-employee communication, constitutes an essential skill for leaders in the digital workplace (Dery et al., 2017).

Leadership also influences the direction and outcomes of technology implementation and digital transformation. Recent studies examined the impact of leadership style on workplace innovation based on existing typologies of transformational, transactional and laissez-faire leadership (Bass et al., 2003). In workplace settings, transformational leadership is found to be more effective than transactional and laissez-faire leadership, and predicts better employee performance, job satisfaction, and higher levels of commitment (Bass et al., 2003; Berson and Avolio, 2004; Liao et al., 2010; Gemeda and Lee, 2020). Transformational leadership is also associated with the adoption of technological innovations in organizations (Carreiro and Oliveira, 2019). For example, Carreiro and Oliveira (2019) studied mobile cloud computing adoption and revealed that transformational leadership components, such as vision and personal recognition, were positively related to the firm's intention to adopt the innovation.

Other studies have highlighted the role of responsive leadership that focuses on employee experiences and connectedness and widespread learning mechanisms (Dery et al., 2017). Responsive leaders encourage experimentation with new technologies and provide opportunities and resources for continuous learning, as discussed below (Dery et al., 2017). For example, studies have highlighted the importance of establishing dedicated units for digital transformation that report directly to senior leaders and/or the CEO and whose role is to drive change throughout the whole organization (Chanias et al., 2019). Similarly, other studies have found that leaders must provide resources and make structural changes to support digital transformation strategic efforts (Matt et al., 2015; Hess et al., 2016). The change process includes reflexive practices by individuals and structural changes such as increased investment in digital technologies, resources, collaboration and new ways of working and practice to support digital transformation (Chanias et al., 2019).

Human Resources

Organizations must ensure that their employees have the right skills and competencies as they undergo digital transformation, where human capital resources are one of the most important resources available (Noe et al., 2014). There is increasing recognition of human resource development (HRD) professionals' role in allocating resources, supporting workplace learning and development, and facilitating organizational change in the context of new technologies (Benson et al., 2002; Li and Herd, 2017; Chuang and Graham, 2018). Case study research maintains that new competencies can be gained through updating existing capabilities through training and new hires or recruiting employees experienced with integration processes or outsourcing hard-to-find skills and competencies (Hess et al., 2016). While the latter two options may be less risky and require less initial investment, a disadvantage is that companies fail to develop competencies internally and may suffer from a lower competitive edge in the future (Hess et al., 2016). Aside from case studies and macro-studies of job automation, there is limited empirical research on the influence of new technologies on employment and related impacts on human resources. However, Chuang and Graham (2018) found that HRD professionals need to urgently increase their knowledge of the impact of technological change on employment and job structures. Priority areas for HRD professionals increased focus on developing human skills and balancing the introduction of new machines and technologies. Moreover, greater understanding of how to transition workers to increasingly skill-polarized work environments, including managing the threat of technological unemployment, is needed (Chuang and Graham, 2018).

The advancement of digital technologies, such as electronic HRM systems and increased HR analytics, is also changing HRD professionals' role in the context of digitalization (Grant and Newell, 2013; Marler and Fisher, 2013; Marler and Boudreau, 2017). While there is growing attention to the role of e-HRM in allowing HR professionals to enhance their strategic role within organizations (e.g., Grant and Newell, 2013), research on e-HRM is still in an early stage, with limited empirical evidence on whether e-HRM predicts strategic outcomes (Marler and Fisher, 2013). While there is evidence that HRM predicts e-HRM outcomes, this relationship is contextual, with research designs not yet sufficient to establish causal direction (Marler and Fisher, 2013). The literature on HR analytics, defined as HR practices enabled by information technology analytics, benchmarking, and data-driven decision making, is also limited (Marler and Boudreau, 2017). While there is a positive relationship with HR analytics and

organizational effectiveness, there is limited scientific evidence to aid decision-making in the adoption of HR analytics. Nonetheless, three moderators may affect the relationship between the adoption of HR analytics and organizational outcomes, including HR professional analytics skills, managerial buy-in, and the integration of HR information technology. For example, current challenges include both the quality and accessibility of e-HRM software systems and HR capabilities in analyzing and interpreting data (Marler and Boudreau, 2017).

ORGANIZATIONAL CULTURE/CLIMATE

There is growing recognition of the role of organizational culture in digital transformation (Hartl and Hess, 2017; Osmundsen et al., 2018); yet, few studies have examined this empirically. Case study research has, however, found that traditional command and control structures often reinforce work-group silos and make it much harder for employees to respond rapidly to customer demands and needs (Dery et al., 2017). Instead, alongside top-down transformation efforts, including clear task and role descriptions of senior leaders, bottom-up strategies such as employee engagement are important in digital transformation and innovation (Dery et al., 2017; Chanias et al., 2019). Key initiatives include engaging internal actors in "episodes of digital strategy making" (Chanias et al., 2019, p. 30). Specifically, leaders and managers can initiate cultural change through various communication measures, such as all staff emails, workshops, "fireside chats," and promotional materials (Chanias et al., 2019, p. 25). The engagement of internal stakeholders and representatives across different organizational departments through communications, such as videos, manuals, posters, ideas, and workshops for employees on new digital technologies, helped facilitate the change process (Chanias et al., 2019). Developing concept pitches and prototypes through internal and external channels (e.g., employees pitching for ideas) positively impacted the organization and showed a higher possibility for digital innovation than previously anticipated by leaders (Chanias et al., 2019). Mueller and Renken (2017) found that communication and collaboration technology enabled a digitally enabled workplace and supported process innovation. In particular, alignment with IT-processes, including internal communication and marketing and employees' involvement, helped them reinvent and reimagine their work (Mueller and Renken, 2017). As discussed above, collaborative technologies, including social media platforms, can promote innovation and develop open and entrepreneurial cultures (Dery et al., 2017; Chanias et al., 2019). However, key challenges include resistance by senior leaders and managers and conflicts between departments on digital transformation plans and processes. The slow pace of change and leadership and employee turnover were also cited as key challenges (Chanias et al., 2019).

While case study research has revealed important insights into digital transformation processes, more rigorous integration of existing theoretical and empirical frameworks are needed. Organizational culture is defined as a pattern of shared assumptions, beliefs, values, and norms learned by a group and taught to new members (Schein, 2004). The study of organizational culture has a long trajectory within anthropology, sociology, and social psychology (Hartnell et al., 2011). While organizational culture has been traditionally studied using qualitative methods such as ethnography, survey-based methods have become more dominant in recent decades (Schneider et al., 2013; Denison et al., 2014).

Recent reviews have focused on the link between organizational culture and employee and organizational processes and outcomes (Hartnell et al., 2011; Denison et al., 2014). The Competing Values Framework (CVF) is one of the most highly utilized organizational culture measures and theorizes that four different culture types exist across two opposing value systems: flexibility versus control and internal versus external orientation (Quinn and Rohrbaugh, 1983). These relate to organizational effectiveness indicators due to their underlying assumptions, beliefs, values, and artifacts. For instance, a "clan" based culture, which prioritizes human resources and affiliation, can be linked to employee effectiveness criteria such as employee satisfaction and commitment. Meanwhile, an "adhocracy" culture, which relies on risk-taking, creativity, and adaptability, can be linked to innovation outcomes (Hartnell et al., 2011).

Generally, meta-reviews have found that CVF's culture types are significantly associated with organizational effectiveness (Hartnell et al., 2011). While all culture types had moderate to strong associations with operational effectiveness, job satisfaction was notably higher in organizations with clan cultures (i.e., family like, collaborative organizations) than adhocracy and market cultures. However, market culture was more strongly associated with subjective innovation, quality of products and services, and financial effectiveness (Hartnell et al., 2011). Another meta-review of the CVF found that organizational culture is an important factor in driving innovation (Büschgens et al., 2013). Managers of innovative organizations were more likely to implement a developmental culture, emphasizing an external and flexibility orientation that is largely consistent with an innovative organization's goals. On the other hand, hierarchical cultures that emphasized control and internal orientation were less likely to be found in innovative organizations (Büschgens et al., 2013). Nonetheless, regardless of orientation, it is important to align innovation strategy with organizational cultural values to ensure its effectiveness (Büschgens et al., 2013), where other studies have confirmed the fit between organizational culture and innovation strategy (Chen et al., 2018).

In a study of digitalization experts, Hartl and Hess (2017) reported that experts highlighted flexible (i.e., clan/adhocracy) over control (i.e., hierarchical/market) organizational cultures as critical to digital transformation success. In digital transformation, cultures that promoted values such as openness toward change, agility, a tolerance toward failure, and a willingness to learn were more valued. Innovation, risk affinity, and entrepreneurship alongside cooperation, community, and customer-centricity were also cited as important organizational values. Another study conducted with company stakeholders found that organizations can develop digital cultures, break down resistance to digitalization and cultivate transparent-oriented

cultures by adopting strategies such as reverse mentoring to improve digital competencies and skills (Brunetti et al., 2020).

Organizational climate is a related yet distinct concept to organizational culture and is defined as employee perceptions of policies, practices, and employee experiences, along with behaviors that employees observe as being rewarded and supported (Ostroff et al., 2003; Schneider et al., 2013). Organizational climate can be both a global concept (Jung et al., 2003) or linked to more narrow strategic goals (Zohar and Hofmann, 2012). Nonetheless, organizational culture and climate overlap, with commonly used climate measures developed from existing culture constructs such as the CVF (Patterson et al., 2005). Establishing the level at which perception data is collected and analyzed (e.g., individual versus group versus organizational) plays a vital role in organizational climate research (Zohar and Hofmann, 2012; Schneider et al., 2013). In general, studies have shown positive climate-performance relationships. A recent meta-analysis by Beus et al. (2020) integrating the CVF found positive climate–performance associations for different climate types, with job attitudes as a common mediator. Transformational leadership, innovative work behavior, and LMX-exchange have been linked to higher innovation climate (Aarons and Sommerfeld, 2012), while innovative work behavior played a mediating role in the relationship between organizational climate for innovation and organizational performance in other studies (Shanker et al., 2017).

Additionally, transformational leadership and climate in organizations foster adaptive performance in workers (Charbonnier-Voirin et al., 2010). In a multilevel analysis, Charbonnier-Voirin et al. (2010) found a positive relationship between transformational leadership and adaptive performance at the individual level, while team-level transformational climate exerted positive cross-level effects on adaptive performance. Finally, team-level climate for innovation moderated the relationship of individual perceptions of transformational leadership with adaptive performance. Shipton et al. (2005) found that effective HRM systems predicted product and production technology innovation and that innovation was more enhanced when there was a supportive learning climate but inhibited when there is a link between appraisal and remuneration. Overall, these findings highlight the importance of culture and climate to other individual, group, and organizational factors examined in this review.

SUMMARY OF FINDINGS AND DISCUSSION; A MULTI-LEVEL FRAMEWORK FOR DIGITAL TRANSFORMATION

Our review sought to identify important factors for workplace digital transformation and present them in a multi-level framework. The framework (see **Figure 1**) integrates identified factors with potential moderators at the individual, group, and organizational levels. Specifically, we married studies on digitalization and digital transformation with existing models of organizational behavior and management (e.g., Ployhart, 2015; Robbins and Judge, 2019). By so doing, this work bridges existing gaps in the digital transformation research literature that has primarily focused at the technology and business level (e.g., Verhoef et al., 2019; Vial, 2019) with less integration of employee, work-group and organizational factors.

At the individual level, we theorized that five factors related to effective digital transformation among employees: technology acceptance and adoption; perception and attitudes toward technology and digital transformation; skills and training; workplace resilience and adaptability, and work-related wellbeing. At the group-level, we identified three factors necessary for digital transformation: team communication and collaboration; workplace relationships and team identification, and team adaptability and resilience. Finally, at the organizational-level, we proposed three factors for digital transformation: leadership; human resources, and organizational climate/culture. Our review of the literature suggests that these factors are important to be considered when planning for and embarking on digital transformation. Nevertheless, there is evidence that specific digital transformation outcomes may be moderated by a host of personal, contextual and cultural moderators, which should be taken into account when implementing digital transformation. While in this review and in the framework summarizing our findings we have added an expanded list of these moderators for reference, in reality they might not be present or relevant simultaneously. More research is needed to understand the role of moderating factors in digital transformation. Following this synthesis, we discuss the implications of our findings for further research and practice.

As the introduction of digital technologies is often the cornerstone of digital transformation in the workplace, it is critical that acceptance and attitudes of employers toward new technologies fosters its adoption and consequently facilitates digital transformation plans. Our review identified that if employees perceive that a particular technology or system will be useful to their work and will help them to perform well, and is easy for them to learn and use, they are more likely to accept it. Additionally, we found that technology adoption differs by contextual factors, such as age, gender task-technology fit, and prior work experience. Technological adoption and acceptance is also associated with resilience and opportunities for training. Peer and top management support influence technology adoption at the group and organizational levels. In general, studies showed that employees are generally motivated to support new technologies and see benefits such as enhanced productivity and work quality, however, attitudes and perceptions are moderated by occupation, job role, gender, age and technology type. For example, when technology was perceived as leading to job loss or reductions, attitudes were negative and related to increased turnover, cynicism, depression, lower organizational commitment and career satisfaction. Nevertheless, perceived organizational support and competitive psychological climate helped to moderate negative perceptions and outcomes. Employee expectations of autonomy, competence,

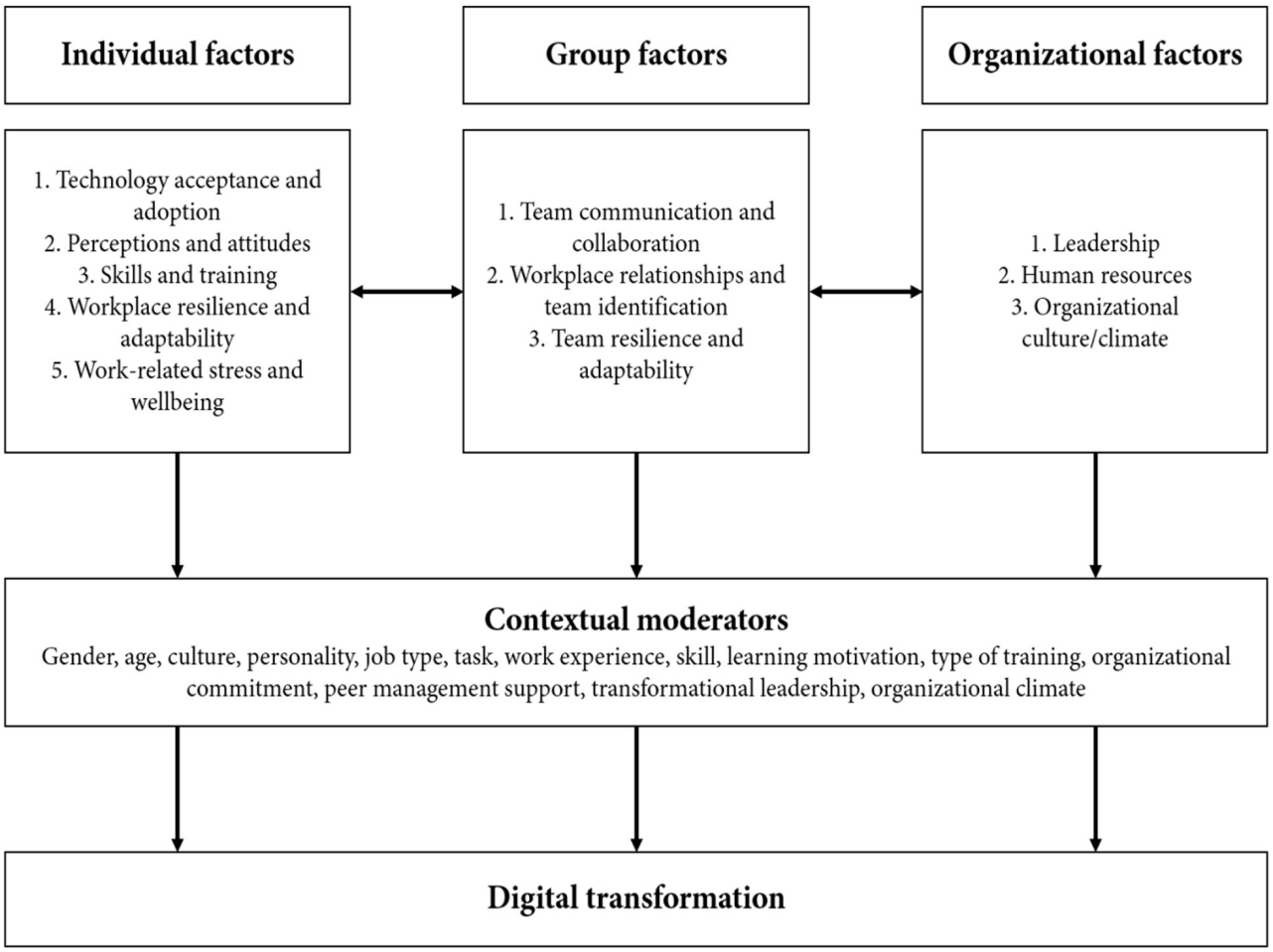

FIGURE 1 | A multi-level theoretical framework for understanding workplace digital transformation.

and engagement were also linked to increased support for digital transformation.

Skills upgrading or retraining are also important precursors of digital transformation as studies have shown that employees need a mix of cognitive, technical digital skills in increasingly digital work environments. However, it can be a practical challenge to motivate employees to do so. We found that factors such as learning motivation, attitudes, personality, and skill-levels at the individual level are likely to moderate learning outcomes and the transfer of training to practice. In addition, co-workers' attitudes, supervisor and peer support, being able to volunteer for training instead of being mandated to, and the extent to which employees are involved in the design of training programs are also important factors to consider in the transfer of skills and training at the group and organizational levels. Developing skills and providing adequate training is an urgent imperative as organizations undergo digital transformation. Prior research on the role of individual factors, such as cognitive ability and motivation, alongside peer, supervisor and team support for training, can help companies to develop and refine training programs, ensure that adequate resources are provided for training, and create personalized training opportunities that cater to different employee needs.

Digital transformations in workplaces can be a period of change and uncertainty for individuals and organizations alike. Thus, it is highly likely that individual resilience and adaptability in the workplace will be key traits for seamless digital transformation, however, these have not been well studied at present. Existing theory and research have shown that workplace resilience is related to job satisfaction and performance, organizational citizenship behavior and commitment, work engagement, openness, and commitment to organizational change and behavioral adaptation. Adaptability, a related concept, suggests that adaptable workers will be more successful during digital transformation as they are more proactive and take responsibility for adjusting to changing situations. As with resilience, personality traits such as openness to experience, emotional stability, conscientiousness, and ambition are positively related to individuals' adaptive performance and are relevant as digital transformation takes place.

Due to evidence that digital technology contributes to increasing stress and fragmentation and blurring of work-life boundaries, employers will need to employ strategies to mitigate these detrimental impacts on employee well-being and engagement. A key area of focus could include programs and training to foster workplace resilience and adaptability and cultivate a mindset shift in being adaptable in the context of ongoing job and digital disruption. Technostress may be increasingly salient in digitalization and digital transformation, leading to increasing fragmentation and blurring of work-life boundaries, which can lower productivity, well-being, and organizational commitment. New technologies can also exacerbate other occupational stressors such as work overload and lack of control, especially among managers but could also yield positive outcomes at work, including increased effectiveness and innovation.

The nature of work might also evolve as digital technology is introduced and work processes evolve. However, working in teams and collaborating across teams is likely to remain essential to organizational functioning and the quality of collaborative work practices. These are in turn linked to higher levels of innovative performance in work teams and organizations. As new digital communication tools are introduced in workplaces, it is necessary to ensure that they facilitate information flow, ideas, and task integration to enhance collaboration rather than adding unnecessary complexity to the process. The rapid increase in the ability for teams to work virtually across technology platforms certainly facilitate both task-oriented and relational communication among team members and lead to positive outcomes, such as more efficient knowledge sharing and information flow, more precise task coordination, and increased transparency, while flexible and cross-functional teams can also facilitate collaboration and support digital transformation goals. Other structural mechanisms, such as digital hubs and internal digital experts further support innovation and digital solutions among teams. Conversely, a lack of collaboration and communication can impede digital transformation efforts and lead to resistance.

Despite the increased adoption of technology in workplaces, the quality and style of workplace relationships will continue to be important to support workplace transformation. Specifically, high-quality supervisor-subordinate relationships and team-members' exchange positively promote innovative work behaviors, while misalignment between new technologies and established team identities can lead to resistance. Indeed, the growth of multi-functional management and communication technologies provides new opportunities for employee and team engagement and interactions. This also fosters adaptable and resilient teams and build stronger team identification, which bodes well for thriving amidst challenges and adversity during digital transformations.

Organizational leaders continue to be essential in leading change, including motivating employees to embrace digital transformation. The adoption and implementation of new technologies is likely to disrupt established structures and routines, which will in turn cause uncertainty and resistance.

Therefore, transformational leadership styles may be more effective in digital transformation than transactional and laissez-faire leadership, due to more positive outcomes in employee performance, job satisfaction, and organizational commitment. Leaders who are responsive to employee experiences and encourage experimentation may also be more effective in leading digital transformation.

Alongside the role of leaders, digital transformation is creating expanded roles for human resource professionals. Priority areas include increasing knowledge of recruiting, retaining, reskilling, and transitioning workers in increasingly skill-polarized work environments and developing positive organizational culture, including in relation to learning. HR professionals can also focus on enhanced used of e-HRM systems and HR analytics to strengthen their strategic roles. Finally, organizational culture and climate are likely to shape digital transformation processes and outcomes in the workplace. Specifically, there is evidence that traditional command and control structures reinforce work-group silos and make it much harder for employees to respond rapidly to customer demands. Instead, bottom-up engagement in digital strategy and change supports digital transformation and innovation. More research is needed, however, to understand the role of organizational climate and culture in shaping digital transformation. On the whole, these findings and the framework presented here are relevant for organizations and managers as they digitalize and embark on digital transformation.

Directions for Future Research

This study has some limitations but also presents several opportunities for further research. Our review is broad in scope and integrates qualitative and non-qualitative studies using varying research designs rather than being a systematic review. We opted for this targeted approach as the field of digital transformation is multi-disciplinary and still in its nascent stages, thus limiting the potential and usefulness of systematic reviews and meta-analyses. While we have integrated an expansive set of literature into a framework that links individual, group, and organizational factors to digital transformation processes and outcomes, further research is needed to test these hypotheses and relationships. The studies included in the reviews were also largely cross-sectional studies that used self-report measures that provide useful insights at one particular time point but have limited value in understanding change processes, which longitudinal or qualitative studies are better suited for.

Nevertheless, a key contribution of this review is the integration of several under-studied individual, group, and organizational factors into a holistic, multi-level digital transformation framework. For example, technology adoption has been studied extensively and in a wide range of workplace settings. As the uptake of new technologies increases due to rapid digitalization, we propose that other research further integrates the rich body of literature on technology adoption with digital transformation processes and outcomes. This proposed framework provides researchers and practitioners with a useful overview of the body of knowledge that exists today

and a reference for identifying either areas for future research or issues to focus on when embarking on digital transformation.

This review has highlighted the importance of context at the individual, group, and organizational levels. At the individual level, factors such as gender, age, personality, education, job type/job tasks, and experience/skill levels are all likely to play a role in digital transformation outcomes, such as job satisfaction, productivity, and task performance, alongside work-related wellbeing, and stress, organizational commitment and turnover. Social norms and peer and management support may influence group outcomes such as team effectiveness, empowerment and participation, resilience, and adaptability. At the organizational level, leadership, organizational culture and climate are likely to influence digital transformation outcomes, yet may be moderated by factors such as human resource management, support for training, and organizational setting. Future research should test these relationships, including more study of noted contextual factors to draw out relevant industry and policy findings. Many of the factors included in our review occur at multiple organizational levels, with some overlap of concepts across different levels. Therefore, more attention is needed to clarify the relationships between different factors at multiple organizational levels.

Lastly, existing reviews and digital transformation studies have mostly focused on strategic or business level processes, with scant attention to employee-related factors at the individual, group, and organizational levels. For instance, existing digital transformation research has focused mainly on executives and organizational leaders' perspectives rather than those of employees. Therefore, a priority for future research includes further study of employee attitudes and perceptions of digital transformation, given that employee perceptions are likely to differ from those of managers.

CONCLUSION

The rapid advancement of new digital technologies in the workplace is inevitable and will lead to transformation across the economy while increasing concerns about the future of work among organizations and their workers. Organizations need to embrace digital technologies and transform in order to remain competitive and survive. Employees are a crucial part of the digital transformation process's success and understanding their perceptions and attitudes toward technological change is important, alongside other strategies to enhance their digital capabilities. This review distilled the important factors in digital transformation at three different levels (individual, group and organization) to highlight the crucial role that employees, organizational leaders, managers, and human resource departments play in this transformation process. Organizations and their leaders also need to be mindful of the unintended adverse effects of technological change and digital transformation on employees and mitigate impacts on work-related health and well-being through promoting resilience and adaptability among individuals and teams with requisite support.

AUTHOR CONTRIBUTIONS

BT and SC conceptualized the review. BT performed the bibliographic search and prepared the first draft of the manuscript. SC helped develop this review and the first version of this manuscript. YW, ZS, HL, and PO contributed to the selection of literature and the results. SL helped develop this review and edited the full manuscript. All authors contributed to and approved the final manuscript.

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The Role and Meaning of the Digital Transformation As a Disruptive Innovation on Small and Medium Manufacturing Enterprises

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The research reported in this paper explores the impact of digital transformation as a disruptive innovation on manufacturing SMEs. The research is based on a qualitative Delphi study encompassing 49 experts from eleven EU countries. The paper aims to demonstrate how disruptive innovations affect organizational changes and determine critical factors in organizations that impact the initiating and promoting R&D of disruptive innovation. We discovered that disruptive innovations impact product/process development methods, new production concepts, new materials for products, and new organization plans. Additionally, we identified organizational changes related to the development and use of disruptive innovations in the future. We also indicate how disruptive innovations influence social and technological changes in the organizational environment. The analysis also disclosed three main groups of disruptive innovations and their impact on future smart factory development, namely the following: technological changes, the emergence of innovative products, business models and solutions and organizational culture as one of the crucial key success factors. The analysis also examined the enablers of the successful development/introduction of disruptive innovations, wherein internal and external factors were determined. Additionally, we presented obstacles and the approaches necessary to mitigate them. We can conclude from the findings that in the timeframe of 5–10 years, only the SME that uses/develops disruptive innovations will survive in the market. However, the companies do not always have a clear idea of the meaning of disruptive innovations. Therefore, it is important to set clear goals regarding the achievement of disruptive innovations in companies. It is also necessary to creatively apply presented instruments enabling improvement of organizational changes and apply some additional concepts, which we have suggested.

Keywords: digital transformation, disruptive innovation, Industry 4.0, Delphi study, SME, smart factory

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INTRODUCTION

The emergence of disruptive innovation theories dates to 1995, when Bower and Christensen (1995) published the article entitled Disruptive Technologies: Catching the Wave, which outlined the thesis that innovation drives corporate growth. Over the past 25 years, this thesis has become a guide for entrepreneurs and managers. Scholars usually ask why industry leaders do not remain leaders when technological or market changes occur. The answer can be found in the fundamental idea of disturbances theory as a tool that predicts behavior (Dillon, 2020). Its core value lies in the ability to evaluate and predict within the organization. The ability required by the organization is then one of choosing the right strategy and avoiding the wrong one (Shang et al., 2019). Such an instance is presented by the sale of the laptop IBM program to Lenovo, which is probably one of the most essential business decisions contributing to the continued growth and survival of IBM.

Disruptive innovations are defined as those based on which a product or service has been developed that incorporates a technology initially introduced in simple applications at a lower market price range (Christensen et al., 2018). These products or services are affordable in their original form. Disruptive innovations are not considered breakthrough innovations or ambitious upgrades of existing products or services that would dramatically change business practices and business models. Instead, they consist of straightforward and affordable products and services. Competitors recognize the market potential of such products and services, which are capable of transforming a particular industry. There is a knock-out effect of competition on the incumbent producers. They recognize factors of the primary producer (such as an internal organization) that prevent further product development and market penetration in compliance with predicted customer needs and expectations (Christensen et al., 2013; Dillon, 2020).

While work automation and computerisation were the critical paradigms of the Third Industrial Revolution (1960-2010), the Fourth Industrial Revolution (also named Industry 4.0) brought the digitalisation and informatisation of processes. Industry 4.0 can be understood as a broad socio-technical paradigm (Mariani and Borghi, 2019). It presents a policy concept for increasing economic growth, which has fostered the emergence of innovation-based entrepreneurship, and which is based on development and research, deregulation, increased risk capital financing and international protection of intellectual property (Christensen et al., 2018; Herrmann, 2019). The networking of the economy as a strategic tool for acquiring knowledge and information and connecting people with expertise in a modern knowledge society is crucial. The networking of businesses (e.g., incubators and technology parks) offers synergies in the joint management of information, knowledge and human resources. Knowledge and information become crucial for success in the Fourth Industrial Revolution (Kabir, 2019). The organization is required to do as much as possible, including optimizing resources, reducing costs per unit produced and enabling greater efficiency. Higher productivity with cost optimisation means a competitive organizational advantage. From the position of value and the value system, it is also vital to understand the current direction: striving for a balance between business and private life, a creative environment and the possibility of self-realization (Martin-Rojas et al., 2019). The new phase of evolution is connected with the development of the social superstructure and occurs only if suitable conditions are created in the broader social environment, namely the development level of information knowledge, individual consciousness, and attitude toward the environment (Nanterme, 2016; Bongomin et al., 2020).

During the Third Industrial Revolution, enterprises developed technologies that reduce cost and complexity. The development of technological processes has also enabled enterprises to produce more technologically advanced and higher quality products and services and develop new business models. However, in Industry 4.0, manufacturers are being challenged by the digital transformation, in which niche technologies, together with the Industry 4.0 concept, are understood as disruptive innovations. The most important developmental step within Industry 4.0 is establishing cyber-physical systems (CPS) which connect the physical environment and cyberspace (Ren et al., 2015; Lu and Xu, 2018). Within the systems, mechanisms are created that enable interaction at the human-to-human, human-to-machine and machine-to-machine level along the entire value chain (Kagermann et al., 2013). These processes affect changes in organizational culture and become an increasing challenge for companies and society, as the involvement of humans in the processes of direct communication and collaboration with the machine as an equal partner brings new challenges, such as the resistance of employees, the fear of replacing humans with machines and artificial intelligence-based technology, and the question of the adequacy of the skills necessary to manage organizational processes in the context of smart manufacturing (Hirsch-Kreinsen, 2016; Kiel et al., 2017; Seeber et al., 2020).

In manufacturing companies, the integration of CPSs into production creates cyber-physical production systems (CPPS) (Schiele and Torn, 2020). These systems become increasingly important in smart factories for creating connections along the entire supply chain (connection with suppliers – the company's external environment) (Roblek et al., 2020). However, in the enterprise's internal environment, changes in the production processes, wherein smart factory factors such as the industrial internet of things, CPPS and production systems consisting of one or more CPS come to the fore (Panetto et al., 2019). CPS is understood as a physical object with a built-in system in which the control process unit (computer power supply) is located, the industrial cloud, whose goal is to store, analyze and share data, with some form of network connectivity (Mabkhot et al., 2018). Thus, smart factories strive for self-organization based on establishing automatic machine configuration and process optimisation, enabled by the decentralization of production control. Innovative production process control software influences the transformation of shop floor management by introducing advanced technological processes based on lean management philosophy. For example, the Enterprise Resource Planning (ERP) at the planning level (top floor) uses objective performance data that captures all resources of the enterprise (shop floor) in real-time.

The Manufacturing Execution System (MES) influences the improvement of production processes. It can connect production data and ERP data, including business planning that includes resources, customer requirements and expectations (Gruber, 2013; Oesterreider and Teuteberg, 2016).

In addition to CPPS, another characteristic of Industry 4.0 that influences the emergence of disruptive innovations within smart factories is that Industry 4.0 is based on and driven by technological development, represented by both self-oriented production manufacturing and service-oriented architects (Xu et al., 2018; Müller, 2019; Oztemel and Gursev, 2020). Technological development has influenced the emergence of smart products and services. It can be concluded that the result of Industry 4.0 is seen in the concept of smart factories, which is based on the intelligent production of smart, personalized products and within this production has a high degree of collaboration in production networks that also include external partners of the company value chain (Wang et al., 2017; Zhong et al., 2017; Frank et al., 2019).

The main objective of the research study is to identify disruptive innovations and understand their impact on future organizational agility. The paper also aims to present how disruptive innovations affect organizational changes and determine critical factors in organizations that impact the initiation and development of disruptive innovation. We focused on small and medium manufacturing enterprises (SMEs) in the European Union.

Based on these future expectations, the following research question was established:

Research Question: *What organizational changes should be expected from SMEs that enable the development and implementation of disruptive innovations and how do disruptive innovations pertaining to organizational changes influence future organizational agility?*

The following types of disruptive innovations were analyzed (and it has been estimated that they have an important impact on future smart factory development): (1) technological changes, (2) the emergence of innovative products, business models and solutions, and (3) organizational culture. These concepts enable manufacturing enterprises to reduce costs, improve flexibility and productivity, enhance quality and increase the speed of business processes (Brunelli et al., 2017; Junaid, 2020).

The research was conducted in European SMEs because micro, small, and medium-sized enterprises represent 99% of all European Union enterprises (Müller, 2019). The European Union promotes SMEs through various action programs, thus co-financing research programs in SMEs, which enable them a higher level of innovation and competitiveness (Hessels and Parker, 2013). Thus, SMEs have become the most propulsive companies in the EU and represent the European economy's backbone (Dabić et al., 2016).

The paper consists of the following sections: introduction, followed by conceptual background (theoretical review). The third section includes methodology. The fourth section presents the research results. The paper concludes with a discussion of results and conclusion, including paper limitations, and proposes research in future development trends.

CONCEPTUAL BACKGROUND

The digital transformation in organizations is changing technology and business models. It brings challenges and opportunities for established companies and newcomers in the field of disruptive innovations. One of the most relevant results of the Fourth Industrial Revolution is the smart factory. The transformation of the classical factory into a smart factory begins with the digital transformation, measurements and informatisation of everything related to production systems. However, the development and implementation of Industry 4.0 niche technologies [advanced robots, additive manufacturing, augmented reality, simulation, horizontal and vertical system integration, the Industrial Internet of Things (IIOT), cloud computing cybersecurity, big data and big data analytics] for a manufacturing enterprise represents a disruption to the innovation that is transforming production (Brunelli et al., 2017). For example, Bruer et al. (2018) and Tortorella et al. (2018a) examined the connection between lean manufacturing and Industry 4.0. Ben-Daya et al. (2017) gave attention to the connections between the Internet of Things (IoT) and supply chain management. Liu et al. (2014), Li et al. (2017) and Oettmeier and Hofmann (2017) pointed out the influence of additive manufacturing on processes and performance in the supply chain. Ivanov et al. (2016) presented a dynamic model and algorithm for short-term supply chain in smart factories. The short-term smart factory supply chain is by their opinion based on "temporal machine structures, different processing speed at parallel machines and dynamic job arrivals." New research regarding supply chain management research (Chang et al., 2020; Venkatesh et al., 2020) focuses on blockchain technology and its disintermediation effects. However, niche technologies as disruptive innovations also influence the organizational culture (Sultan and van de Bunt-Kokhuis, 2012; Tortorella et al., 2018b). Based on previous research into disruptive forces occurring in the industry, five crucial manufacturing disruptive methodologies that enable smart manufacturing can be highlighted. These five disruptive forces are (Li, 2016; McKinsey & Company, 2018):

(1) Connectivity-driven business models: The development and widespread availability of Internet technologies in the 21st century have made connectivity an essential factor in the emergence of new business models, among which the monetisation of data is a significant challenge. It is characteristic of the age of digitisation that software has become much more important than hardware. Interaction with customers is increasingly digital, in many cases managed without intermediaries, and takes place via digital industry platforms such are Amazon Web Services or, in the automotive industry, Mercedes Me Connect or Lexus Enform. Intel enables organizations implementing IoT solutions to connect almost any type of device to the cloud through their system architecture. It does not matter whether the device is connected to the native internet. IBM Watson technology platforms offer companies the opportunity to extend cognitive computing to IoT, and Microsoft Azure IoT platforms help companies to connect

devices, prepare an analysis of previously unused data, and integrate business systems (Ionut Pirvan et al., 2019). Gawer and Cusumano (2013, 417) defined industry platforms as "products, services, or technologies that act as a foundation upon which external innovators, organized as an innovative business ecosystem, can develop their complementary products, technologies, or service."

(2) Artificial Intelligence and autonomous systems: industrial companies are increasingly investing in robotics and machine learning. These investments enable them to develop technologies that enable the further development of the company's core activities (for example, the development of an automatic vehicle for transporting materials and products within the company) (Roblek et al., 2020). Thus, learning data and developing intelligent algorithms becomes a competitive advantage for companies. The development of artificial intelligence and autonomous systems, both concerning production and incorporation into products, has already had and will continue to have an even more significant impact on the entire industry (Oztemel and Gursev, 2020).

(3) Internet of Things (IoT): the basis for evaluation, integration and optimal process control is process-related data. The data is obtained from measurements performed by different sensors (IoT). Intelligent sensors with an integrated microprocessor play an essential role in measuring and enabling their rapid digitalisation. Integrated intelligent sensors enable the execution of logical functions, two-way communication and adaptation to environmental changes, decision making, self-calibration and self-testing in start-up situations. The sensors are becoming smaller and more user-friendly. The IoT can be described technically as a combination of sensors such as RFID, other communication devices (i.e., embedded computers), CM applications, Enterprise Resource Planning (ERP) integration and business intelligence technology (Mabkhot et al., 2018). It is essential in manufacturing to expand the role of IIoT, CPPS and production systems consisting of one or more CPS. The CPS represents a physical object with an embedded system containing a control processing unit (computer power), the industrial cloud that can store, analyze and exchange data, and form a network connection. The emergence of CPPS in any production system enables economic, social and even ecological benefits (Thiede et al., 2016). McKinsey Global Institute predicts that the IoT potential is 10–20 percent energy savings and a 10–25 percent improvement in work efficiency (McKinsey & Company, 2018). However, according to casual theory, the question arises as to whether big data eliminates the need to search for causality? Here, it is necessary to first pay attention to the fact that organization data does not represent the phenomenon itself, but it is necessary to understand it as representational of this phenomenon. The purpose of providing continuous research within organizations, communities, and individuals is to reveal new insights by creating new data within new categories. It is necessary to be aware that big data overlaps or neglects irregularities unless we enable this with a search-analytical algorithm. The problem is that big data is much more focused on correlation than on causality and thus ignores average events or conditions (Song and Taamouti, 2019; Wamba et al., 2020).

(4) Electrification: the Fourth Industrial Revolution concerns the sustainability aspect of production and the environmental aspect, and the technical aspect of converting fossil energy to renewable energy and resource efficiency. However, environmental legislation and customer demand for sustainable products and services are forcing the industry to manufacture products that use electricity (e.g., electric cars) and other renewable energy sources (Moldavska and Welo, 2019).

(5) Cybersecurity: the increasing connectivity both within companies (man to machine and machine to machine) and between companies (company to company), companies and consumers (company to the customer) and other systems such as defense, transport, and banking reminds us of the importance of cybersecurity. As more and more closed systems open, there is a more significant threat to both work and property processes (such as industrial espionage). It is estimated that the cybersecurity market's annual growth will be 5–10 percent by 2025 (McKinsey & Company, 2018). Companies have, therefore, begun to introduce the skills required for cybersecurity. Particular views of industry leaders suggest that they see cybersecurity as a battlefield for competitive advantage and diversity (McKinsey & Company, 2018).

Digitisation and informatisation enable the connecting of (smart) factories with other smart infrastructure elements – people, machines, and products. It is about connecting the entire value chain throughout the lifespan. People are involved as customers, constructors, technologists, managers and enhancers, repairers and analysts (Zhou et al., 2018). It can be concluded that connectivity enables organizations to adapt their systems to the needs of their customers in all aspects, specific requirements, quantities, deadlines and delivery points. The main challenges that organizations face in the digital transformation framework are standardization, security, and IT infrastructure. The real establishment of mentioned elements in the broader industrial environment will take several years, which is why some prefer to use the word evolution instead of the term 'industrial revolution' (Alvarez-Pereira, 2019).

In the context of research in the field of various manufacturing companies (breweries, automotive, food, textile, footwear industry, etc.), various authors (e.g., Yoo et al., 2012; Nosalska et al., 2019; Osterrieder et al., 2020) note that, in the context of Industry 4.0, digital transformation is coming which will lead to the emergence of smart factories. The digitalisation of production also affects customer requirements and business model change, the emergence of the digital (smart) supply chain (Garay-Rondero et al., 2020; Schniederjans et al., 2020), additive manufacturing technologies (D'Aveni, 2018) and increases the competitiveness of companies. The importance

of disruptive innovations are noticeable in the context of full automation, robotisation and the development of manufacturing technologies that allow a higher degree of interconnectivity (IIoT), leading to increased communication between machines and local data processing. The research conducted in various German manufacturing industries shows that the machine and plant engineering companies are mainly facing changing workforce qualifications, while the electrical engineering and information and communication technology companies are mainly concerned with the importance of different critical partner networks, and automotive suppliers predominantly exploit IIoT-inherent benefits in terms of increasing cost efficiency (Arnold et al., 2016).

Hamzeh et al. (2018) researched the importance of technology and the Industrial Revolution concept for SMEs. The research was conducted among SME consulting managers who believed that technological development based on Industry 4.0 technology innovation would impact production costs, improve agility, and enhance service offerings. It should be noted that this is only a prospective study carried out among a very heterogeneous group of SME consulting managers. Chan et al. (2019) were attempting to determine how SMEs achieve the agility to respond to disruptive digital innovation. Their findings show "that for SME; mitigating organizational rigidity is enabled by the mechanism of achieving boundary openness while developing innovative capability is enabled by the mechanism of achieving organizational adaptability. At the same time, given the inherent challenges of resource constraints, SMEs also need to balance the tension of organizational ambidexterity".

The transformation of traditional factories into smart factories will provide new insights into how disruptive innovations technology affects business process transformation, agility, value chain transformation, organizational culture, and human resource policy changes (Loonam et al., 2018). However, management in organizations must be aware that organizational and business issues remain the same in the age of smart organizations. The forces that cause disruptions are constant and affect both the internal and external organizational environment (e.g., supply chains which are transforming in the value chains) (Akkermans and Van Wassenhove, 2018). To ensure the successful operation of organizations and their long-term existence, leaders (often founders or significant shareholders) must provide adequate resources in the form of tangible and intangible assets. Therefore, they must be aware of the importance of acquiring knowledge that will enable the organization to cope with disruptive events and form a foundation on the basis of which management will be able to react to disruptive forces in a timely manner and provide a system for continuous management of disruptive events (Jaques, 2017). In doing so, the management must be aware of the importance of disruptive innovations theory and, on this basis, be able to predict what will happen without the hindrance of personal opinions (Wördenweber and Weissflog, 2006).

Organizations that want to be successful disruptive innovators must embed in their organizational culture the mindset that disruptiveness is not the creation of something new or breakthrough and that disruptive innovations are not events but a process in which resources are allocated within the organization, with a view to continuous technological evolution and meeting the changing needs of existing and potential new consumers (Rastogi et al., 2019). As part of its strategy, management must be aware of the importance of disruptive innovations policies within the Fourth Industrial Revolution. To this end, the organization's strategy includes the importance of developing and adapting the system, organizational culture, organizational processes and other factors that enable the provision of fluidity even under reduced innovation conditions (Jaques, 2017; Hopp et al., 2018).

Szymańska (2016) and Mohelska and Sokolova (2018) explained that for ensuring success in the new work environment created by the Industry 4.0 era, it is crucial that organizational culture must be characterized by openness to various fields of activity. A new type of culture requires a new, open system of values, standards, thinking patterns, and actions perpetuated in the organization's social environment, and contributing to its goals. The organizational culture in the Industry 4.0 era is primarily open to the environment, supports extensive cooperation therewith, provides freedom of relations, uses the potential of employees and external partners, and is open to new knowledge, changes, and sometimes to the resulting mistakes. Moreover, it focuses on implementing unique visions and strategies while ensuring discipline and successfully integrates participants in the described relationships around new activities (Al-Haddad and Kotnour, 2015).

METHODOLOGY

Delphi Methodology

Most Delphi researchers focus on the reliable and original research of ideas or advancing new information, which is useful in making important (strategic) decisions. Delphi studies are often used in deductive research but can be combined with data collected with qualitative methods that ensure a more pragmatic approach to instrumentalisation (Rowe and Wright, 1999). Consequently, this approach also allows for methodological triangulation (Yin, 2002), improves validity (Yin, 2013) and increases contextual understanding of the phenomena (Fiss, 2009).

The Delphi method is used particularly for predictions and forecasts concerning the future development of technology and the impact of new technologies on society and the economy. It is based on the statistical processing of collected opinions obtained from experts in a specific field. The Delphi method is a structured scientific method with clear rules and procedures. The experts are asked to answer some pre-selected questions, each on its own, and then the "average answer" is calculated. It is assumed that there are no "correct" answers, but the approach results in a free estimation of the probability that some events will occur. After collecting, processing and submitting answers to the same questions, definitive predictions are made (Higgins, 1994). The Delphi method's key features are anonymity among survey participants, structured feedback that experts receive after giving opinions and allowing them to adjust their previous opinions until they reach an agreement (Hsu and Sandford, 2007). Usually,

the Delphi method involves two to three rounds of exchange of opinions between experts and the researcher (Adler and Ziglio, 1996). Two are considered adequate (Boulkedid et al., 2011; Gary and Heiko, 2015) as the addition of further rounds adds a further administrative burden and places pressure upon participants that results in lower response rates (Gary and Heiko, 2015).

According to Loo (2002), the Delphi method can be used to forecast the future for strategic management and organizational development, among other potential applications for organizational management. Okoli and Pawlowski (2004) explained that the Delphi method was recognized as a widespread instrument in information systems research to identify and evaluate executive decision-making issues. Hallowell and Gambatese (2010) imply that Delphi technology is used in construction engineering and construction management when conventional methods fail because the latter may not be suitable for research involving disruptive factors and require sensitive data access. The Delphi technique is valued in such cases because it enables researchers to obtain highly reliable data from certified experts through strategically designed surveys. For this reason, we have chosen the Delphi method for our research. It helps us to establish procedures for obtaining and refining expert and professional opinions in the field.

Delphi Study Design

The survey was conducted in two rounds. The Delphi study's first round includes open-ended questions about expectations pertaining to the introduction of disruptive innovations in an organization, challenges experienced in introducing disruptive innovations, and steps for a successful introduction of disruptive innovations. The survey questionnaire was prepared in accordance with the questionnaire used in the MIT Sloan Management Review and Boston Consulting artificial intelligence survey (Boston Consulting Group, 2020). The questions were modified in accordance with the disruption innovation theme of our research. We tested the questionnaire on a sample of 12 persons that we had previously used in the survey. Following the comments of the participants, some minor mistakes have been addressed and complementary material was added to some questions in accordance with the topic of the research.

The questionnaire with four open questions was prepared in a survey tool named One Click Survey or 1KA (One Click Survey, 2021), and a link to the questionnaire was sent by email. The first question was: What disruptive innovation have you introduced into the organization and your strategy for further development? The second question was: What effect has disruptive innovation had on your organization so far? The third question was: What organizational changes do you think would result from disruptive innovations in the future (5–10 years)? The fourth question was: What are the key factors in the organization's internal and external environment that enable further development and disruptive innovations?

Participants were given 10 days to provide their opinion and share expertise insights. Answers to open-ended questions were analyzed using qualitative content analysis. We informed the research participants of the results and allowed them to familiarize themselves therewith.

Based on the qualitative analysis of the answers obtained from round one of the Delphi study, seven expectations concerning the introduction of disruptive innovations in the organization were formulated. In the second round, participants were required to choose the appropriate answer in regard to introducing disruptive innovations in their organization. They were required to choose on the Likert scale the results they expected to achieve by introducing disruptive innovations. The third question includes ranking the predominant challenges that their company has experienced in introducing disruptive innovations. In the fourth question, they were required to specify the most important steps necessary to enable disruptive innovations. In the fifth question, they were asked to describe the importance and role of individual cultural values in developing and implementing disruptive innovations in their company. In the sixth question, they were required to list cultural values by their relevance to disruptive innovations in a changing environment.

We sent the questionnaire prepared using the 1KA tool in the second round to the participants who had answered all the open questions. All survey participants were given 14 days to provide answers. After 1 week, a reminder was sent. At the beginning of the third week, we thanked all participants who had answered the questionnaire. So, it can be concluded that all procedures necessary to undertake the standard Delphi method were followed during the study (Linstone and Turoff, 1975).

A comprehensive approach to the concept of the Delphi method was used. The information concerning the system of criteria and their relative importance creates the conditions for improving the quality of the design of a multi-criteria decision-making basis. The official expert prediction of the qualification weighting criteria was achieved through a methodologically defined, organized and systematized harmonization of individual assessments using descriptive statistical processing of these assessments and predictions (Hsu and Sandford, 2007).

Delphi Panel

For this study, an expert was considered to have a broad understanding of smart manufacturing with specific expertise in at least one of four functional areas: human resource management, information systems management, research and innovation, and manufacturing. To be selected, an expert was required to hold either a middle or high-level managerial position in a smart manufacturing company. Moreover, each expert was required to be accessible and interested in the research results.

Participants

The selection of suitable experts is of special importance. For this reason, the systematic approach was applied to select the appropriate participants for the study. In the first step, within various projects regarding innovations, workshops were conducted which were attended by participants and experts in the impact of disruptive innovations on the small and medium manufacturing enterprises. A list of those experts was formed. In order to meet methodological prerequisites for the Delphi study, the sample of appropriate experts was selected by applying various criteria, i.e., both genders were included in the study, from different work position levels (from board

members to operation workers), years of work experience, country, and educational level. As a heterogeneous group of experts reflects the positively cognitive biases of the participants (Winkler and Moser, 2016), an emphasis was placed on an adequate heterogeneity of selected experts. Overall, a total number of 92 experts was identified and invited to participate in the study. All of them were contacted. By the end of the study, 49 experts from eleven countries (Slovenia (14), Italy (3), Spain (2), Hungary (5), Croatia (7), Czech Republic (5), Austria (3), Sweden (2), Germany (7), and Malta (1)) had completed both rounds of the Delphi study. Therefore, the participants' final sample is purposive and consists of two board members, fifteen managing directors, seven technology directors, seven heads of business units or department, eight experts, three consultants, and seven operation workers. Their SMEs are, on average, more than 10 years old, with more than fifty employees, and generate an average of 3.3 million EUR in revenues per year. The SME primary industry is manufacturing, and the primary activity is R&D or product development, project management, strategy management, general management or information technology. They all have experience in using disruptive innovations as disruptive innovations in production, disruptive innovations algorithms and techniques, or disruptive innovations tools as an end-user.

Assumptions and Biases of the Delphi Participants

The expert panel composition was based on identifying, evaluating, selecting, and recruiting relevant research participants. There is no general rule about the size of a Delphi study panel. Thus, the size depends on the purposes of the researcher, the desired heterogeneity, and the availability of the research expert (Loo, 2002). Researchers in past studies have used the Delphi method with 15–35 participants (McMillan et al., 2016) and studies with 40–60 participants (Kent and Saffer, 2014; Roßmann et al., 2018). The panel size in this study belongs to the second group and includes experts in digital transformation and smart manufacturing, which has become a complex topic involving different structures and actors, and the number of experts in this field is increasing. In practice, it has been shown that composite panels allow for more accurate estimates, as opposed to more diverse views, thereby reducing the specific polarization of preferences and responses (Yaniv, 2011).

The study involved a large number of stakeholders performing different functions within smart manufacturing. We ensured that the experts came from different countries. Potential experts were identified based on a database search and a network approach. The selection criterion focused on knowledge about smart manufacturing and the practice of a profession in this field. The experts were required to make appropriate statements about the importance of disruptive innovations and their future significance in the context of smart manufacturing. In the next step, we evaluated the experts regarding corporate functions and the importance of disruptive innovations in their smart factory environment.

RESEARCH RESULTS

The results of the study are presented in this chapter. Thus, the final rankings are shown, which were obtained based on the data analysis, and we added the explanations obtained through an analysis of the qualitative comments of the participants in the first phase of the study.

We decided to divide the research topic into two parts because a company's digital transformation affects the emergence of change and the development of a new organizational culture. Thus, digitalisation in conjunction with the increasingly important informatisation represents an important field of research for the future, which includes not only technological changes in the field of final products (e.g., electric cars) and the robotisation of production and logistics processes (both have consequences for the supply and value chain and future employee structures of companies, etc.), but also raises the question of the emergence of a new organizational culture and leadership with increasing cooperation between humans and machines (Caruso, 2018). The first part addresses the impact of disruptive innovations on the organizations, while the second part presents the impact of the disruptive innovations on the organizational culture.

The Impact of Disruptive Innovations on the Organizations

In the second round of the Delphi study, the participants were first asked about adopting disruptive innovations in their organizations. **Figure 1** shows that 48% of the participants think that their organization is on the right track with disruptive technologies, while 24% of the participants think that their organization is behind schedule with adoption and 22% of the participants think that their organization is ahead of schedule in adopting disruptive technologies and 6% of the participants think that their organization has not yet begun to adopt disruptive technologies but plans to do so. None of the participants thinks that their organization has not yet begun to adopt disruptive technologies and does not plan to adopt them.

The second question analyzed the % of participants expecting an increase in organizational performance by introducing disruptive innovations. **Table 1** shows the listed outcome expectations in accordance with their importance for the participants.

According to the results in **Table 1**, the study participants indicated that they expect that 29% of the participants think that the introduction of disruptive innovation will increase sales by 10–20%. 35% of the participants think that there will be an increase in market share by 1–10%, and 37% of the participants think that operating costs will decrease by 10–20%. 27% of participants think business speed and agility will increase by 10–20%, 31% of participants think customer satisfaction will increase by 50–100%, 33% of participants think the new product/service development time will decrease by 10–20%, and 35% of participants think the number of more talented personnel hired and retained will increase by 20–50%.

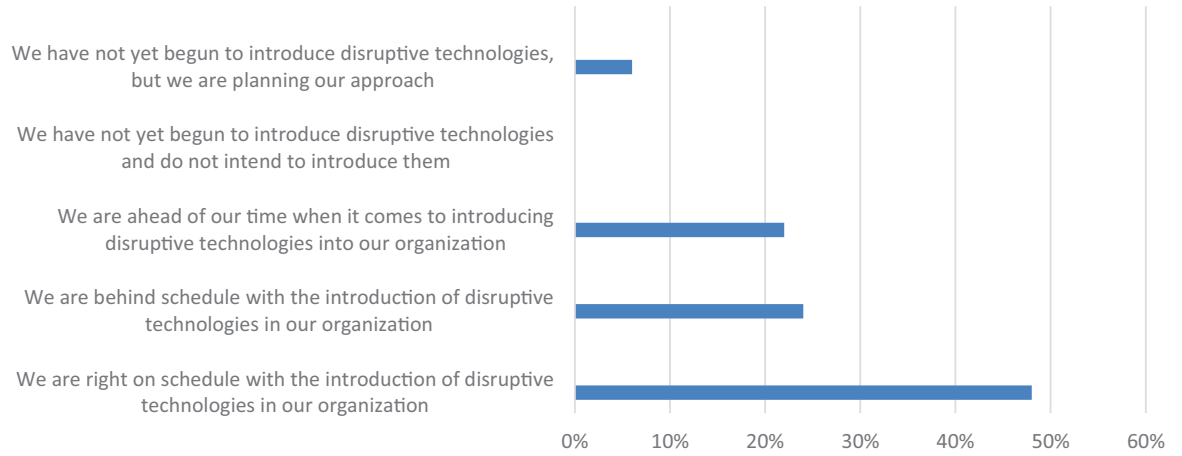

FIGURE 1 | The level of introduction of disruptive technologies in the organizations (*n* = 49; source: authors).

TABLE 1 | Results of participants' SME achievement expectations by introducing disruptive innovation.

Expectations	1–10%	10–20%	20–50%	50–100%	100–200%	200–500%	500%>	Valid	Average	St. dev.
Increase revenue	9	14	12	8	5	1	0	49	2,80	1,35
	18%	29%	24%	16%	10%	2%	0%	100		
Increase market share by	17	12	8	5	6	1	0	49	2,60	1,53
	35%	24%	16%	10%	12%	2%	0%	100		
Reduce operating costs by	9	18	11	5	4	2	0	49	2,70	1,34
	18%	37%	22	10	8	4	0	100		
Increase business speed and agility by	8	13	9	10	6	3	0	49	3,10	1,49
	16%	27%	18%	20%	12%	6%	0%	100		
Improve customer satisfaction by	5	8	12	15	6	3	0	49	3,40	1,36
	10%	16%	24%	31%	12%	6%	0%	100		
Reduce the development time for new products/services by	10	16	7	5	3	8	0	0	3,00	1,73
	20%	33%	14%	10%	6%	16%	0%	100		
Improve amount of better talent hired and retained by	6	13	17	7	0	6	0	0	3,00	1,44
	12%	27%	35%	14%	0%	12%	0%	100		

(n = 49; source: authors).

In the third question, participants were asked to identify and name the three most important challenges for their company in introducing disruptive innovations. **Figure 2** shows that the most important challenges for companies in adopting disruptive innovations are the following: lack of the right in-house capabilities (11 votes), tendency to think short-term vs. plan long-term (7 votes), internal politics (5 votes), lack of a dedicated budget (5 votes), over-reliance on legacy technology (4 votes), lack of the right technology/tools (4 votes), cultural resistance (3 votes), lack of formal strategy/plan (3 votes), data silos (2 votes), lack of central coordination/ownership (2 votes), lack of senior management support (2 votes), and one participant indicated no challenges.

In the first part of the Delphi study, participants mentioned in their qualitative comments that a lack of the right technology/tools occurs in their organizations. However, participants do not pay much attention to this problem (or do not perceive it) because they lack the right internal skills and budget. They also mentioned that they have a higher-than-average tendency to think short term while planning long term. In the first part of the study, participants also pointed out the lack of a positive attitude among senior management regarding supporting technology implementation and helping employees overcome implementation or development challenges. Participants also believe there is a lack of central coordination in their organizations regarding ownership. In the qualitative comments, participants also pointed to issues related to over-reliance on outdated technology that, if not addressed, could lead to the creation of a dysfunctional organization. A culture of resistance may be associated with the challenge of a dysfunctional organization.

Concerning the challenge referred to as cultural resistance, the first part of the study examined which organizational culture values correspond to the adoption of disruptive

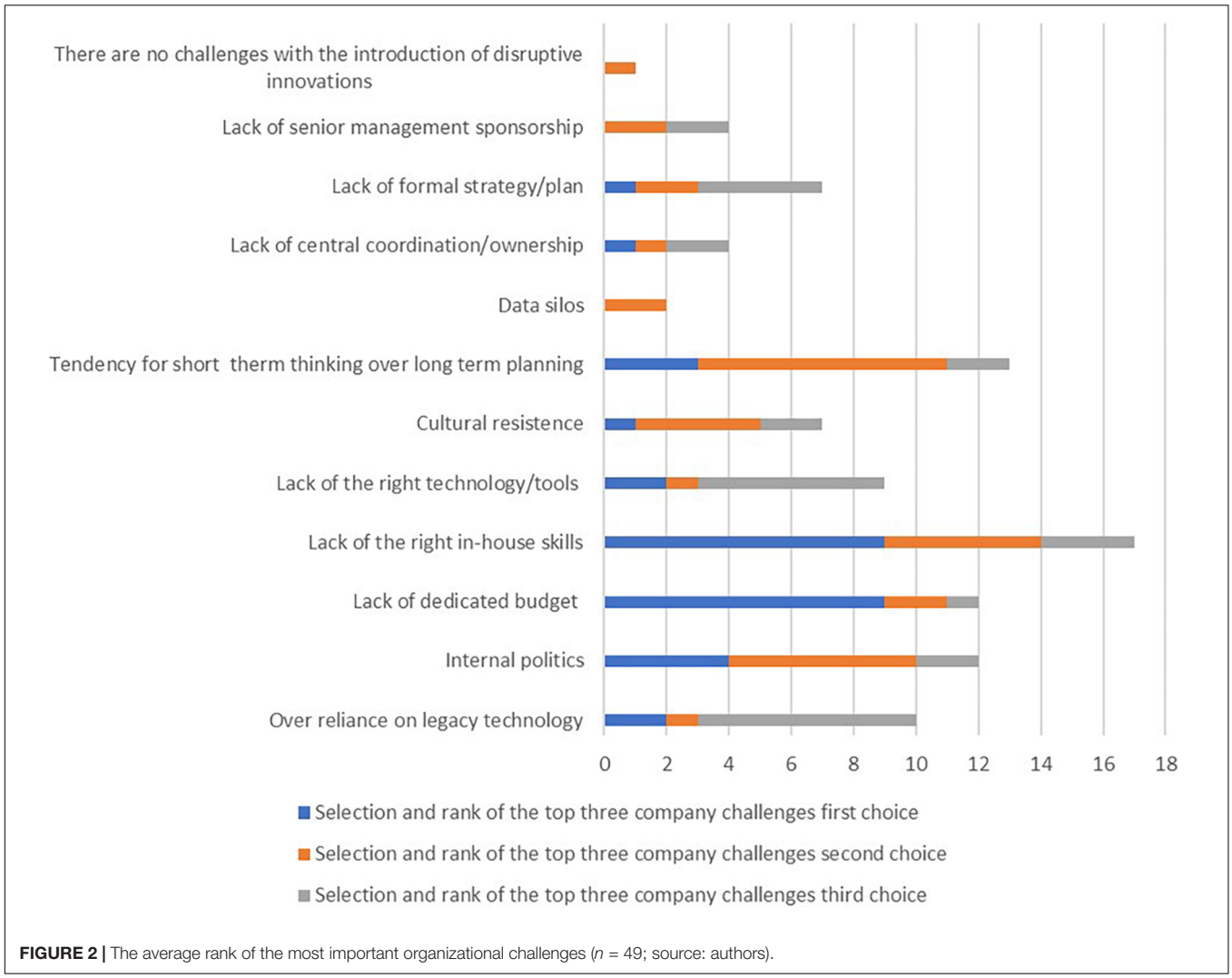

FIGURE 2 | The average rank of the most important organizational challenges (n = 49; source: authors).

innovations. It was found that the interplay between external and internal environments, technology orientation, and appropriate communication is of great importance. In the context of the development and use of Big Data, organizations are faced with the emergence of large volumes of unstructured data. Therefore, organizations must implement tools based on algorithms (e.g., Hidden Markov Model) to extract terms from data silos. Failure to address this challenge can lead to a dysfunctional organization. Within the internal policies, participants pointed out a lack of methods and procedures.

Participants in the Delphi study's first part pointed out that disruptive innovations in business processes initially involve some resistance due to lack of internal knowledge, but this can be mitigated with the right methods. Some organizations had problems with employee resistance, especially with all methods, and needed more time for organizational change due to information support.

Participants highlighted the importance of digital transformation, enabling the introduction of new smart factory modules, technological improvements, robotisation (e.g., a laser camera system for seam tracking in mig/mag welding) and virtual (CPS) development. The consequences are apparent in the elimination of operators in the work process as such processes become modified by the deployment of robots. They also mentioned the importance of business methods such as Kaizen-5s and the implementation of 6 Sigma. According to them, disruptive innovations also change product/process development methods, bring new production concepts, new materials for products and new organizational plans (flat organizations, organizational flow changes, and more internal communication). For example, they enable greater effectiveness, real-time information for better decision making, fewer bottlenecks, seam tracking systems to enable better penetration and less dispersion of weld quality, and changes in supply chain management (e.g., the supplier can monitor inventory through online access).

The participants also emphasized that the strategic decision to engage in disruptive innovation is critical to success. Innovation does not arise from inspiration but from a clear, ambitious goal, business excellence, hiring the best talent inside or outside the organization, dedicated funding, and a strict timeline. Positive

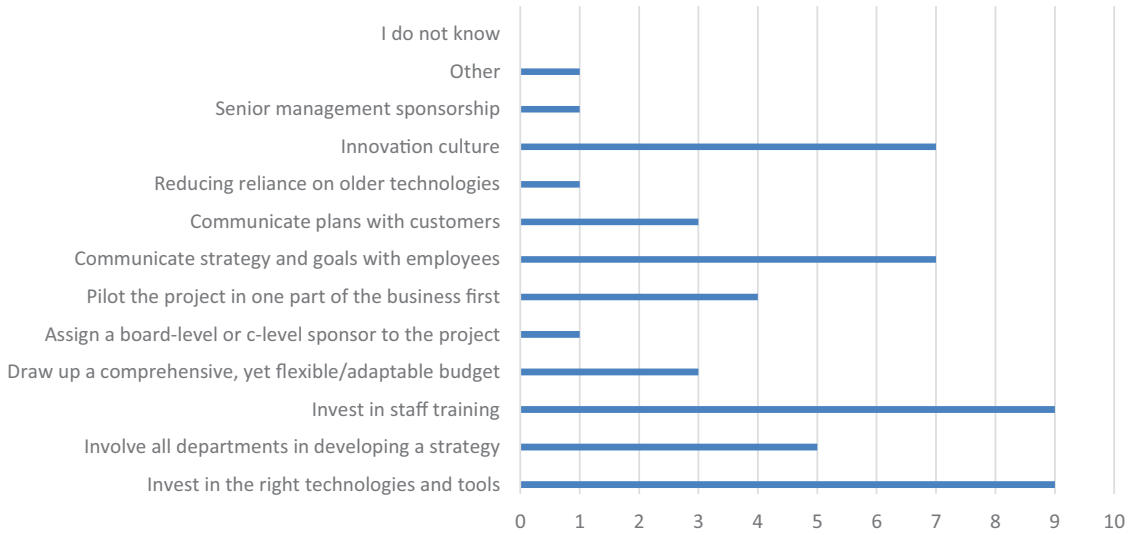

FIGURE 3 | The most important steps to enable the successful introduction of disruptive innovations (n = 49; source: authors).

disruptive innovations include making the organization more agile and flexible. Other disruptive innovations, such as electric cars, bring some risks in the future and opportunities for a greater level of sustainability. Generally, if the disruptive program or product generates a significant cash flow, the organization must adapt to that opportunity.

Regarding the position of what organizational changes will occur in 5–10 years due to the development of disruptive innovations, the participants came to the encouraging conclusion that in 5–10 years, only the SMEs that develop disruptive innovations will survive in the market.

The participants' comments included full digitisation, more virtual development, a different way of working, new offerings, new knowledge, new production concepts and market opportunities, shorter time-to-market, and collaboration between different market players. They also think that companies will have fewer staff, and supervisors with a higher educational level. Smart factories will need highly educated people and continuous updating of knowledge to manage their systems. Some participants also stated that the paradigm is changing dramatically right now due to the coronavirus, and it is difficult to predict what will happen in the future.

Participants expect that artificial intelligence will have an increased presence in business, especially in regard to big data. In the participants' opinion, fewer people will require administrative or middle management, especially in middle-sized organizations. They asserted that the decision-making process must be quicker; development times for new products will be shorter; and the niches will become more critical because people will expect personalized products or services. The robotic lines will require different methods of guidance and monitoring. Reorganization of information support will be required, as will the increased awareness of line managers. It can be concluded that the business landscape will change drastically in the coming years as companies that are unwilling to adapt lose their market shares to new companies with new visions and monetisation approaches.

Participants ranked the most important organizational factors capable of enabling the further development of disruptive innovations in the internal and external environment as follows: the cosmopolitanism of the team, which can bring courage, openness and open-mindedness, which drives innovation, communication with people and their consultation, competition in the market, competitiveness, the desire for progress, new working methods, and the gathering of ideas. Helping top management to adjust and urge the adoption of high-level, open-source development toolkits allows a high level of abstraction and rapid development.

Among the internal factors that have proven to be the best and most effective in all aspects are openness to change, willingness to adopt new or innovative business models, organizational culture, budgeting, and external subjects' willingness to participate. Among the external ones: competition (and cooperation, where complementary technologies are available or have the x-industrial application potential) and environmental friendliness (no safe/clean environment, no existential duration).

The organization's expectations regarding the results achieved with disruptive innovations are based on the participants' knowledge of the expected results of disruptive innovations in their organizations.

In the fourth question, participants were asked to mark the most important steps from the list that would enable the successful introduction of disruptive innovations. **Figure 3** shows that the participants decided that the most important steps for a successful introduction of disruptive innovations are: investment in the appropriate technologies and tools, communicating strategy, investment in staff training, employee goals and innovation culture. Among the least important steps, participants ranked reducing reliance on older technologies and

assigning a board-level or c-level sponsor to the project and senior management sponsorship.

The next subsection presents the answers regarding organizational culture changes in organizations due to disruptive innovations. We want to stress that the next subchapter is based on the same questionnaire (questions 5–6), which addresses the impact of disruptive innovations on the organizational culture.

The Impact of Disruptive Innovations on the Organizational Culture

Development of the innovation culture is based on methodological knowledge of disruptive innovations. In question 5, the participants were asked to describe the importance and role of the individual cultural values in developing and implementing disruptive innovations in their organizations. The comments received in response to this question are added to the answers received in response to question 6.

In question 6, the participants were asked to rank the listed cultural values by their relevance in terms of their contribution to disruptive innovations in a changing environment and to provide a qualitative comment. The results are presented in **Figure 4**.

The cultural values listed according to their relevance are:

(1) *Openness to change*: The processes of change in SMEs are seemingly independent of each other, but the facts clearly show that they are closely interrelated. Specific social rules (e.g., legal, economic, and ethical) apply to each phase of change. It is important to be aware that change always has a deterrent effect on employees and that employees often feel threatened by innovations, which is why it is necessary to convince them of the benefits of change.
For these reasons, the focus of leadership and management shifts spontaneously from functions and processes closer to direct relations with employees. Managers should be careful, when implementing organizational changes, to establish an appropriate work environment and rules and regulations, because only the efficient use of intellectual resources allows continuous improvement. It is appropriate to have such processes in a firm internal staff in a company that manages these processes.
This distrust of employees toward the introduction of innovative solutions in the company requires that organizational change behavior should be encouraged at all levels of leadership, management, and implementation. Organizations need creative employees who can become involved in strategic thinking processes and can pass on new values, creativity and innovation to other colleagues.

(2) *Innovation approach, innovation culture and climate*: From the content analysis of the qualitative attitudes of the interviewees, it can be concluded that digitalisation and informatisation stand for the transformation of organizational processes through the use of innovative, disruptive technologies and solutions that will change the supply chain, technology, technological processes, the value chain and the future employee structures of companies. As it can also be seen from the next respondent's answers, employees expect the emergence of a new corporate culture, increasing awareness of the importance of innovation and introducing new technologies and the interaction between management and employees for mutual cooperative cooperation in developing an innovative environment (including reach goals and creating a list of incentives for employees). Approximately 1–3% of company staff dedicates SME time for innovation, so it is important to stimulate and reward such staff (not only financially but also through other means of motivation – knowing individuals' cultural values might help managers to obtain the optimum performance from an innovative team). It is important to note that the benefits of innovation are inevitable in the background of innovation culture. According to the respondents' experiences, people were more inclined to embrace innovation if they saw a benefit to the individual. It is also important to emphasize that it is easier to manage an innovative company when managers and other employees originate from the same technical background because it is then easier to understand the situation in the market and transfer the appropriate knowledge for reaching the set goals. As part of developing cultural values for developing an innovative company, it is necessary to ensure that the natural curiosity of employees is maintained. It is also necessary to consider that better relationships promote the development of the company's culture and climate toward unification, better understanding, and the achievement of its set goals.

(3) *Willingness to acquire new knowledge*: Companies must realize that in a modern organization in the Fourth Industrial Revolution, learning must take an active role in operations. Employees who want to educate themselves further to make the organization more sustainable must be encouraged to do so because further education is not connected with costs. The management should know that considerable benefit can be derived from having qualified employees.

(4) *Tolerance to failures*: the respondents point out the need to consider that mistakes occur in developing and implementing disruptive innovations. According to the respondents, intolerance to mistakes is the biggest obstacle to disruptive innovation. The reaction to mistakes also depends on the employee's position, so the higher the decision-making level of a person, the more lenient the reaction to mistakes. However, learning experiences are never drawn from a mistake.

(5) *Orientation to end customers (clients)*: the respondents believe that customer orientation depends on the nature of the company's products or services. However, awareness of empathy and listening to the customers helps in achieving/satisfying customer needs and thus improving the business.

(6) *Trust*: according to the respondents, "trust and security" are related, but they are also influenced by the "appreciation and treatment of the employee" by his superiors. Unfairness is just as detrimental to the issue of trust as it is undesirable.

(7) *Organization agility*: respondents indicate that their companies are dedicated to technological solutions and

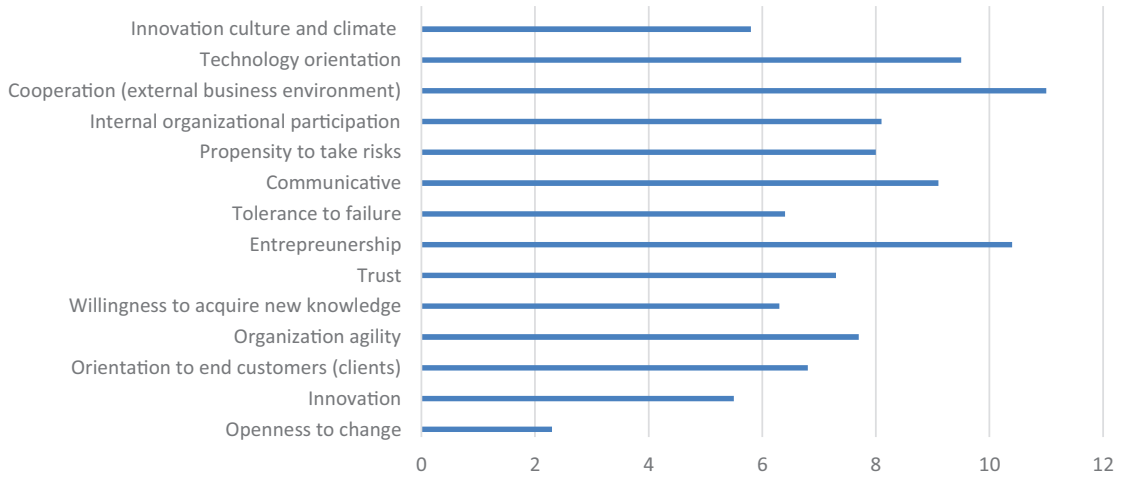

FIGURE 4 | Cultural values by relevance, ranked from 1 (most relevant) to 12 (least relevant) in terms of their contribution to disruptive innovations in a changing environment (n = 49; source: authors).

the openness of ownership/management structures to introducing new technologies.

(8) *The propensity to take risks*: risk-taking is evident in large new technology projects in organizations. Companies in which the culture discourages risk-taking become moribund. Innovation is 99% failure and 1% success.

(9) *Internal organizational participation*: internal organizational collaboration is carried out in accordance with employee rules and qualifications. If innovation is perceived as a process, and different departments participate in the development, then the innovation process is more effective and productive.

(10) *Communicative:* this pertains less to cultural values than it does to the nature of a person's character – extroverted vs. introverted. However, certain environments can influence good communication and bad communication, so, in part, the community's cultural values influence the form and scope of the communication action.

(11) *Technology orientation*: according to the respondents, it is an asset for a company if the owners/managers originate from a technical background: a vision/strategy that is built into the culture needs to be passed on to the other employees.

(12) *Entrepreneurship*: according to the respondents, no individual would become an entrepreneur if their attitude was not one that is oriented toward exploring opportunities. The difference in how to do so is grounded in moral-ethical standards, which are part of one's cultural values (also derived from childhood). Certain respondents pointed out that entrepreneurship is tied to making money from innovation. Thus, it might be a good step if management can explain how an innovative entrepreneurial spirit in the company can increase profitability. Among other answers, it is worth noting then that many employees started their careers in start-up companies.

(13) *Cooperation*: two different relationships emerged between companies: cooperation vs. competition. It is typical for small high-tech companies to cooperate (otherwise, they have little chance of surviving in the larger market). From this point of view, the younger generation's cultural values are somewhat different from those of the older generation or those of the larger companies in which there is a competitive relationship between companies. In a cooperative relationship with external companies, communication occurs at the level of the most qualified professionals.

The cooperative relationship is gaining importance because the innovation life cycle is becoming shorter, and companies cannot afford to develop everything themselves. Therefore, the involvement of external parties plays an important role (e.g., outsourced development of partial technologies, test procedures, supply chains, etc.).

Following the analysis of organizational culture factors and innovative SMEs, it is possible to form the key meanings of the individual roles of organizational culture. Thus, it is important for SMEs, which want to be leaders in innovative development that the leaders and managers of the company enable the knowledge and information to be shared between all key personnel as quickly as possible. Within the framework of enabling an innovation approach and the innovation culture and climate, it is necessary to ensure that the emergence of new technologies does not have a negative impact on employees (the issue of dismissal of employees). Thus, the key social capital must be represented by employees, who will be given support in the form of guidance and motivation supplied by the company's management to dedicate themselves to development without possible existential threats. It is important that employees trust their managers and leaders. As part of knowledge management, which we understand as a long-term and complex process of knowledge creation, transfer, and use

within an individual organization, companies must provide the function of knowledge transfer and use as we have already established and enable employees to have constant access to the acquisition of new knowledge. The company must therefore encourage and motivate employees to attend various forms of education. It is also important for an innovative organization to accept certain risks as one of the factors. Therefore, a certain level of attention must be paid to risk management and tolerance to the failures in R&D. The company's technological infrastructure must enable the customer to fulfill almost every wish regarding the company's products efficiently and with high quality. However, the technology infrastructure alone is not enough to fulfill the wishes of customers in the best possible way. Of course, the essential factor of the company philosophy must become an absolute focus on the customer and on the best educated and most highly motivated employees. Within the framework of organizational agility, both business owners and management must focus on permanent investment in new technologies. It is beneficial for the company if the owners and management support the technological orientation of the company, and define this in the vision/strategy of the company. An innovative entrepreneurial spirit is also encouraged in innovative organizations. In doing so, the company must provide employees who join the internal enterprise with payment outside the usual salary system in the organization. The employee must thus agree to a reduction in salary in the event of business failure, which is understood as entrepreneurial risk. In the event of success and generated profit, the individual is, of course, rewarded. An internal entrepreneur is, of course, different from a classic entrepreneur. The basic characteristic of an internal entrepreneur is that they are directed by the management of the company, while a classic entrepreneur is completely independent. The internal entrepreneur is also less risk-averse, but at the same time knows that in the event of failure, they will remain relatively safe within the company. Finally, we must mention the importance of developing a cooperative culture, which is important for creating a positive climate between individual organizations involved in the development or manufacture of a particular product.

DISCUSSION AND CONCLUSION

A Delphi method was applied as a tool in order to identify points of agreement about disruptive innovations within a group of experts. The study's goal was to determine the answer to the research question: *What organizational changes should be expected from SMEs that enable the development and implementation of disruptive innovations and how do disruptive innovations pertaining to organizational changes influence future organizational agility?*

This section will briefly summarize the key results and add the discussion, which illustrates the results and enables a wider picture and a comprehensive answer to the research question.

At the beginning of the research, the participants were asked how they define disruptive innovations. We discovered that participants have very similar definitions of what disruptive innovation means. The definition could be summarized as innovations based on developing specific and affordable products or services. They are not considered to be breakthrough innovations or ambitious upgrades of existing products or services. Into their organizations, they introduced, for example, the following disruptive innovations: several modules for the smart factory, different approaches to regular workdays, product innovations (e.g., products that reduce emissions in diesel gate engines), technological improvements (e.g., the technology that changes the production of components for electric motors), innovations of supply models and working processes.

In our opinion, a significant part of the identified and presented examples of disruptive definitions are only partially compliant with the basic definition of disruptive innovation. In the work of Christensen (1997), disruptive innovation is defined as something that creates a new value by disrupting existing value network(s), resulting in displaced dominating market-leading organizations or dominating products and services. Such innovations are more often than not produced by newcomers or even complete outsiders rather than existing market-leading entities. Moreover, "Disruption" often describes a process whereby a smaller company with fewer resources can successfully challenge established incumbent businesses (Christensen et al., 2013). The Disruptive Innovation is not each innovation, but those that significantly affect the way a market or industry functions.

Before continuing with a discussion, we shall provide a synopsis of the second part of the research findings. The participants pointed out that disruptive innovations in business processes initially bring some resistance due to a lack of internal knowledge but can be mitigated with the right methods. Some organizations had problems with employee resistance to all methods and need more time for organizational changes based on information support. Disruptive innovations impact product/process development method changes, new production concepts, new materials for products and new organization schemes (flat organizations, organizational flow changes, and more internal communications). So, they enable higher effectiveness, real-time information for better decision making, fewer bottlenecks, seam tracking systems enable better penetration and smaller spread of weld quality, and changes to the supply chain management (e.g., the supplier was allowed to observe inventories through online access).

Analyzing the "disruptive" innovation examples in this section we can realize that innovation examples are mainly not true disruptive innovations, but often improvements as a result of horizontal enabling technologies such as tracking systems and chain management tools, and ICT/digitalisation implementation. In other cases, the innovation was an implementation of widely accepted management models such as flat organization and improved internal communication. If we merge findings from this and previous paragraphs, it is clear that in many cases we detected a misunderstanding of the term 'disruptive innovation.' According to innovation typology (Nedelko and Potočan, 2013; OECD, 2021), respondents often presented process and organizational innovations which were new for the company but did not have the disruptive innovation character.

This is compliant with the finding by Prof. Christensen that: "In our experience, too many people who speak of "disruption" have not read a serious book or article on the subject. Too frequently, they use the term loosely to invoke the concept of innovation in support of whatever it is they wish to do. Many researchers, writers, and consultants use "disruptive innovation" to describe any situation in which an industry is shaken up and previously successful incumbents stumble. But that's much too broad a usage." (Christensen et al., 2013).

Why are we stressing this issue? It is not the basic problem that the respondents do not know exactly what disruptive innovations are. It is more worrying that they might be satisfied with their innovation activities, believing that they properly manage disruptive innovations.

The last part of the summarized results presents the most important organizational factors capable of enabling the further development of disruptive innovations in the internal and external environment. These are as follows: the cosmopolitanism of the team, which can bring courage, openness and open-mindedness, which drives innovation, communication with people and their consultation, competition in the market, competitiveness, the desire for progress, new working methods, and the gathering of ideas. Helping top management to adjust and urge the adoption of high-level, open-source development toolkits allows a high level of abstraction and rapid development. Among the internal factors that have proven to be the most effective in all aspects are openness to change, the willingness to adopt new or innovative business models, organizational culture, budgeting, and external subjects' willingness to participate. Among the external ones are competition (and cooperation, where complementary technologies are available or have the x-industrial application potential) and environmental friendliness (no safe/clean environment and no existential duration). Regarding the position of which organizational changes will occur in 5–10 years due to the development of disruptive innovations (third research question), the participants drew a satisfying conclusion that in 5–10 years there will be companies that develop disruptive innovations, while the rest will probably not survive in the market. The views regarding organizational changes that will occur in the future include full digitisation, more virtual development, a different way of working, new offerings, new knowledge, new production concepts and market opportunities, shorter time-to-market, and cooperation between different market participants. They also indicate that organizations will have fewer working staff, and supervisors with a higher educational level. Smart factories will require, for the purposes of managing their systems, more people with a higher level of education and continuous updating of knowledge. Some participants also state that the paradigm is currently changing dramatically due to the coronavirus and it is hard to predict what will happen. Participants expect that artificial intelligence will have an increased presence in business, especially in regard to big data, so that fewer people will be needed in administrative workplaces or middle management places, especially in larger companies. Decisions must made more quickly; the time to develop new products will be shorter; the niches will become more critical because people will expect personalized products or services. The robotic lines will require different methods of guidance and monitoring. Reorganization of information support will be essential, as will the increased awareness of line managers.

Based on these interesting research findings, we can make some conclusions. The first obvious finding deals with the business landscape, which is changing drastically and will continue to do some in the coming years. Companies that are not able or willing to adapt are losing their market shares to new companies with "disruptive" visions and monetisation approaches. We also estimate that companies are aware of present and future organizational challenges and mechanisms which are essential for a successful near future (5–10 years) organization, as presented in previous paragraphs. Our research results also reflect the idea of the Top 10 Skills of 2025, introduced by World Economic Forum (WEF, 2021). In addition to the presented key success factors, we would like to explicitly stress the Open Innovation and Triple/Quadruple Helix concept, which are already "a must." Cooperation with academia is also an important tool for achieving disruptive and breakthrough innovations. Last, but not least, there are also methods available that enable the creation of disruptive innovations (Likar and Trcek, 2020). However, companies are, in our opinion, aware of the necessary organization culture instruments, representing prerequisites for disruptive innovations. But it is not enough to be aware of appropriate key success factors only. It is obvious that these must be applied in a creative and efficient way. Thus, the presented instruments can enable improvement of organizational changes.

Nevertheless, it seems that one aspect is missing – a clear understanding of the term "disruptive innovation." Companies should understand what disruptive innovations are and set clear goals, i.e., more ambitious disruptive innovation development goals. Only in this way will they be able to focus their potential appropriately and perform all the necessary activities to achieve disruptive innovations and improve business results.

PRACTICAL IMPLICATIONS

Based on the results, we prepared a set of practical implications for companies.

Firstly, a clear understanding of the term "disruptive innovation" is often missing. Companies should understand what disruptive innovations are - those that significantly affect the way a market or industry functions. Therefore, they should reconsider and set clear goals, i.e., more ambitious disruptive innovation development goals. Only in this way will they be able to focus their potential appropriately and perform all the necessary activities to achieve disruptive innovations and improve business results. A prerequisite is a clear vision of top management, which should be supported by concrete, clear and focused systemic changes and activities as follows.

It is important to develop employee competencies so that they feel confident to be ready for new challenges. One of the crucial competencies is the desire for progress, readiness to learn, prompt adoption of new working methods, and

creativity/innovation orientations. In addition, the development of cosmopolitanism of the team is important as this can bring courage and open-mindedness, which drives innovation and competitiveness.

How to achieve this in praxis? The company should systematically develop these competencies in employees, using well prepared and focused training, communicating with them and giving them their own (top management) example. In addition, target competencies should be selection criteria when hiring and employing new staff. What is more, it is not enough to focus on employees. The company should also require such competencies from external partners.

One of the crucial areas is related to organizational culture improvements. It should support openness to change, the willingness to adopt new or innovative business models, and new production concepts. Therefore, companies should strive more toward flat organizations and enable organizational flow changes. They should strive toward the improvement of internal communication, enabling the knowledge and information to be shared among all key personnel as quickly as possible. Attention should be given to the company's knowledge management, meaning a long-term and complex process of knowledge creation, transfer, and use. The next important aspect is related to motivation and the rewarding of individuals/employees, especially in the event of business success. When focusing on disruptive as well as other types of innovations, it is essential to accept certain risks and introduce a clear tolerance model for the failures. Special attention should be focused on improvements in the supply chain management. Obviously, the activities should be supported by appropriate budgeting. Last, but not least, trust among management and employees is one of the "hygienic" prerequisites for success.

The open innovation concept should also be implemented. Within this concept, special attention should be paid to cooperation with academia representing an important tool for achieving disruptive and breakthrough innovations.

As to marketing, companies should implement a dynamic market opportunities identification concept as well as provide shorter time-to-market. The research also stressed absolute focus on the customer as an important factor. It should be mentioned that such an approach can also be vague, as the company only focuses on fulfilling the customers' needs. We think that such a concept can often kill disruptive innovations. Therefore, it is also important to develop breakthrough innovations which are not based directly on customers' needs but have a clear market acceptance verification.

Enabling technologies should also be implemented, i.e., full digitisation at all company levels. One of these should be focused on the working process, especially within/after the Covid-19 experience. It is related to more virtual development and the adoption of working from home. In addition, artificial intelligence should be considered as a support to various business processes.

LIMITATIONS OF THE STUDY

A possible limitation of the research is the homogeneity of the participants. It is related to the companies encompassed having different innovation and economic levels. In addition, there are differences between countries. Taking into account these differences, further studies would be welcome. In the future, it will be necessary to carry out studies in the field of SMEs in accordance with their innovation level, economic performance, and business sector. In addition, quantitative approaches would illustrate complementary aspects, but these require an appropriately higher number of respondents. Obviously, it will be necessary to focus on steps that enable the successful introduction of "real" disruptive innovations.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical approval was not provided for this study on human participants because the research was performed in accordance with relevant institutional and national guidelines. In Slovenia, the consent of ethical commission is required for other types of research (e.g., medical research). For social science research there is no such praxis. But the authors have to stress that our respondents were informed about the research goal and the fact, that their opinion will be used for the analysis and published anonymously. Only those respondents who have agreed with the aforementioned filled out the questionnaire. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

VR: performance of all tasks, analysis, and basic text preparation. MM and BL: concept preparation, involvement in international data collection, writing of parts of text, and supervisory work. FP: concept preparation and supervisory work. All authors contributed to the article and approved the submitted version.

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