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Twitter and YouTube as digital tools in higher education: a systematic review

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This paper presents a systematic literature review of existing studies reporting on Twitter and YouTube as digital tools in higher education. We used the PRISMA extension for scoping reviews to select articles for review and report the results. The analysis was conducted using tools such as QualSyst for quality assessment and VOSviewer for bibliometric mapping. 27 articles were selected from several databases for the final analysis on the use of YouTube and Twitter in higher education (2019–2024), highlighting their roles in communication and teaching. Key research clusters include interaction and teaching methodologies, digital video libraries, student engagement, and the role of online learning communities in enhancing collaboration and academic performance. Twitter is valued for the collaborative learning, and YouTube for summarizing and reinforcing educational content.

KEYWORDS

higher education, YouTube, Twitter, social networks, systematic review

1 Introduction

The study of social networks for the year 2023 carried out by the Spanish association of advertising and digital communication, IAB (Interactive Advertising Bureau), found that Twitter (also known as “X”) is one of the most popular social networks and is used by some generations, although in the last year it has declined in the frequency of daily visits. YouTube, on the other hand, is one of the most used social networks in a cross-curricular way between generations and with better ratings among its users, maintaining similar values of permanence to the previous year (IAB Spain, 2023).

Higher education institutions use social networks as a means of one-way communication with students to inform them about university activities and support the teaching-learning process through the use of images. Among the main results of the research by Stuart et al. (2019), it is highlighted that 61% of the images had an informative purpose, compared to 20.9% of humanizing images, reinforcing the predominance of Twitter as a source of information and communication. The success of digital platforms as online spaces is due to the creation of virtual learning communities as an opportunity for interaction and the exchange of resources (Angulo-Armenta et al., 2021). They also contribute to facilitating collaboration between educational institutions to promote academic discussions, strengthen professional networks, and foster innovative research, being substantial communication channels for university students (Wang et al., 2020).

In terms of their purpose as educational support tools, social networks such as YouTube are used to summarize content, reinforce subject-specific terminology, and review complex concepts, helping students and teachers (Jackman, 2019). Other findings showed statistically significant positive correlations between student interaction and academic performance. They identified how Twitter provides students who do not usually participate in the classroom with

a new online space to engage, debate, and share content, helping to overcome isolation (Kunka, 2020).

Focusing on YouTube, Wang et al. (2020) investigated whether self-regulated English language learning was enhanced through the social network outside the classroom. Based on a qualitative study, the surveyed students were asked about perceptions of a self-directed learning approach to learning English by exploring YouTube as a digital learning resource. Student interaction through liking and sharing videos with peers was identified, contributing to interactive learning outside the classroom and underlining their involvement in formal and informal learning. In turn, students' oral performance also shows significant progress in improving communication skills (Saed et al., 2021), concluding on the pedagogical implications and proposing YouTube as a complementary medium, based on videos outside the classroom. In this sense, there are numerous studies that corroborate the improvement of learning due to the introduction of social networks in higher education classrooms, such as the introduction of Twitter in the teaching-learning process, which allows complementing the methodologies. In this way, it improves communication and interaction with the content, with the main objective of boosting student learning and social responsibility (Torres-Barzabal et al., 2020).

Three dimensions were analyzed by Černá and Borkovcová (2020) in the educational process: as a tool for communication, for sharing study materials, and as an assessment tool. The results obtained from the study highlighted YouTube in terms of satisfaction, types of activities on the platform, and time spent. However, in addition to showing the educational benefits, they also raised questions about the dangers of using social media. Chan et al. (2022) analyzed in their study the various reasons for addictive behavior with regard to YouTube due to its excessive use, given the rapid expansion of social networking. They concluded that enjoyment, time spent online, and information seeking are factors that can predict negative behavior. Brailovskaia and Margraf (2022) stressed the importance of implementing strategies such as government prevention programs to protect students' mental health by providing opportunities that encourage physical activity. In addition, monitoring usage time and purpose are key issues to reflect on in order to avoid loss of control and anxiety symptoms on social networks due to compulsive use, which generates high levels of stress (Apaolaza et al., 2019) and which produces negative behaviors and distractions in students, as Masrom et al. (2021) point out.

Authors such as Burhanli and Bangir-Alpan (2021) specified possible factors why university students opt for YouTube for learning, emphasizing their interests and individual learning needs, the ease of use, and the limitations of on-campus delivery mode education. In addition to their potential, the negative effects of inappropriate use of social networks have also been demonstrated (Fernández-Rovira, 2022). In this sense, Gatta et al. (2023) proposed the need for moderation strategies in social networks and multiplatform discussions due to the proliferation of inappropriate and harmful content shared online in an interconnected manner. They explored how content from one platform is used to support extreme ideologies on other platforms, relying on YouTube and Twitter for their study. For these reasons, Torres-Barzabal et al. (2020), considered enhancing didactic training on the use of Twitter before extending it to the rest of the educational community. For this reason, it is core to have access to digital education in order to develop the skills to thrive in the online era (Jackman, 2019).

Therefore, integrating social networks into the teaching-learning process requires fostering a shared culture based on innovation and

experimentation (Ben Youssef et al., 2022) to enhance the learning experience of higher education students.

This systematic review focuses on a review of the literature published between 2019 and 2024, on the use of social media, Twitter and YouTube in higher education in Spain, to focus on the specific characteristics of the Spanish higher education context, including its institutional, pedagogical, and technological frameworks.

2 Methodology

This systematic review follows the guidelines of the PRISMA Declaration (Urrútia and Bonfill, 2010), which includes a flow chart and a checklist, responding to the objectives formulated. The bibliographic search was carried out by consulting the Web of Science, Scopus, and Dialnet databases, using the following keywords in Spanish and English: social networks, higher education, training, Twitter, and YouTube. Articles published in English or Spanish were included, as these are the predominant languages in the scientific production of the Spanish educational field. This decision aims to ensure accessibility to the selected studies, although it may limit the inclusion of relevant research in other languages. Only studies conducted in Spain were selected, with the aim of analyzing a specific geographical and educational context.

For the Boolean search, keywords were combined with the following AND and OR operators, as their introduction was necessary for a proper search equation: (YouTube OR Twitter) AND (university OR "higher education") AND (educat* OR teaching OR learning). This search resulted in a total of 144 records, depending on the language of the search, the keyword combinations, and the database consulted in each case. Once the inclusion and exclusion criteria had been applied in the search, a bibliography review was carried out of the selected articles, which are detailed as results. After verification of the subject matter and elimination of duplicate articles, the sample consisted of 27 final records. The excluded articles did not meet the objectives of the research, given that they focused on fields other than education and were published before 2019. Subsequently, source selection (taking into account degrees and abstracts), followed by a filtering process (assessing full-text articles), was carried out, considering the following eligibility criteria specified below:

- Type of publication: Empirical articles published only in peer-reviewed scientific journals were selected, excluding reviews, book chapters, manuals, and doctoral theses.
- Publication date: Only studies that were published between 2019 and 2024 were considered, as they provide an up-to-date analysis of social networks.
- Country: Spain
- Field of knowledge: articles covering the field of education were collected, excluding areas other than education.
- Participants' current studies: due to the interest of addressing higher education, students in training, Bachelor's Degree, Bachelor's Degree, Postgraduate, and PhD were considered.
- Language: Articles published in English or Spanish were included.
- Type of social network: in line with the focus of the study on the social networks YouTube and Twitter, other social networks were not considered.

However, exclusion criteria include:

- Type of publication: Studies that are not academic articles published in peer-reviewed scientific journals, such as wills, reviews, manuals, etc., were excluded.
- Publication date: studies older than 2019.
- Country: other than Spain.
- Field of knowledge: other than education.
- Participants' studies in progress: educational stages that were not part of higher education.
- Language: studies in languages other than Spanish and English.
- Type of social network: articles that addressed social networks in general or those other than YouTube and Twitter were excluded.

Figure 1 shows the selection process, which resulted in a final sample of 27 publications. These were subjected to a Methodological Quality Assessment using QualSyst checklist (Kmet et al., 2004), enabling a more critical evaluation of the scientific articles.

3 Results

To contextualize the findings of this systematic review, a comparative analysis of 27 scientific studies published between 2019 and 2024 was conducted. These studies examine the educational use of Twitter and YouTube within higher education in Spain, offering diverse perspectives on how these platforms influence teaching

methodologies, student engagement, academic performance, and digital literacy.

Table 1 summarizes the authors, year of publication, social network studied, and main findings of each work. It reveals common patterns and divergent outcomes across research, allowing for the identification of thematic clusters and pedagogical trends. This comparative approach enables a deeper understanding of the strengths, limitations, and evolving roles of social media as educational tools. Of the 27 studies analyzed, 18 focused on Twitter and 10 on YouTube. The studies on Twitter are mainly related to interaction, peer assessment, and the enhancement of academic motivation. In contrast, the studies on YouTube focus more on content comprehension and the development of digital skills. Additionally, there is a higher frequency of publications in 2022, which may be linked to the consolidation of hybrid education in the post-pandemic period.

3.1 Keyword co-occurrence analysis

Keyword co-occurrence analysis is a technique used to identify themes and relationships in the scientific literature. This method groups terms that frequently appear together in articles reflecting research trends (López-Fraile et al., 2023; Van-Eck and Waltman, 2010).

To perform this analysis, keywords were extracted from the selected articles, and their co-occurrence was analyzed using network analysis techniques. A co-occurrence matrix was constructed where

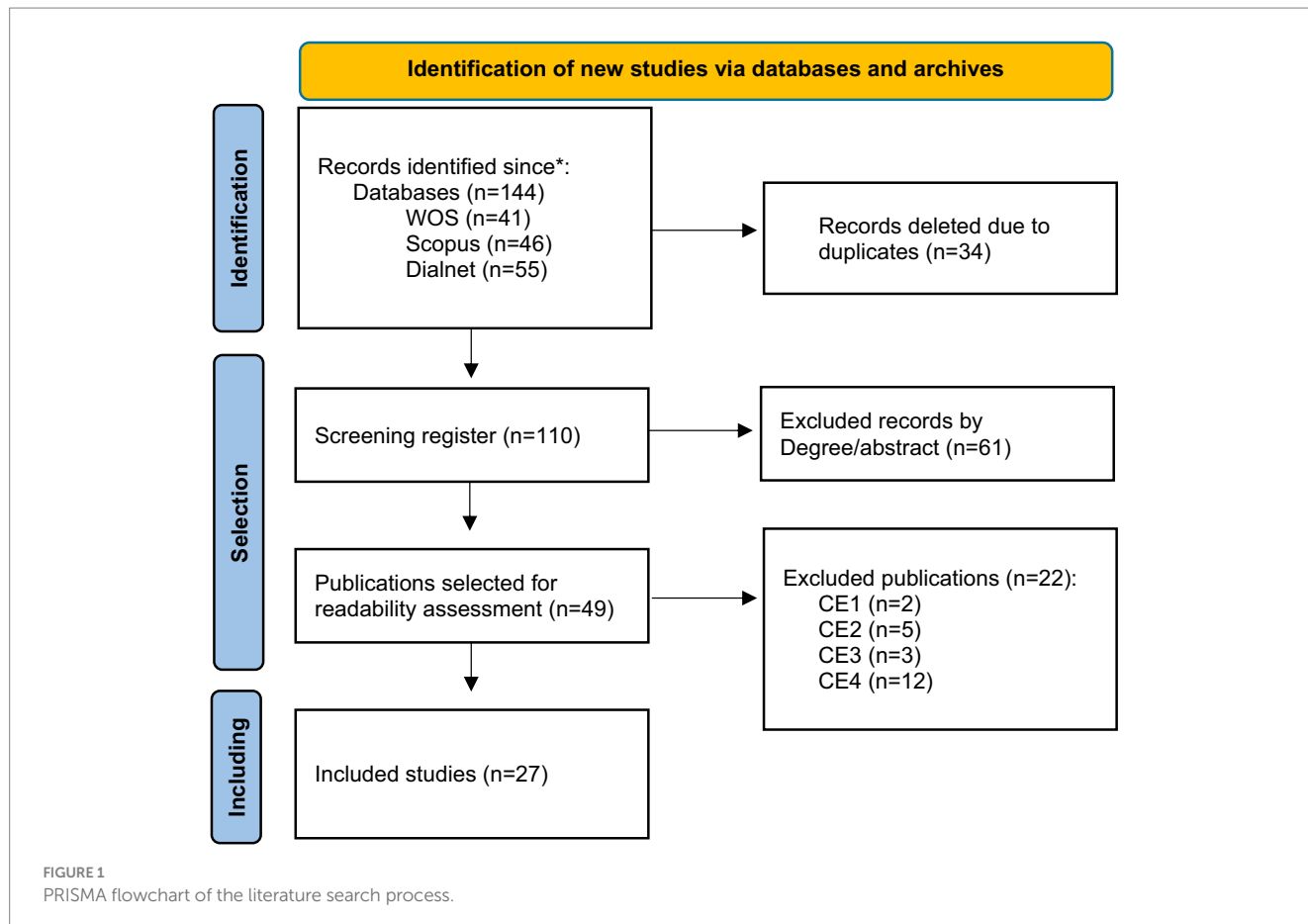


TABLE 1 Summary of studies on Twitter and YouTube use in higher education (2119–2024).

| Authors and year of publication | Social network (YouTube, Twitter) | Results |
|---|-----------------------------------|---|
| Gallardo-López and López-Noguero (2020) | Twitter | The impact of Twitter on the social pedagogy year was analyzed. A student satisfaction survey was conducted on the use of Twitter, which yielded positive results in terms of learning, participation, and group collaboration. |
| Malik et al. (2019) | Twitter | Twitter improved learning, motivation, and participation in educational settings. Mixed results on retention rates with the use of Twitter in the classroom. Most of the studies were conducted in higher education in North America and Europe. |
| Arias-García (2022) | Twitter | Anonymous assessments through the Moodle platform with consensus on participation and ideas. The rubrics emphasized the importance of images but lacked an assessment of cognitive information. |
| Cívico Ariza et al. (2022) | Twitter | Progressive growth of scientific production, mainly in the field of social sciences. The United States is the most prolific country in terms of scientific output. |
| Fernández-Ferrer and Cano (2018) | Twitter | Students provided timely feedback in 73.7% of cases. The use of Twitter increased collaborative work, with an average of 5.46 tweets. The relevance and academic tone of the students' tweets improved over time. Peer feedback significantly improved the quality of tweets and academic performance. Twitter encouraged student participation and peer assessment for sustained learning. |
| Fernández-Carballo (2021) | YouTube | Poor command of English due to lack of oral attention. More emphasis is placed on grammar and vocabulary than on listening and speaking skills. |
| Froment et al. (2022) | Twitter | Students perceived the professional profiles as the most credible. Positive correlation between credibility and student motivation. |
| Gallardo and Jordi-Taltavull (2019) | YouTube | High student motivation and participation in the practical activity were observed. Students found it difficult to select music videos relevant to economic geography. Themes addressed in video clips included the contrast between wealth and childhood and the importance of nature. |
| Gil-Fernández et al. (2019) | YouTube | WhatsApp, YouTube, and Facebook were the preferred social networks. The cluster analysis revealed three main groups according to educational use. Statistically significant differences in the use of social networks in on-campus and online universities. The reliability of the questionnaire was high, with a Cronbach's alpha of 0.841. |
| León-Gómez et al. (2019) | YouTube, Twitter | Bachelor's degree students are more active on social media than master's degree students. Pinterest and YouTube are the most widely used for educational purposes. Instagram and Twitter are the least used for educational purposes. Gender differences in the use of social networks among students. |
| López-Torres et al. (2022) | Twitter | Group 1 had the highest interaction on Twitter, with 1,642 tweets. Systematic interventions on Twitter positively affected trainee teachers' perceptions of social media. Group 1 showed a significant increase in the educational potential's perception of social networks. |
| Lozano Díaz et al. (2020) | YouTube | Students valued YouTube in lessons, but not for individual learning. The majority used mobile devices to access the Internet and interact via email. Students felt that YouTube is useful for learning and that the videos are appropriate. Future research: creating content for students on YouTube, learning processes, and comparisons. |
| Matosas-López et al. (2021) | Twitter | The use of social media has limited predictive ability for educational resources. There are strong associations between patterns of social networking and digital resources in the samples. Recommendations for future studies involving participants from various fields. |
| Monguillot and González (2021) | Twitter | Positive comments on the use of Twitter for learning, motivation, and teamwork. Lack of interaction between students on Twitter to improve feedback. Students found Twitter useful for learning to interact and recommended its use. |
| Morales-Sánchez et al. (2021) | YouTube | Improved student participation and understanding of theoretical content. It encouraged critical reading and reflection on literature through the practices of the booktuber. Improving digital writing and reading skills in an informal context. |
| Pardo (2024) | YouTube | BookTuber can effectively promote reading and literacy among future teachers by encouraging them to create video literature reviews, thus enhancing their language, communication, and digital competencies. |

(Continued)

TABLE 1 (Continued)

| Authors and year of publication | Social network (YouTube, Twitter) | Results |
|---------------------------------------|-----------------------------------|--|
| | Twitter | Students perceived the professional profiles as the most credible. Positive correlation between teacher credibility and student motivation. |
| Pérez et al. (2019) | Twitter | Educational scenarios were explored, improving design and practical implementation in each cycle. Practical knowledge was generated that enriched the understanding of social networks, in particular Twitter. It provided critical information for recommendations and design principles for social networks. |
| Pérez-Suasnavas and Cela (2021) | Twitter | The control group obtained higher grades and participation than the experimental group. The experimental group showed better grades after the application of the JittWT methodology. Student participation has a positive impact on academic performance. |
| Pérez-López et al. (2020) | Twitter | Twitter enhances student participation through active collaboration and enjoyment. Positive affective reactions improve performance and satisfaction in learning. Learning activities on Twitter outside the classroom reinforce theoretical concepts. |
| Ríos-Moyano et al. (2021) | Twitter | Detailed explanation, design, and development of the project during the first weeks. Statistical data are provided to propose improvement actions for future years. Collaborative methodology is used to create and disseminate digital content. |
| Ríos Vázquez and Romero Tena (2022) | YouTube | Consistent internal reliability in the sample, close to excellence. Students' device preferences vary according to gender and educational level. Most find the video lectures useful, especially for reviewing the content. Female learners perceive video lessons to be more useful. Technical quality is crucial, especially for teachers. |
| Sanchez Parra (2022) | YouTube | Animated musicograms are well received by music teachers for teaching purposes. Positive trends in music teachers' interest and commitment to musicograms. Musicograms have potential for interactive and engaging music education. Musicograms enhance musical learning in a fun and motivating way. |
| Santoveña-Casal and Bernal (2018) | Twitter | Dimensions of the perceived academic experience: learning, belonging, general aspects, and student-student interaction. The sample included 525 students, mostly women, aged between 21 and 53. |
| Santoveña-Casal (2019) | Twitter | The influence of assessment options on performance was analyzed to test hypotheses. The influence of Twitter engagement on performance was analyzed to confirm the hypotheses. Results of students' perceptions on Twitter about interpersonal relationships and training. |
| Suárez-Guerrero et al. (2020) | Twitter | The results include limitations in the representativeness of the sample and possible biases. The participants rated the educational experience described in the study very positively. |
| Tárraga-Mínguez and Gómez-Marí (2022) | Twitter | The small sample size and the specific questionnaire were limitations. Twitter enhanced learning about education policy for future teachers. |
| Vázquez-Cano and Sevillano (2019) | Twitter | A total of 102 students, mostly female, from different age groups participated. The use of Twitter in higher education benefits synthesis, collaboration, and research. Educational activities on Twitter should be relevant, clear, and compulsory for students. |

the rows and columns represented the extracted keywords, and each cell indicated the number of times two keywords appeared together in the same articles. This matrix served as the basis for cluster analysis, which identified groups of keywords that tend to appear together.

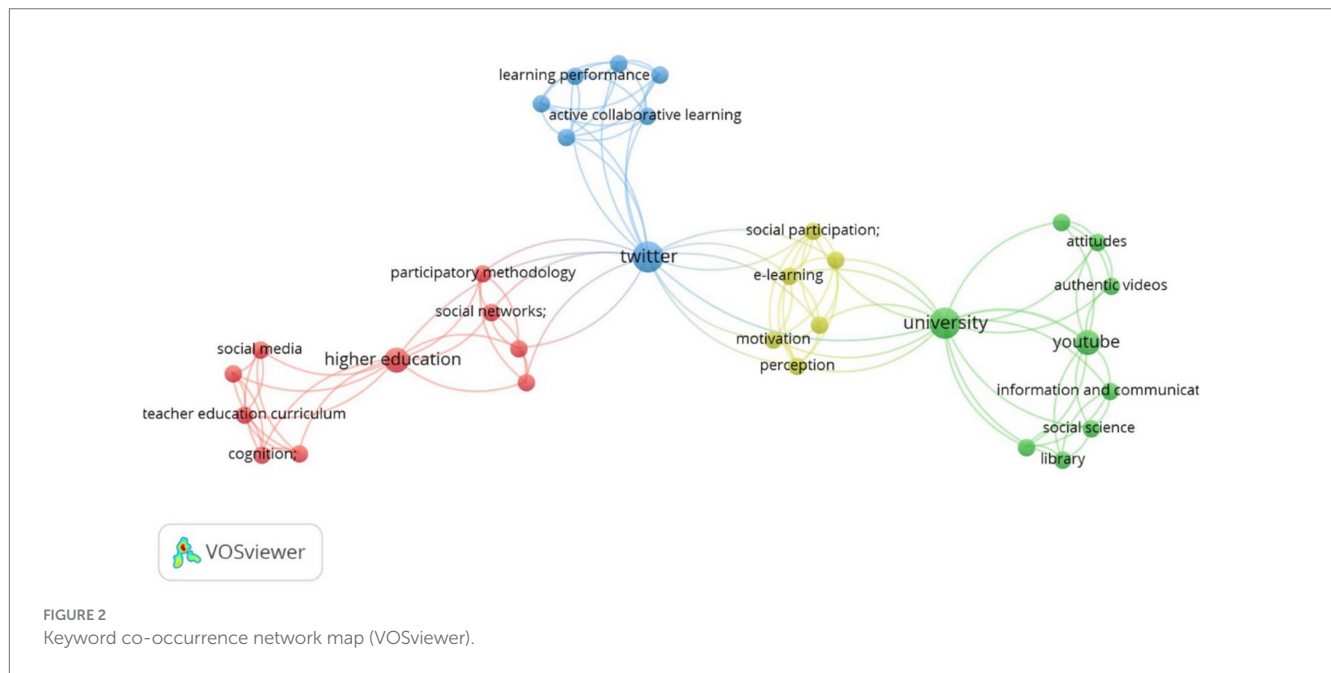
The co-word analysis was conducted with the VOSviewer software, using the Association Strength method to measure the strength of association between keywords and their frequency of occurrence. A graphical co-word network map was generated, where nodes represent keywords. In this visualization, larger nodes indicate keywords with higher frequency, reflecting greater prominence in the literature. Additionally, the proximity between nodes on the map signifies how often two keywords co-occur, with closer nodes representing concepts that are strongly related or commonly studied

together. This visualization aids in understanding the structure and focus areas of the research field, highlighting dominant themes, interconnections between topics, and potential gaps for future investigation.

3.2 Results of the keyword co-occurrence analysis

Figure 2 presents an analysis that identifies four main clusters, each representing a set of frequently co-occurring keywords and represented by colors.

Each cluster is specified below, along with a description of the cluster and the keywords included.



3.2.1 Cluster 1: educational methodologies and interactive communication (red color)

Description: This cluster groups terms related to new educational methodologies and the use of interactive communication in higher education. The keywords reflect a focus on active methodologies, participation, the use of social networks, and teacher training.

Keywords:

- Higher education
- Cognition
- Collaborative learning
- Innovative methodologies
- Interactive communication
- Participatory methodology
- Social media
- Social networks
- Teacher education curriculum

3.2.2 Cluster 2: use of video and information technologies in university education (green color)

Description: This cluster focuses on the integration of information technologies and video repositories in university education, highlighting the use of the social network YouTube and the attitude toward these technologies.

Keywords:

- Attitudes
- Authentic videos
- EFL (English as a Foreign Language)
- Information and communication technologies
- Library
- Social science
- University
- Video
- YouTube

3.2.3 Cluster 3: collaborative learning and satisfaction (blue color)

Description: This cluster highlights the use of Twitter to enhance collaborative learning. It includes terms reflecting learning performance and student satisfaction and engagement.

Keywords:

- Active collaborative learning
- Enjoyment
- Learning performance
- Quantitative
- Satisfaction
- Student engagement
- Twitter

3.2.4 Cluster 4: e-learning, motivation, and the role of the teacher in social interaction (yellow color)

Description: This cluster focuses on e-learning, student motivation, and the perception of the teacher's role in social interaction and participation. It highlights the importance of social interaction and participation in the online learning environment.

Keywords:

- e-learning
- Motivation
- Perception
- Social interaction
- Social participation
- Teacher's role

4 Discussion and conclusions

The 2023 social media study conducted by the Spanish advertising and digital communication association, IAB (Interactive Advertising Bureau), revealed significant findings on the use of digital platforms

across different generational groups. Twitter remains one of the most popular and widely used networks, although it has seen a decrease in daily visits over the last year. In contrast, YouTube maintains a strong presence among generations, being highly valued by its users and showing consistency in engagement levels compared to the previous year (IAB Spain, 2023). This review compiles 28 scientific articles focusing on YouTube and Twitter as learning tools in higher education in Spain, published between 2019 and 2024.

Higher education institutions often use social media as a one-way communication channel to inform students about university activities and support teaching via images. Stuart et al. (2019) found that 61% of shared images served informative purposes, and 20.9% were humanizing, reinforcing Twitter's predominant use as a communication tool.

Other studies corroborate the educational benefits of social media. For instance, Gallardo-López and López-Noguero (2020) and Torres-Barzabal et al. (2020), showed Twitter's role in complementing teaching methodologies, enhancing communication, and fostering students' social responsibility. Cluster 1 in this review aligns with these findings, emphasizing interaction among participants, teacher training, and key methodologies. Malik et al. (2019) also support the positive impact of Twitter on learning motivation and participation, although retention results are mixed, underscoring the complexity of assessing long-term effects. Gil-Fernández et al. (2019) observed that Twitter use enhances collaborative work and peer feedback, improving academic performance, a conclusion echoed by Froment et al. (2022), who emphasize the motivating effect of credible professional profiles.

Regarding YouTube (Cluster 2), this platform stands out as an asynchronous digital video library for summarizing content, reinforcing terminology, and reviewing complex concepts (Jackman, 2019; Wang and Chen, 2020; Torres-Barzabal et al., 2020). Saed et al. (2021) reports that student interactions like liking and sharing foster active learning and communication skills development, while Burhanlı and Bangir-Alpan (2021) attribute YouTube's appeal to personalized interests and ease of use. Nonetheless, Fernández-Carballo (2021) identifies deficiencies in oral language learning on YouTube, where grammar and vocabulary dominate, pointing to content quality challenges.

Lozano Díaz et al. (2020) and Ríos Vázquez and Romero Tena (2022) confirm students' general appreciation of YouTube for lessons and review but note demographic differences in device usage and gendered perceptions of video usefulness, indicating that technological and social factors mediate effectiveness. Sanchez Parra (2022) further suggests innovative formats like animated musicograms enhance engagement, though such innovations remain niche.

Cluster 3, focusing on student satisfaction and engagement, is consistent with Kunka (2020) and Santoveña-Casal (2019), who found that Twitter interaction correlates positively with academic performance and social belonging. However, Monguillot and González (2021) and Vázquez-Cano and Sevillano (2019) highlight insufficient student-student interaction on Twitter to maximize feedback, suggesting that mere activity is insufficient without structured facilitation.

Cluster 4 emphasizes online learning communities and e-learning motivation, paralleling findings by Angulo-Armenta et al. (2021) and Wang et al. (2020), who note the role of social networks in fostering collaboration and academic discourse beyond institutional boundaries. Despite these benefits, inclusivity and sustained participation are underexplored, and the active role of educators in community building remains critical.

The reviewed literature also raises concerns about negative effects of social media misuse on mental health (Fernández-Rovira, 2022;

Chan et al., 2022; Brailovskaia and Margraf, 2022). This review calls for preventive strategies, monitoring usage, and user training to avoid stress and distractions (Apaolaza et al., 2019; Masrom et al., 2021; Gatta et al., 2023; Torres-Barzabal et al., 2020), an area needing more empirical attention in higher education contexts.

The clusters identified provide a structured overview of key areas of research and highlight the importance of innovative methodologies, the use of information technologies, collaborative learning, and online education.

5 Limitations and future research directions

This systematic review has certain limitations that need to be considered in order to properly frame its findings.

First, the geographical scope is limited to studies conducted in Spain. This decision was made to focus on the specific characteristics of the Spanish higher education context, including its institutional, pedagogical, and technological frameworks. However, this regional focus limits the generalizability of the results, as the use and educational appropriation of social media platforms may vary across different cultural and educational settings (Cívico Ariza et al., 2022). Future studies could expand the scope to include international comparisons.

As a second limitation, although the 28 selected studies provide valuable insights into the use of Twitter and YouTube in higher education, it is crucial to consider potential biases that may affect the generalizability of the results. Most of the studies rely on convenience samples, which can introduce selection bias, as participants are often students or teachers already familiar with or positively predisposed toward using social media. This may lead to an overestimation of the perceived benefits of these platforms for learning (Suárez-Guerrero et al., 2020; Tárraga-Mínguez and Gómez-Marí, 2022). Additionally, the lack of control groups in some experimental studies makes it difficult to establish clear causal relationships between the use of these platforms and educational outcomes, which could exaggerate the reported effects (Pérez-Suasnavas and Cela, 2021).

Third, many of the studies analyzed focus on specific contexts, such as social science subjects or teacher training, which limits the representativeness of the findings in other disciplines, such as natural sciences or engineering. This representativeness bias may not reflect the impact of social media in areas with different pedagogical dynamics (Matosas-López et al., 2021).

In addition, a potential future line of research would be to incorporate qualitative studies that explore in depth the experiences of students and teachers with the use of Twitter and YouTube as educational tools, allowing for a more enriching and contextualized analysis. Moreover, the review did not include gray literature, such as dissertations, institutional reports, or technical documents, which could potentially provide valuable empirical insights. Including these sources in future reviews could contribute to a more robust and inclusive evidence base.

Finally, this study focused exclusively on Twitter and YouTube, as they are the most widely used platforms in the educational field (Olivares de la Fuente et al., 2024). However, other social media platforms such as Instagram, TikTok, and LinkedIn are also playing an increasingly prominent role in teaching and learning, especially among younger student populations and in areas such as informal learning. Future research could broaden the analysis to include these

platforms, exploring their pedagogical potential, levels of adoption by educators and students, and impact on learning outcomes.

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.

Author contributions

PO-D: Investigation, Methodology, Data curation, Supervision, Writing – review & editing, Software, Conceptualization, Visualization, Resources, Validation, Project administration, Writing – original draft, Formal analysis. EJ-G: Writing – original draft, Software, Writing – review & editing, Formal analysis, Validation, Visualization, Methodology, Data curation, Supervision. ÓG-L: Supervision, Visualization, Writing – review & editing, Validation.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that no Gen AI was used in the creation of this manuscript.

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