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Impact of an inquiry-oriented proposal for promoting technology-enhanced learning in a post-pandemic context

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Introduction: This study examines the effectiveness of learning processes developed through a technology-enhanced approach in higher education. Therefore, we analyzed Webquests together with other gamification resources, considered relevant research studies on the impact and advantages of this inquiry-oriented learning approach, and examined students' perceptions of the effects of these online learning tools on developing their organizational skills and effective planning for learning.

Methods: Participants in the study were 73 student teachers enrolled in the core unit of Social Studies, in the second year of the Primary Education degree at the University of Murcia (Spain). In this study, a pre-test and posttest design was applied and questionnaires were administered to students at the beginning and end of the term to examine the impact of this inquiry-oriented approach on the development of students' learning processes. Their perceptions of the learning achieved were analyzed using statistical software for Excel (XLSTAT).

Results: The results indicate that these online tools effectively promote technology-enhanced learning and collaborative work, especially among the most motivated and digitally literate students, underlining the importance of motivation and digital literacy as catalysts for learning.

Discussion: The study also highlights the need for further research on the impact of digital resources in promoting competency-based learning alongside other motivational online approaches in tertiary education.

KEYWORDS

inquiry-based learning, online learning, learning processes, teacher education, higher education

1. Introduction

Information and communication technologies (ICTs) have widely spread in recent years, promoting the joint effectiveness and efficiency of global initiatives in several post-pandemic scenarios. Their relevance has accelerated the adoption of interrelated actions with a collective objective, maximizing the quality and speed of operational processes of people and organizations across countries, regions, and languages to develop interconnectedness and collaborative working (Younan et al., 2020).

In the field of education, ICT services have made it easier for learners and institutions to disseminate, manage and optimize information and educational processes, triggering significant research and debate on what innovative methods and approaches can best meet the needs and interests of learners and educators, especially after the pandemic period. The use and exploitation

of these tools and resources have become a guiding principle in various educational institutions focused on increasing the confidence of educators and learners in new forms of online learning. Digital education is rapidly reducing the importance of traditional instruction by transforming education worldwide, from elementary to higher education, especially during and after the pandemic (Purwanto et al., 2023).

The increasing incorporation of laptops, smartphones, tablets and other digital devices for educational purposes in education systems globally has promoted learner-centered approaches that move learners away from direct instruction and traditional teaching methods, captivated by the advantageous conditions offered by these innovative approaches: giving access to diverse sources of information, more flexible environments in contrast to traditional and more restricted time and space contexts. In this line, the adoption of Internet-based programs has provided a huge collection of content on online educational platforms and more opportunities to integrate students into new learning situations for creative and educational purposes, stimulating their ability to choose learning strategies and techniques that best suit their needs (Yuhanna et al., 2020). The digital age, in which educators and learners are deeply embedded, offers new approaches to online teaching that engage learners' attention, enhance their reasoning and improve their organizational skills, minimizing the relevance of printable material as an important source of information and learning. Moreover, these innovative learning trends emphasize collaborative work, data sharing and student cooperation to enhance best practices in various digital environments (Hamakali and Josua, 2023).

In particular, disseminating web-based resources such as Webquests clearly demonstrates how these online tools support the transition to new ways of acquiring knowledge in digital form (Adanan et al., 2020; Dousti and Amirian, 2023). These technology-based platforms were created more than 20 years ago by Bernie Dodge at San Diego State University (Dodge, 1995) and later by his colleague Tom March, who promoted them as strategic online resources for integrating web-based content into their daily teaching practice. The theoretical foundations these two education professionals developed were based on three main pillars: inquiry-based learning, scaffolded learning processes and learner-centered practices (March, 2007). Within a web-based inquiry-oriented approach, students are encouraged to experience a process of transforming newly acquired information from the browser into new learning products through reflection and creative thinking (BinTaleb, 2021; Chen, 2021). Thus, students are exposed to various selected resources to learn to see things through multiple lenses, explore a challenging situation and take effective steps toward a solution through high-level questioning (Grant et al., 2022). These challenging learning environments can encourage learners to catch up quickly, but can also make them feel overwhelmed. To alleviate this potential situation, scaffolding can help learners become more competent in completing the task. It provides structure and content to learners, as appropriate, enabling them to construct knowledge and maximize their learning outcomes. Three types can be listed according to Dodge (2022): reception, transformation and production. Reception scaffolds help learners when they are not fully prepared to retrieve information from a resource they have not worked with before. They may take the form of tips, glossaries or observation guides. Transformation may involve explicit guidance for learners to reshape the information provided into new forms of understanding. Examples of transformational scaffolding include help with comparison, analysis or decision-making. Production scaffolding includes supporting learners to create a solid knowledge base and new products. They are offered templates, creative thinking strategies and multimedia resources for creative purposes. These few examples underline the importance of adopting learner-centered approaches that focus on the learner as an active agent and pave the way for decision-making processes. Indeed, through WebQuests, learners are given ample opportunities to put their learning skills into practice and develop knowledge construction processes more autonomously (Martín and Quintana, 2011; Akhand, 2015). In short, WebQuests encourage learners to make the most of their time on the Internet by selecting and prioritizing information to personally orient their work toward more structured and strategic digital collaboration, refocusing their energy, attention and effort in a more self-sufficient way. To this end, learners can gradually acquire knowledge and improve the management of their learning process by improving their organizational skills, activating their decision-making abilities and fostering their digital competencies, which will make them feel more empowered and increase their motivation.

Initially, two different types of webquests were implemented for this purpose, involving a different time frame, namely short and long-term. The former usually last one, two or three lessons and are designed for learners to focus on acquiring knowledge and refining specific skills, while the latter give more autonomy and time for the learner, between one week and one month, to examine a body of knowledge, evaluate it and construct and build new meaning that is coherent and reflects a more sophisticated understanding of the newly constructed knowledge, as well as meaningful and relevant learning (Awada et al., 2020).

Webquests usually consist of the following organizational components (Dodge, 1995):

1. An introduction that creates a virtual context to engage learners and orient them by providing background information and identifying the task.
2. A task that describes precisely what learners should do as they progress through this web-based tool. It should be visually appealing and thought-provoking to capture learners' attention.
3. A process that specifically defines the steps learners must take to complete work on this technology-driven platform. Pre-defined resources, such as links to online information, can be provided to direct learners' energies toward building productive learning.
4. Resources comprising the set of materials intended to be used to accomplish the task. They should be easily accessible for learners to analyze, evaluate and integrate new meanings into previously substantial knowledge structures.
5. Assessment serves as a guide not only for educators to determine whether learners have done what was expected of them, but also for learners to measure their academic performance through this digital resource.
6. A conclusion that allows learners to look back on what they have learned and/or achieved as they went along in their work, and to ask themselves whether it was adequate to acquire relevant learning and how they would improve it in future tasks.

As described above, students' learning progress is enhanced by this well-planned scaffolding structure that guides them in the right direction, facilitates the best use of their time on the Internet and

fosters their creativity and problem-solving skills within a learner-centered approach (Alebous, 2021; Wahyuni et al., 2021).

Recent literature has highlighted how these inquiry-oriented approaches support active learning through the application of a variety of active and challenging strategies (Sánchez and Trigueros, 2017; Murphy et al., 2020). This learning allows students with different levels of digital literacy to progress at their own pace and gain experience and autonomy in ICT integration. In this sense, Tsichouridis et al. (2020) explored the use of these online tools to promote students' attitudes toward learning scientific concepts and found that they effectively created a positive environment among students, especially when learning complex topics and concepts. This flexible environment often develops due to the greater freedom of students to choose the strategies they wish to adopt and implement. Álvarez-Herrero and Valls-Bautista (2021) examined the learning strategies used by students to achieve their outcomes and found that they chose games as the main tool to enhance their project-based learning, which made them feel more relaxed and motivated.

The fact that learners can work more actively and freely than in traditional learning methods makes them more willing to participate in daily lessons. According to Corujo Vélez et al. (2020), who conducted research in which participants had to create their WebQuests by taking an active role in a collaborative framework, students were involved in online tasks and activities, communicating quite frequently with each other, brainstorming, analyzing and co-evaluating their online resources. Within this constructivist approach, WebQuests help students to organize the space, manage their time and plan effectively their learning tasks (McMahon, 2011; Capella, 2013). In this sense, Moundridou et al. (2020) conducted a study to explore the benefits of online platforms for fostering constructivist learning among student teachers and found that they contributed to improving students' knowledge and skills in learning design.

Moreover, as Charania et al. (2021) state, the constructivist use of these digital tools can lead to the activation of higher-order thinking skills that facilitate the development of students' capabilities in new learning contexts. Krathwohl (2002) revised Bloom's taxonomy and identified six broad cognitive categories, namely knowledge, comprehension, application, analysis, sinthesis and evaluation, being the last three of them those which revolve around higher order thinking and the use of WebQuests. Within this approach, Ozeldi and Yakin (2021) delved into the effectiveness of these online resources in developing organizational skills and highlighted the development of analysis, connection and evaluation skills among trainee mathematics teachers under a web-based approach. Indeed, Wang (2021) included programming tasks in a WebQuest design to develop students' problem-solving skills and found it a very effective way of scaffolding their learning experiences. In a similar vein, Aydin (2016) analyzed the impact of WebQuests as useful tools used in second language acquisition and foreign language learning and found that using these online tools improved interaction, communication and benefits in developing higher order thinking skills and scaffolded learning. Other studies also focus on the usefulness of WebQuests in facilitating discussion, reflection and evaluation; for example, Ebadi and Rahimi (2018) explored the effectiveness of a technology-enhanced learning environment based on the use of WebQuest on students' critical thinking and academic writing skills, and concluded that it accelerated learning progress, as students took fewer lessons to cover the required content due to the development of complex reasoning and reflection.

However, recent research highlights the challenges of using these technological tools, mainly due to the digital divide, and access to online resources, including adaptability. In this regard, Berezova et al. (2018) examined the impact of webquests on the writing and reading performance of university students and found that participants complained about the unfamiliar vocabulary they had to deal with and some inconveniences in gathering relevant information. Similarly, Amini et al. (2020) highlighted the lack of access or low internet speed as two main challenges in implementing this web-based resource. In the same vein, Srisinthon (2021), who examined the effectiveness of Webquests in a Chinese tourism course at a Thai university, put the stress on some technical problems in using them, such as a weak and irregular wi-fi connection, and concluded that a more flexible WebQuest design that could be used on laptops and mobile phones, as well as better wi-fi connection in the university, would engage students more in effective online learning.

Given the above, this study aims to examine the impact of this inquiry-oriented approach on the development of students' learning processes. To achieve this purpose, the following research objectives were listed:

> *RO1:* To analyze trainee teachers' perceptions of the effectiveness of these online platforms on their learning processes; more specifically, to analyze their views on the impact this digital approach had on their learning as a function of respondents' gender, self-perceived motivation, and digital competence.

> *RO2:* To measure participants' self-perceptions of the impact of some strategies that promote active learning, collaborative work and inquiry-oriented cognitive processes within this technology-enhanced approach as a function of participants' gender, self-perceived motivation and digital competence.

2. Methods

To achieve these objectives, we adopted a quasi-experimental design using pre and posttest questionnaires, designed *ad hoc* to establish the effectiveness of these online resources in a higher education context. According to Rogers and Revesz (2020), this design can effectively determine whether there is a causal relationship between a particular treatment, which may take the form of a specific program or project, and the final outcome. It is also helpful because it tends to have more practical applications, particularly in the field of social sciences. Furthermore, the administration of pre and posttest favors a directionality of the research, as following Stratton (2019), it aims to test a dependent variable (technology-driven learning) before and after the intervention with one or more independent variables (gender, self-perceived motivation, and digital competence).

2.1. Participants

The webquest program was applied in two groups of the Degree in Primary Education at the University of Murcia, Spain. The participants were enrolled in the core Social Studies unit, which is

compulsory for all second-year university students. In this research, the convenience sample consisted of 73 student teachers 17 males (23.2%) and 56 females (76.7%) who were chosen for their willingness to participate and their easy availability. The justification for the selection of this sample is based on the fact that the researchers themselves have asked their students to participate in this research as study subjects. The sample size, although not large, does not necessarily indicate a bias in this type of research (Chou and Feng, 2019). At the beginning of the term, they were informed of the entire research protocol, under the recommendations of the Research Ethics Committee of the University of Murcia. Participants were between 19 and 21 years old ($M = 19.54$ and SD = 3.17), although there was a minority of students above that age (2.73%). Less than 5% of the participants had repeated a grade. Almost half of the participants in the study were highly motivated in the field (41.1%).

2.2. Data collection tools

Quantitative data on the impact of this inquiry-oriented approach were collected using an *ad hoc* questionnaire, one of the most widespread data collection techniques, which aims to analyze and collect information in a well-structured and systematic way on the groups and variables needed to undertake the research. The advantages of this technique include the following: obtaining a large amount of data from many participants on various aspects, allowing easy and quick administration, allowing opinions to be expressed anonymously and voluntarily, and simplifying the analysis of the opinions expressed.

However, the questionnaire also has certain disadvantages, such as inaccuracy in obtaining participants' exact opinions. Compared to face-to-face interviews, not answering questions in person can lead to various interpretations, because it is impossible to elucidate the respondent's meaning. Other drawbacks are the limited response rate, the possible lack of comprehension which may lead to inaccurate answers, or the design's impersonal or overly formal style.

It consists of three sections and 27 items, the first consists of nine statements related to their self-reported motivation to use this web-based resource. The second section consists of seven statements about the learning acquired through this digital tool. The third section focuses on how this inquiry-oriented platform can promote democratic education and active citizenship. A Likert scale was used to measure participants' opinions on these questions, ranging from "1": strongly disagree to "5": strongly agree, so that respondents could openly rate each statement according to their personal way of thinking.

This questionnaire is based on a research instrument called "Evaluation of the training program based on gamification and flipped-classroom" which was already used in another study and initially validated by external experts (Gómez-Carrasco et al., 2019). It was adapted to this study from the original questionnaire and validated through a focus group discussion, in which the authors of the study above and three ICT experts provided feedback on the instrument's effectiveness, reliability and validity.

In terms of reliability, the questionnaire obtained an alpha coefficient of 0.940, which is considered highly reliable (González Alonso and Pazmiño Santacruz, 2015). Regarding the instrument's construct validity, Bartlett's sphericity test and the Kaiser-Meyer-Olkin adequacy index (KMO) were applied for each section of the questionnaire. In all three sections a critical level (Sig.) of <0.001 was obtained in Bartlett's sphericity test, and the results after applying the KMO adequacy index were 0.848, 0.828, and 0.884 in each section, respectively, supporting the validity of the data collection instrument.

2.3. Procedure and data analysis

This core unit was held in the first term of the academic year 2022/2023 (September–December). Sessions were held on Tuesdays from 4 to 6 p.m. and Fridays from 6 to 8 p.m. This core unit aimed for students to acquire knowledge and teaching skills in some relevant topics related to social sciences such as multiculturalism and interculturalism, citizenship or education in democracy. It provided a framework for systematic learning from disciplines such as anthropology, economics, geography, history, philosophy, political science, psychology, and sociology, including relevant content from the humanities. Most classroom activities included a clear articulation of these disciplines and were group-based, i.e., problem-solving activities, comparative teamwork, and case study analysis around pressing issues, which aimed to develop intellectual processes, creating multiple and frequent interactions and calls for participation through which students became more active and helped each other to make their learning more effective.

Specifically, two types of WebQuests were used in the core unit. WebQuests created by the teacher and WebQuests created by the students. The former were designed on academic content by the teaching team on a weekly basis. They aimed to increase motivation, digital literacy and promote social and civic competences. They also aimed to promote high-level thinking, and to develop problem-solving skills on the contents worked on, which resulted in the awarding of points or equivalent recognition for the work developed.

Students had to design their WebQuests in class for the same purpose. They were free to choose one of the themes around which their WebQuest should revolve, namely xenophobia, fake news, gender equity or sustainable development. They used their laptops, tablets or mobile phones to create them in groups of four or five, although they usually divided up the strategies on the digital platform to complete them. To do this, each week students were asked to search for research articles and other sources of academic information to design, analyze and evaluate content specific to social science teaching and to test their understanding and reworking of the main ideas resulting from the exchange of perspectives and the search for consensus. They were given a weekly timetable from the beginning of the core unit to self-regulate their teamwork by themselves, providing them with autonomy to manage their time, deciding the pace at which they complete their tasks and setting their own deadlines, thus encouraging self-regulation and managing the development of autonomous learning skills. They were also asked to design them following the structure of a social studies lesson plan and a specific primary school level by selecting appropriate national curriculum objectives and social studies curriculum standards to provide effective roadmaps of what should be taught in social studies classes. These elements were vital for students to develop their critical evaluation skills and to assess the quality and credibility of the content covered in class, and to filter relevant information for the digital tasks they were doing. To do so, self-evaluation and co-evaluation practices were carried out in the core unit with the aim of fostering students to lead these processes and develop their abilities to act as evaluators of their own learning and their peers.

Thus, these collaborative digital lesson plans served as an organizational basis for training students in the demands and challenges of future social studies teachers and often supported them in analyzing the questions and content previously worked on in class. The groups of students were also encouraged to develop active methodologies and collaborative work, providing opportunities for them to brainstorm and share ideas, exchange points of view, analyze and solve problems, thus improving communication and effective teamwork (Corujo Vélez et al., 2020). At the end of the term, they presented their WebQuests that were specifically tailored to curriculum guidelines and the content they had previously worked on. Discussions were held about their final products and how they had decided on a relevant topic, chosen a motivating task or integrated various technological strategies into social science lesson plans. At this point, co-evaluation was carried out so that more viewpoints were taken into account in a flexible and democratic atmosphere. Self-assessment was carried out at the beginning and at the end of the core unit, when the questionnaire was sent to the students to collect their opinion and to check whether or not the dependent variable (knowledge or attitude) had changed after the application of the inquiry-oriented approach (independent variable). Subsequently, the data were imported into a statistical program to analyze the impact of this inquiry-oriented approach on the development of the students' learning processes and to draw the relevant conclusions from this research.

Specifically, participants' responses were thoroughly analyzed using the XLSTAT statistical package. Nonparametric tests (Mann Whitney U) were applied for gender, self-reported motivation and level of ICT competence. Before that, Kolmogorov–Smirnov tests were applied to determine whether the variables were normally distributed. The mean values of the sample data are represented numerically in the following section together with information on standard deviation classified by gender and level of self-reported motivation and ICT proficiency following the pretest-posttest design.

3. Results

This section presents the findings of this study based on the information collected because of the quantitative methodology applied. The data collected and analyzed are arranged in a logical sequence with the help of tables to present the results more effectively.

Table 1 shows the means and standard deviations for each variable referring to the perception of the learning processes considered in the study according to the gender of the participants. Female students have a higher perception than male students in all learning processes studied in both tests. Within this subgroup, the perception is higher in the item "Active learning methodologies," while male students focus on the item "Educational research." Finally, it should be noted that the lowest perception in both subgroups is related to self-evaluation processes.

Nonparametric Mann–Whitney U-tests were conducted to determine whether student teachers' overall perceptions of the WebQuest-based training program differed statistically. No significant differences were found between male and female students regarding the progression of their learning processes at the end of the term.

According to the participants' level of digital competence, Table 2 shows the descriptive statistics of the perceptions of their learning processes according to the level of digital competence, with the most digitally competent students scoring higher than the least digitally competent. Specifically, the item with the highest score in the first subgroup is "Active learning methodologies," while the least digitally competent focus on the item "Educational research."

We applied Mann–Whitney U-tests for nonnormal distributions to test whether the overall perception of the participants' learning processes differs according to digital competence. This test showed statistically significant differences between the two subgroups in the overall score on the perception of their organizational skills, the development of active learning methodologies, the use of a variety of resources and self-evaluation processes, with the first subgroup scoring significantly higher than the second.

Table 3 shows the means and standard deviations of the participants' self-reported motivation for each variable referring to the perception of their learning processes used in the program during the four-month period. Among the subgroups, the more motivated respondents rated all items related to learning processes more positively than the less motivated participants. The highest scores were obtained for "Active learning methodologies" in both subgroups, with the second highest item being "Collaborative learning" in the first subgroup and "Educational research" in the second subgroup.

Mann–Whitney U-tests were conducted to test whether the shared perception of students' learning processes significantly differed according to self-reported motivation. This test revealed statistically significant differences in all items under study between the two subgroups, with "Collaborative learning" being the item with the most significant differences between respondents ($p = 0.002$).

Table 4 shows the means and standard deviations of the respondents according to gender for each variable referring to the perception of the strategies used to promote technology-enhanced learning. Overall, female students rated the strategies used during the four-month period more positively than male students, with scores above 4 out of 5 for all the items presented. Within each subgroup, and differentiating each of the strategies and techniques, the highest scores were obtained in "Small group work" by female participants, while male students scored higher on "WebQuest tasks."

Mann–Whitney *U*-tests were conducted to examine whether the student teachers' perceptions of the learning strategies used in the four-month web-based approach showed statistical differences. The results showed no statistically significant differences between the two subgroups.

Table 5 presents the descriptive statistics on the variables referring to the strategies developed in the period under study according to digital competence. In summary, the more digitally proficient students scored all items higher than the less digitally proficient students, scoring above four in the pre and posttests. Within each subgroup, both scored higher on "Small group work" and "Practical in-class activities," with the first subgroup also scoring higher on "WebQuest tasks" and the second subgroup scoring higher on "Other ICT resources."

Mann–Whitney U-tests revealed significant differences in perceptions of the use of "WebQuest tasks," "Kahoot tests," "Small group work" and "Practical in-class activities" in favor of the more digitally proficient.

Table 6 shows the means and standard deviations of the participants concerning the strategies used to promote technology-enhanced learning according to self-perceived motivation. Generally,

TABLE 1 Descriptive statistics for the variables involved in the acquisition of technology-enhanced learning analyzed by the gender of the study participants.

Issues related to learning through WebQuests	Women ($n = 55$)		Men ($n = 18$)		Mann–Whitney U	Z	p
	Pre-test AM (SD)	Posttest AM (SD)	Pre-test AM (SD)	Posttest AM (SD)			
Organizational skills	3.96	4.16	3.71	3.87	4788.5	−0.459	0.208
	(0.82)	(0.81)	(0.68)	(0.95)			
Active learning methodologies	4.14	4.31	4.01	3.93	4637.5	−0.459	0.123
	(0.76)	(0.69)	(0.61)	(0.88)			
Use of a variety of resources	4.09	4.2	3.47	3.86	4592.5	−0.574	0.084
	(0.85)	(0.75)	(0.51)	(0.83)			
Collaborative learning	4.01	4.2	3.71	4.01	4654.5	−0.567	0.304
	(0.75)	(0.73)	(0.58)	(1.06)			
Self-evaluation process	4.03	4.07	3.58	3.86	4820.6	−0.459	0.877
	(0.78)	(0.79)	(0.79)	(0.99)			
Educational research	3.98	4.25	3.41	4.02	4585.7	−0.517	0.447
	(0.82)	(0.67)	(0.71)	(0.65)			

TABLE 2 Results of nonparametric statistical tests for variables relating to the evaluation of the variables used to promote technology-enhanced learning evaluated based on level of digital competence.

Issues related to learning through WebQuests		High digital competence AM (SD)		Medium digital competence AM (SD)		Mann–Whitney U	Z	p
Organizational skills	Pre	4.28	(0.72)	3.81	(0.78)	5802.50	−0.415	0.049*
	Post	4.39	(0.78)	4.02	(0.79)			
Active learning methodologies	Pre	4.31	(0.63)	4.06	(0.74)	5709.22	−0.382	0.018*
	Post	4.52	(0.73)	4.13	(0.65)			
Use of a variety of resources	Pre	4.01	(0.67)	3.92	(0.86)	5567.25	−0.401	0.032*
	Post	4.43	(0.58)	4.02	(0.77)			
Collaborative learning	Pre	3.92	(0.82)	3.94	(0.71)	5652.70	−0.450	0.130
	Post	4.39	(0.72)	4.08	(0.78)			
Self-evaluation process	Pre	4.07	(0.73)	3.89	(0.82)	5884.21	−0.374	0.014*
	Post	4,39	(0.65)	3.91	(0.81)			
Educational research	Pre	4.23	(0.83)	3.75	(0.81)	5637.73	−0.448	0.125
	Post	4.36	(0.65)	4.15	(0.66)			

the most motivated students scored above four on the posttests, while the least motivated participants scored below four on the pre and posttests. More specifically, more motivated students scored higher on "Small group work," "Kahoot quizzes" and "Practical activities in class," while less motivated students scored higher on "Other ICT resources."

Nonparametric tests showed significant differences between the two subgroups in "WebQuest tasks," "Kahoot questionnaires," "Small group work" and "Practical in-class activities," indicating that more motivated students perceived that they had learned more with them.

4. Discussion

In the last 3 years, higher education institutions have been affected by substantial changes in the pandemic and post-pandemic period that have resulted in the imposition of social and physical constraints, in new ways of learning and the development of effective tools (Verde and Valero, 2021). Since tertiary educational administrations must simultaneously offer and demand digital competencies to learners, this study aimed to understand university students' attitudes toward the use of these online tools and gamified digital approaches.

Specifically, this study aimed to determine the student teachers' views on using WebQuest applications in conjunction with other ICT resources, e.g., Kahoot! quizzes, both by introducing them to WebQuest learning resources and by examining their impressions of the WebQuest design process. By completing the WebQuest tasks, preservice teachers have gained experience managing their learning, analyzing social issues affecting their lives, adopting diverse perspectives and checking their progress through collaborative work and critical thinking. It was observed that through active methodologies, participants effectively realized the potential of

TABLE 3 Results of nonparametric statistical tests for variables relating to the evaluation of the variables used to promote technology-enhanced learning evaluated based on level of self-perceived motivation.

Issues related to learning through WebQuests		High motivation AM (SD)		Medium motivation AM (SD)		Mann–Whitney U	*Z*	*p*
Organizational skills	Pre	4.03	(0.73)	3.87	(0.72)	6454.50	−0.406	0.006*
	Post	4.36	(0.78)	3.88	(0.85)			
Active learning methodologies	Pre	4.31	(0.66)	4.01	(0.75)	6262.85	−0.445	0.023*
	Post	4.46	(0.56)	4.08	(0.81)			
Use of a variety of resources	Pre	4.17	(0.71)	3.87	(0.75)	6132.50	−0.465	0.040*
	Post	4.34	(0.61)	4.01	(0.86)			
Collaborative learning	Pre	4.17	(0.71)	3.81	(0.72)	6218.65	−0.387	0.002*
	Post	4.43	(0.66)	3.97	(0.84)			
Self-evaluation process	Pre	4.06	(0.75)	3.87	(0.79)	6502.65	−0.386	0.003*
	Post	4.34	(0.71)	3.81	(0.85)			
Educational research	Pre	4.01	(0.91)	3.75	(0.77)	6234.22	−0.452	0.030*
	Post	4.38	(0.61)	4.05	(0.67)			

TABLE 4 Descriptive statistics for the strategies involved in the acquisition of technology-enhanced learning analyzed by the gender of the study participants.

Learning strategies	Women (*n* = 55)		Men (*n* = 18)		Mann–Whitney U	*Z*	*p*
	Pre-test AM (SD)	Posttest AM (SD)	Pre-test AM (SD)	Posttest AM (SD)			
Webquest tasks	3.81	4.07	3.41	4.06	4646.5	−0.421	0.556
	(0.78)	(0.72)	(0.71)	(1.03)			
Kahoot! quizzes	3.98	4.16	3.82	3.93	4694.8	−0.459	0.604
	(0.82)	(0.74)	(0.72)	(0.88)			
Other ICT resources (blogs)	3.98	4.18	3.88	3.85	4600.3	−0.495	0.617
	(0.78)	(0.69)	(0.69)	(1.02)			
Educational video resources	3.91	4.05	3.52	3.53	4663.8	−0.580	0.081
	(0.78)	(0.76)	(0.71)	(1.12)			
Small group work	3.93	4.27	3.58	3.92	4702.5	−0.509	0.488
	(0.75)	(0.73)	(0.71)	(0.99)			
Practical in-class activities	3.92	4.16	3.47	4.06	4615.8	−0.482	0.800
	(0.76)	(0.73)	(0.79)	(0.71)			

incorporating technologies into their learning processes. Thus, there was an increase in their autonomy in the design of online activities, which allowed them to validate the advantages and gains of these web-based tools in digital practices, including learning enhancement (Miralles Martínez et al., 2013). Nonparametric tests showed no statistically significant differences between male and female students in the overall score on the perception of their learning processes, with female students scoring higher. These results align with other studies in which female students rate the strategies adopted under active technology-based approaches to achieve more motivating learning outcomes better than male students (Gómez-Carrasco et al., 2019).

In this vein, an effective increase in motivation was observed in all participants, which indicate that many of them could continue to use and integrate WebQuests in their learning processes along with other gamified resources (Aldalur and Perez, 2023). In fact, significant differences were found between the most and least motivated learners who participated in the study, reflecting the crucial role that motivation plays in enhancing learning (Elgeddawy, 2018). In this sense, allowing students to create their own web-based resources and to reflect on their own practices can help improve their participation in daily lessons, which can contribute to their future professional development as social studies teachers and to more technology-based lesson planning in schools.

Specifically, it was found that those more competent in the use of new technologies realized more significantly the potential of organizational skills, demonstrating that being competent in digital literacy enhances learning processes and constitutes an added value of this technology-based approach (Leung and Unal, 2013). Specifically, according to Iskeceli-Tunc and Oner (2016) the use of WebQuests can positively affect

TABLE 5 Results of nonparametric statistical tests for variables relating to the evaluation of the variables used to promote technology-enhanced learning evaluated based on level of digital competence.

Learning strategies		High Digital Competence AM (SD)		Medium Digital Competence AM (SD)		Mann–Whitney *U*	*Z*	*p*
Webquest tasks	Pre	4.07	(0.82)	3.62	(0.75)	5660.20	−0.371	0.009*
	Post	4.41	(0.66)	3.95	(0.75)			
Kahoot! quizzes	Pre	4.28	(0.91)	3.85	(0.74)	5731.80	−0.394	0.038*
	Post	4.39	(0.65)	4.02	(0.75)			
Other ICT resources (blogs)	Pre	4.35	(0.63)	3.85	(0.76)	5516.20	−0.436	0.108
	Post	4.36	(0.72)	4.06	(0.71)			
Educational video resources	Pre	4.28	(0.72)	3.70	(0.75)	5605.40	−0.488	0.309
	Post	4.13	(0.83)	3.88	(0.85)			
Small group work	Pre	4.29	(0.71)	3.72	(0.72)	5765.50	−0.385	0.022*
	Post	4.52	(0.66)	4.11	(0.74)			
Practical in-class activities	Pre	4.21	(0.81)	3.71	(0.75)	5624.11	−0.390	0.022*
	Post	4.43	(0.66)	4.06	(0.64)			

TABLE 6 Results of nonparametric statistical tests for variables relating to the evaluation of the variables used to promote technology-enhanced learning evaluated based on level of self-perceived motivation.

Learning strategies		High-Motivated AM (SD)		Medium-Motivated AM (SD)		Mann–Whitney *U*	*Z*	*p*
Webquest tasks	Pre	3.86	(0.78)	3.62	(0.75)	6242.75	0.343	<0.001*
	Post	4.41	(0.62)	3.83	(0.81)			
Kahoot! quizzes	Pre	3.96	(0.86)	3.85	(0.74)	6382.50	0.367	0.001*
	Post	4.43	(0.61)	3.86	(0.79)			
Other ICT resources (blogs)	Pre	4.01	(0.74)	3.85	(0.76)	6178.47	0.471	0.052
	Post	4.32	(0.65)	3.97	(0.85)			
Educational video resources	Pre	4.06	(0.73)	3.71	(0.75)	6323.50	0.500	0.115
	Post	4.12	(0.67)	3.82	(1.01)			
Small group work	Pre	3.96	(0.85)	3.71	(0.72)	6440.75	0.427	0.015*
	Post	4.43	(0.61)	3.97	(0.89)			
Practical in-class activities	Pre	4.03	(0.76)	3.69	(0.75)	6202.96	0.338	<0.001*
	Post	4.46	(0.62)	3.86	(0.68)			

students' mastery of web search skills such as browsing, data filtering or data and information management, as found in this study as participants scored higher on the organizational skills item in the posttests.

It is also necessary to underline the relevance of active methodologies and collaborative work in improving self-reported levels of perception of technology-based learning. Students' posttest scores reflect the success of teamwork in sharing ideas, self-regulation and problem solving on these e-learning platforms. These findings coincide with those obtained by other studies such as those of Corujo Vélez et al. (2020), who highlight the relevance of collaborative skills among students when creating WebQuests, such as communicating and making themselves understood, the ability to adapt to new situations and to generate new ideas and the ability to be socially competent in teamwork and joint decision-making.

Another important and vital point for students to feel responsible for their own learning is self-evaluation. Through the creation of WebQuests, students were provided with opportunities to promote critical thinking, develop their abilities to argue on the basis of the content they have worked on, and be aware of the goals they have achieved, their successes and also their failures, as well as their capabilities (Liang and Fung, 2021). In this study, participants scored higher on this item in the posttests because they were allowed to make use of explicit reasoning and exploratory talk in the co-evaluation practices of teamwork, which clearly contributed to improving the quality of their own learning processes and their impressions of them.

5. Conclusion

In this study we have observed how Webquests can enhance the learning and practice of different skills and competences in a higher education context. The results obtained, which ensure that

the research objectives are met, pave the way for further studies on the planning and design of learning experiences in face-to-face and virtual environments, the development of online collaborative learning resources, the guidance and evaluation of knowledge construction or the management of learning achievements and progress with ICT support.

We have seen that the mastery of digital skills together with higher levels of motivation to learn and work collaboratively in the design of these technology-based resources can facilitate the development of relevant skills related to teamwork, digital literacy, organizational skills, and critical thinking (Carretero et al., 2017; Guerrero et al., 2022). This was made possible through active learning strategies and methods, such as practical classroom activities, videos, discussions, quizzes and cooperative work (Campillo-Ferrer and Miralles-Martínez, 2022). In this line, the fact that student teachers felt responsible for their own learning processes has also been very effective in self-regulating their understanding through original experiences, rather than just passively absorbing information. As autonomous learners, they have had the opportunity to manage their learning time, experience real-life-like situations, reflect on them and construct knowledge by scaffolding their pre-existing comprehension of ideas and concepts (Romero-García et al., 2020). In this sense, the information gathered in the research can help us consider the weight of these learning experiences in rethinking the importance of these learning experiences in the development of teacher education, and the relevance of web-based content in current higher education curricula (Prendes et al., 2018).

This way of students working collaboratively, from constructive thinking, exchanging different perspectives and supporting each other responsibly under the principles of constructivism and dialogical learning, clears the way for more innovative online proposals that more accurately reflect the preferences and interests of students in higher education contexts (Synekop, 2020). In this sense, it seems crucial to develop new forms of teacher education, where students can play an important role in learning community projects within a democratic and reflective approach, where they can engage in cooperative work, with a balanced combination of social sciences, pedagogy and technology-based practices (Corujo Vélez et al., 2020).

In this sense, for future implementations, it is essential to consider some issues to appropriately improve students' learning skills in teacher training (Rodrigues, 2020). It is necessary to allocate more time and digital tools for students to develop their learning competencies and incorporate digital technology into their learning processes, by collecting, examining and interpreting secondary and primary information, and solving relevant current social problems. More specifically, it is essential to design unit plans that integrate motivating digital content that challenges their learning ability to give preservice teachers more opportunities to maximize web-based learning experiences in higher education contexts (Piedmont, 2020). In this sense, it would also be desirable for the core unit of Social Studies to design new lesson plans that combine both techniques more effectively (gamification and web-based learning instructional model) and deal with different theoretical aspects of the subject. These lesson plans could include gamified questions as ice-breaker activities that would allow us to know to what extent the students know the subject before tackling the practical part of the subject.

6. Research limitations

Several limitations have been examined in the present research. The first limitation is that the study was carried out in two groups of students enrolled in the core Social Studies in a city in Spain, which reflects a very specific context, which does not allow for generalizations outside the context under study. The sample size is not large and may affect external validity, reducing the power of the study and increasing the margin of error. It is advisable to enlarge the sample size of participants to obtain more accurate values and lower standards of the deviation of the considered items. The second limitation is related to the activities, tasks and quizzes designed for each WebQuest. The design and choice of different tasks could bring about a change in the participants' perspectives in each of the variables analyzed. Furthermore, the results of this study relate to the preservice teachers' opinions on the use of WebQuests, which should not be equated with their real academic performance during the period under consideration, which stands for another limitation of this study. As suggestions for future research, it is recommended to analyze students' actual academic performance to see whether students' perspectives correlate with their academic results. Another suggestion is to improve lesson plans by adjusting their design to students' needs, interests and preferences and then to examine their actual learning after these adjustments have been made. In this sense, applying mixed methods research with quantitative and qualitative data would allow for an in-depth understanding of student teachers' views on the impact of these web-based resources on teacher education. Similarly, research extending beyond one term could detect possible changes in participants' perceptions at individual and group level, thus adding value and quality to the research.

Data availability statement

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

Author contributions

J-MC-F and PM-M contributed to conception and design of the study and wrote sections of the manuscript. J-MC-F organized the database and performed the statistical analysis. PM-M wrote the first draft of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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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.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2023.1204539/full#supplementary-material

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