digital

MDPI

Article

Student Perceptions of the Use of Gen-AI in a Higher Education Program in Spain

José María Campillo-Ferrer, Alejandro López-García and Pedro Miralles-Sánchez *

Department of Social Studies, Faculty of Education, University of Murcia, University Campus, 12, 30100 Murcia, Spain; jmcf2@um.es (J.M.C.-F.); aloga@um.es (A.L.-G.)
* Correspondence: pedro.miralless@um.es

Abstract

This research analyzed university students' perceptions of the use of generative artificial intelligence (hereafter Gen-AI) in a higher education context. Specifically, it addressed the potential benefits and challenges related to the application of these web-based resources. A mixed method was adopted and the sample consisted of 407 teacher training students enrolled in the Early Childhood and Primary Education Degrees in the Region of Murcia in Spain. The results indicated a clear recognition of the relevance of these technological tools for teaching and learning. Respondents highlighted the potential to engage them in academic tasks, increase their motivation, and personalize their learning pathways. However, participants identified some challenges related to technology dependency, ethical issues, and privacy concerns. By understanding learners' beliefs and assumptions, educators and educational administrations can adapt Gen-AI according to learners' needs and preferences to improve their academic performance. In learning practice, these adaptations could involve evidence-based interventions, such as AI literacy modules or hybrid assessment frameworks, to translate findings into practice. In addition, it is necessary to adjust materials, methodologies, and the assessment of the academic curriculum to facilitate student learning and ensure that all students have access to quality education and the adequate development of digital skills.

Keywords: generative AI; student perceptions; primary education; early childhood education; digital competencies

check for updates

Academic Editor: Julio Cabero Almenara

Received: 14 May 2025
Revised: 17 July 2025
Accepted: 22 July 2025
Published: 25 July 2025

Citation: Campillo-Ferrer, J.M.; López-García, A.; Miralles-Sánchez, P. Student Perceptions of the Use of Gen-AI in a Higher Education Program in Spain. *Digital* **2025**, *5*, 29. https://doi.org/10.3390/digital5030029

Copyright: © 2025 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

AI has revolutionized today's societies, providing users with a myriad of networks and services that improve efficiency, streamline workflows, improve decision-making, and facilitate interaction with others [1]. These tools have had a huge impact in many different fields due to the enormous amount of data generated by companies and individuals that they are able to absorb and analyze for different purposes. Their fundamental role today allows complex issues to be tackled efficiently in many areas such as electronics, health, business, finance, and education. In particular, AI is removing educational barriers by offering innovative opportunities for digital classroom management, intelligent tutoring, and facilitating automated administrative burdens. From a student-centered perspective, these technological resources are also transforming learning processes, helping students grasp the meaning of subject content, consolidate it, and master new learning techniques.

In this study, we focused on Gen-AI and its effects in a higher education context. Peñalvo and Ingelmo [2] identify it as the type of AI that generates content of human-

like quality thanks to its neural networks and sophisticated algorithms that facilitate the generation of images, texts, sounds, and videos. Its progressive integration in recent years has led to research and analysis on the effectiveness and impact of these digital solutions at different educational levels. Because of these distinctive characteristics, this study was implemented to examine the research question (RQ) of whether a Gen-AI-driven training program for teaching social science in education degrees could have a significant impact on students' social science learning and critical thinking.

The article is organized as follows. The Section 2 describes the theoretical background, which continues with an explanation of the methodology in Section 3. Section 4 presents the quantitative and qualitative results, which are analyzed and discussed in Section 5. Lastly, Section 6 presents the conclusions.

2. Literature Review

To shed light on the implications of this technology, we have reviewed the research literature with a particular focus on the theoretical basis underpinning this study. In particular, the implementation of Gen AI in this study is based on the Technology Readiness and Acceptance model (TRAM). Regarding TRAM, Kampa [3] considers it to encompass the willingness to use technology and the feeling of innovation. TRAM includes four dimensions: optimism related to the benefits its use can offer, innovation related to the development of new ideas, discomfort related to the unease and apprehension that comes with using technology, and insecurity associated with the uncertainty felt when using technological solutions. These four attributes harmonize well with the use of these digital resources in higher education, as examined by Ayuso-del Puerto and Gutiérrez-Esteban [4].

In this review, we would like to provide an overview of the progress made in incorporating these technological resources in the classroom. In particular, we have focused on the area of students' perceptions of the potential of these digital tools. In fact, students' beliefs and attitudes towards their integration and use can influence their degree of involvement and the learning outcomes they are expected to achieve. According to Aleixo et al. [5], students' perceptions are especially relevant to gain a deeper insight into the learning context and the conditions involved. Considering that students play a decisive role in the development of teaching and learning processes, their demands and preferences must be met in terms of research and analysis. A collaborative and inclusive environment can have a positive impact on learners' engagement and confidence, even if they have never used Gen-AI-based resources before. In contrast, a more traditional teacher-centered approach can decrease learners' motivation and make them feel less digitally competent to achieve the objectives set out in the teaching plan.

The previous literature on Gen-AI has tended to focus mainly on the quality of the content generated while students' perceptions of the effects produced by these web-based resources are not explored as much as they should be. Han et al. [6] examined the correlations among variables such as learning background, learning behavior, and learning resources and revealed significant connections and explicit benefits. Other studies have found that the application of these web-based tools has a positive effect on the perceived benefit of Gen-AI and student motivation. Essel et al. [7] examined students' opinions and academic performance on the use of chatbots and concluded that students using this AI-powered resource performed better academically than the control group and had a positive perception of their usefulness. Similarly, Lee et al. [8] analyzed the learning motivations, attitudes, and review performance of university students within a chatbot-based approach and found that its use could help students develop a positive attitude, increase their motivation, and improve their academic review performance.

In a similar vein, the recent literature has highlighted time optimization and task automation as some of the main benefits that favor easy activity planning and quick content creation. Bailey et al. [9] analyzed whether time spent using Gen-AI was advantageous among university students and concluded that it helped meet learning objectives and increased their confidence. In a similar vein, Bender [10] explored how positive the integration of Gen-AI in higher education was and concluded that it could speed up the content creation process, which favored a shared understanding of the aims of the task being worked on.

Likewise, some studies have highlighted the fact that Gen-AI can favor personalized learning thanks to the generation of tailored resources such as study materials, quizzes and games based on their preferences and needs, transforming how learners engage with classroom content [11]. Other scholars such as Binhammad et al. [12] confirmed its pivotal role in transforming the way learners work with classroom resources because of its ability to provide them with learning experiences that meet all their demands. In this regard, Chan and Hu [13] studied 399 university students' perceptions of Gen-AI and found that it helped improve personalized learning paths, analytical skills, and administrative workload.

Other authors [14] highlighted its transformative potential to revolutionize students' understanding of creativity, encouraging them to develop their inventive processes and foster the generation of creative content. Shahzad et al. [15] examined the effectiveness of Gen-AI on creativity in higher education and found that it can have a significant positive impact on the development of students' creative processes, adoption intention, and academic performance. In fact, Marrone et al. [16] examined the benefits of creativity by conducting focus groups of students and concluded that it had positive effects on students' learning because it favored time management and enhanced the development of novel ideas. They also found that those students with a higher understanding of AI showed more positive attitudes than those with lower understanding.

In the same vein, some authors explored the extents to which students benefited from immediate AI-generated feedback to improve their understanding and help them become more engaged in their knowledge acquisition processes. Chien et al. [17] analyzed how immediate Gen-AI-based feedback could guide students in a contextualized game and found that students felt less anxious during the game and that the digital responses and suggestions provided were effective for students to progressively scaffold their learning. Indeed, immediate feedback and scaffolding are two important techniques for promoting academic performance, fostering student engagement and reducing the workload in higher education. Romadhon [18] examined students' perspectives on the use of Gen-AI to assist them in their writing and concluded that the immediate feedback offered helped students find errors faster, improving efficiency, which was acknowledged by 73.4% of the study participants. Similarly, Lee and Moore [19] reviewed studies published since 2019 on the use of Gen-AI for immediate feedback generation in higher education and found that these digital solutions supported the creation of a more useful and efficient learning environment and improved students' educational outcomes.

Having listed some relevant benefits linked to the use of Gen-AI, it is also essential to acknowledge some challenges and concerns regarding its application in higher education contexts. As Cotton et al. [20] point out, universities must integrate effective strategies for the ethical and sensible use of these types of tools. Undoubtedly, AI has also raised suspicions among faculty for the misuse associated with this technology in written discourses. In view of this, Kamenskih [21] calls for smart learning environments that integrate and implement effective authentication and consent protocols to safeguard data security and confidentiality.

Furthermore, the widespread use of Gen-AI may expose intellectual development in tertiary education to other significant risks. Giannakos et al. [22] identified the lack of academic integrity as a potential threat related to the misuse of these digital solutions that can lead to students passing exams and courses without achieving the necessary competence. In a similar way, some authors examined AI-based cheating and surveyed students for their opinions [23]. The results revealed that students did not want to use Gen-AI to complete whole tasks but to start tasks or to understand content that was new to them. Akkas et al. [24] underlined the fact that although students may be tempted to use Gen-AI for quick and easy solutions for cheating purposes, this undoubtedly raises ethical concerns in the educational community, which should be more sensitive to these transgressive behaviors.

Similarly, other concerns include users' overreliance on Gen-AI that may impact the quality of digital learning processes by affecting the development of problem-solving skills and critical thinking abilities. In this regard, Chan & Tsi [25] asked students the question of whether Gen-AI would replace lecturers in higher education due to its ability to reduce the workload and speed up research results without students waiting for educators' answers. They concluded that students did not strongly believe this would happen in the future because they saw it as an auxiliary tool under the control of humans. Similarly, Anderson et al. [26] highlighted the relevance of ensuring its key role in assisting students in problem-solving skills and extending their cognitive abilities rather than replacing them, thus overestimating its value and contribution.

Having described the main benefits and challenges in relation to the use of these digital solutions, it should be noted that despite the large number of studies focusing on Gen-AI analysis, more research examining student perceptions of the use of Gen-AI-enhanced resources is needed to delve deeper into the ways in which they can be incorporated into current learning practices in higher education, thus justifying this study and addressing the gap in the literature.

The main objective of this research is to consider the implications of a Gen-AI-driven training program for social science learning in Early Childhood Education and Primary Education degrees. This program is based on the use of Gen-AI resources to promote critical thinking in social science teaching. To achieve this aim, the following specific research questions were posed:

1. To what extent are the participants familiar with the use of Gen-AI technologies for educational purposes?
2. What are possible differences in participants' perceptions towards using Gen-AI?
3. What are the potential benefits of the use of these Gen-AI-based resources as perceived by university student teachers?
4. What are the potential challenges and concerns raised by university student teachers in relation to the use of Gen-AI-based resources?

To answer these questions, this study involved university students not only in adopting Gen-AI for educational purposes but also in developing their learning skills through collaborative knowledge acquisition.

3. Materials and Methods

3.1. Participants and Context

In this study, the sample size was 407 student teachers aged 18–51 years, selected by convenience sampling [27]. Most of the respondents were female: 311 females (76.4%) and 96 males (23.6%). The student teachers were enrolled in the Bachelor's Degree in Primary Education and the Bachelor's Degree in Early Childhood Education at the University of Murcia and the Instituto Superior de Educación (ISEN) (Spain). They were in their second

and third year of academic studies and were taking the core unit 'Social Sciences and their Didactics and Didactic Methodology for the Teaching of Social Sciences' in years 23/24 and 24/25. This group was selected due to their unique position as both learners in higher education and future educators responsible for shaping early learning environments. Their perceptions of Gen-AI carry relevance for understanding how such technologies might influence teaching practices and pedagogical beliefs from the ground up. The training program on the use of Gen-AI was conducted in the above-mentioned core units and a survey design was adopted to examine their perspectives on these digital tools for teaching and learning. The student teachers were informed about the implications of this study for their participation and gave their consent as required by the Research Ethics Committee of the University of Murcia (Spain). They were informed that they were granted anonymous treatment of the data collected prior to the study. Data anonymization was ensured by promoting data protection through the encryption of identifiers that linked an individual to stored data.

3.2. Data Collection Instruments

Student teachers were surveyed using a questionnaire that had been previously validated by Ayuso-del Puerto and Gutiérrez-Esteban [4]. It was adapted to the current learning context and a focus group was conducted to improve internal consistency. Surveys constitute one of the most widespread data collection strategies. They offer anonymity and are conducive to an accurate and cost-effective procedure for subsequent scientific research.

The composition of this data collection tool must be sufficiently unambiguous to gather concise data and accurate answers in a scientific manner [28]. Previous literature has highlighted some advantages when adopting this research resource such as its effortless replicability, its ease of administration, or its simple customization. It has also favored the collection of self-reported opinions and views by respondents in an efficient way [29]. However, this survey tool also has some drawbacks, such as acquiescence response bias, which is the inclination of participants to agree with the questions and items asked [30].

In particular, the questionnaire had an introductory section highlighting the importance of the European Framework for Digital Competences (DigComp) developed by the Joint Research Centre (JCR) located in Brussels on behalf of the European Commission It also has initial instructions to answer the questions it includes. In the Section 3.3, participants were asked to include some personal data, such as on their age, gender, and previous participation in AI-based projects.

Specifically, the reliability of the questionnaire was calculated with Cronbach's alpha ($\alpha = 0.929$). In addition, the Kaiser–Meyer–Olkin (KMO) measure was 0.934 and Bartlett's test of sphericity was significant ($p < 0.001$), showing that the data were convenient for exploratory factor analysis (EFA). The EFA revealed five factors that were interpreted according to the items that loaded highly on it:

Factor 1 ("Resource efficiency"):
Items related to usefulness and academic success to detail had high loadings.
Factor 2 ("Design appropriateness"):
Items related to planning and project formulation had high loadings.
Factor 3 ("Resource attractiveness"):
Items related to good idea and interest had high loadings.
Factor 4 ("Suitability as a study tool"):
Items related to learning aid and support had high loadings.
Factor 5 ("Possible difficulties "):
Items related to insecurity and complexity had high loadings.

Once EFA was calculated, the Confirmatory Factor Analysis (CFA) was applied to confirm the predefined factor structure. Comparative Fit Index (CFI) was 0.95 and Tucker–Lewis Index (TLI) was 0.94, which indicated a good fit. Root Mean Square Error of Approximation (RMSEA) was 0.05, which also showed a close fit.

By examining these results, it was confirmed that the factor structure well represented the observed data. The questionnaire consisted of five blocks; the first block consisted of eight items related to efficiency of Gen-AI. The second block consisted of four items related to the appropriateness of Gen-AI-based projects in early childhood and primary education. The third block consisted of three items on the attractiveness of Gen-AI. The fourth block was dedicated to the suitability and consisted of three items. The fifth block consisted of three items on the possible difficulties linked to Gen-AI. For each item, respondents had to choose one of five Likert-model responses, ranging from 1 'strongly disagree', 2 'disagree', 3 'neither agree nor disagree', and 4 'agree' to 5 'strongly agree'. It also included two open-ended questions that were related to the possible benefits and drawbacks of these web tools.

The surveys were carried out at the beginning and end of the term, and during the completion process, the questions and comments of the students on how to fill it in were progressively answered. Out of 427 responses, 407 were finally selected, after omitting the invalid responses due to insufficient effort of 20 participants, −4.7%. Respondents' attention was assessed by checking the time they took to answer in real time since their answers were immediately displayed in the survey report, which also allowed us to know the number of participants who had not yet finished, thus encouraging their participation and involvement. To avoid common method bias (CMB), different measurement instruments were used to ascertain the students' opinion on the use of Gen-AI. Specifically, they also visited https://www.mentimeter.com/es-ES (first accessed on 14 September 2023), which is a word cloud generator, and indicated what the main benefits and challenges of Gen-AI were. In this way, the participants conveyed additional information that helped determine which relevant ideas emerged from the textual data provided. In addition, to minimize CMB, time lags were adopted between the quantitative and qualitative measurements by asking participants to complete both survey tasks in different classes.

3.3. Data Analysis

In this research, after collecting the information through the questionnaire, quantitative data were carefully examined using Statistical Package for Social Sciences (SPSS) v.29.0. In addition, descriptive statistics were gathered after obtaining the results provided by the Kolmogorov–Smirnov tests, which were implemented to examine whether the variables were normally distributed. Mean values have been expressed numerically in the Section 3.4, as has information on the standard deviations in both the pre- and post-tests.

Qualitative data was collected and structured, loading it into the Atlas.ti 22 software, which facilitated the organization and management of the information collected, as well as the visualization and interpretation of the data [31]. By using Atlas.ti, ideas and codes relevant to the objective of the study were identified and labeled; this was progressively achieved through line-by-line analysis to then form categories and subcategories, which were composed of these emerging ideas. In this way, categories and subcategories were generated based on the research focus and after a thorough analysis of the data. They were used for their effectiveness in explaining and summarizing the opinions of respondents by grouping certain thoughts under the same explanatory variable. Once identified, they were visually represented by networks that explored the relationships between different explanatory variables with respect to the phenomena under study.

Similarly, word clouds generated online by mentimeter.com helped provide a more visual representation of students' opinions and views on the topic under study.

3.4. Description of the Intervention Program

The research was conducted in the first terms of the academic years 23/24 and 2024/25 in the core unit 'Social Sciences and their Didactics and Didactic Methodology for the Teaching of Social Sciences'. Within a cooperative framework, students fostered their social and digital skills by working together and completing the tasks presented on a weekly basis. The program was based on a pre-existing one that had been examined by Ayuso-del Puerto and Gutiérrez-Esteban [4]. That program consisted of the design of two AI-driven projects by student teachers working in groups and with pedagogical content provided by Early Childhood Education teachers, following PBL methodological guidelines.

The aim of this program was to foster intercultural understanding and civic values among students through problem-solving activities that required the activation of critical thinking. It also aimed at enhancing AI literacy because they had to use a wide range of Gen-AI powered resources to attain the lesson objectives successfully. For that reason, learners made use of many social science resources such as research articles, pieces of news, evidence-based materials, and other disciplinary content that favored the development of high-order thinking skills to address, collectively, the social issues presented. In addition, they were trained to identify potential challenges during the use of these web-based resources: for instance, by defining prompts more accurately according to the planned objectives.

Students formed groups of four and five to design and generate Gen-AI-based content in multi-faceted activities that developed social, civic, and digital competences. In particular, they prepared lesson plans and devised strategies to reflect on the social and intercultural challenges that have emerged in recent decades and affect modern societies. In this learning process, they got used to specifying their indications and refining them to obtain more precise results, not only for the creative generation of videos, images, surveys, posters, or avatars, but also to personalize the results with different styles, filters, and effects (see Figure 1).

Spectrum of AI applications: Copywriting (CopyAI), text analysis (Chatpdf, summarizer), survey generators (Quizgecko), course generator (Learning studio AI), other AI-powered tools (CharacterAI), blog creator (Junia AI), AI Avatars (Vidnoz), chatbot-based resources (Gemini AI, Hello History, AI Presentation maker), poster generators (Desygner, Postermywall, Venngage, Tomeapp), image creators (Freepik, Bing, Craiyon, Stable diffusion), website creators (Heyleia).

In this manner, they designed Gen-AI-based surveys on social science curriculum content with Quizgecko to gain insight on their civic duties and social behaviors in varying communities and societies. They also delved into the environment and the impact of mankind on the available resources with ChatPDF that encouraged productive collaboration and accelerated their study on this area. In the same way, they went back in time and interacted with historical personalities with Hello History such as Gandhi, Frida Khalo, Albert Einstein, or Napoleon, which allowed them to reflect on some social problem issues across time and space.

These tasks were planned for students to play an important role in unleashing their creative potential, deepening their understanding of the information covered and testing the limits of their AI capabilities. At the beginning of each lesson, they were provided with a step-by-step model containing detailed information on how to proceed and what Gen-AI tools were available to them to generate learning content in different formats, such as image, text, or video, to meet the objectives of the lesson plan. Simultaneously, students had to prepare social studies lesson plans in line with the curriculum standards that included the

use of these digital resources and covered content that challenged primary school students to think carefully about social studies topics.

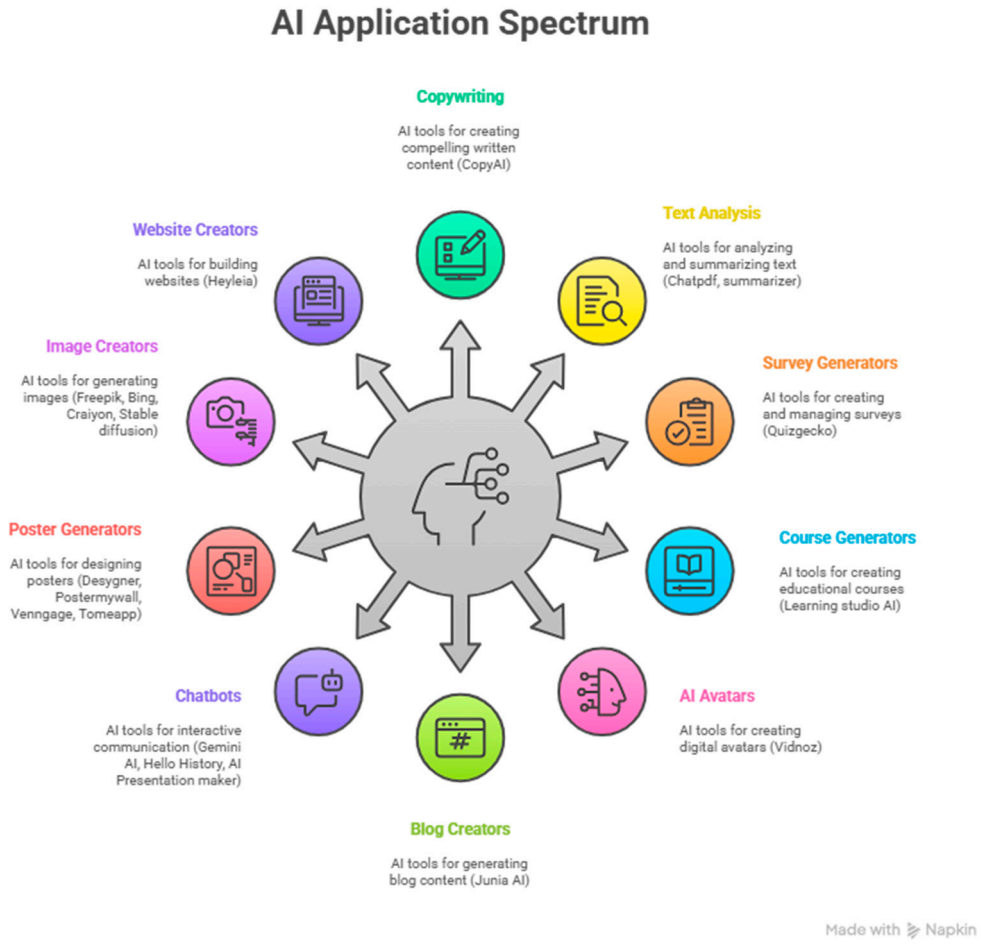

Figure 1. Gen-AI powered resources used by student teachers during the program.

Once they had completed the tasks, they were asked to assess their learning by taking part in competitive tests to see how well they had acquired knowledge and developed their thinking skills. They used their laptops, tablets, and mobile phones and attempted gamified digital quizzes on platforms such as Kahoots and Plickers and, after interacting with these student response systems, discussed which key points were most relevant, and compared and contrasted ideas, engaging them in higher-level thinking.

4. Results

Having analyzed the previously collected data, this section presents the findings identified in a logical manner to be seen in the context of the research questions.

4.1. To What Extent Are the Participants Familiar with the Use of Gen-AI Technologies for Educational Purposes?

The first research question sought to find out to what extent student teachers were familiar with Gen-AI technologies for teaching and learning purposes (see Table 1).

Male students reported slightly more participation in Gen-AI-based projects than female students although there were no major differences between the subgroups. According to these results, it can be stated that the implementation of a Gen-AI-based approach in the above-mentioned core units significantly increased their learning experience in the use of these web-based tools.

Table 1. Descriptive statistics of participation in Gen-AI-based projects by gender.

	Male Students (*n* = 96) M	**Female Students (*n* = 311) M**
Students who reported having participated in Gen-AI-based projects	29.24%	24.91%
Students who reported not having participated in Gen-AI-based projects	70.76%	75.09%

4.2. What Are the Potential Benefits of the Use of These Gen-AI-Based Resources as Perceived by University Student Teachers?

Regarding the second research question, student teachers reported their level of acceptance from a quantitative point of view by completing the first block of the survey. Specifically, respondents had to select one of five Likert-model responses: 1 'strongly disagree'; 2 'disagree'; 3 'neither agree nor disagree'; 4 'agree'; 5 'strongly agree'. Once selected, medians, modes, and ranges were calculated, as shown in Table 2.

Table 2. Descriptive statistics on the level of acceptance of Gen-AI by students.

	Pre-Test (*n* = 407)			**Posttest (*n* = 407)**		
	M	**Mo**	**R**	**M**	**Mo**	**R**
Block 1—Resource efficiency						
1. I would recommend the use of Gen-AI for the teaching-learning process	4	4	4	4	5	4
2. I find that the use of Gen-AI can be useful for learning knowledge in students	4	4	4	4	4	4
3. I intend to use Gen-AI-based projects when I become a teacher	4	4	4	4	4	4
4. Gen-AI projects allow students to acquire knowledge more quickly	4	4	4	4	4	4
5. I would like my university professors to use Gen-AI for my training	4	4	4	4	4	4
6. Gen-AI-based activities facilitate the learning of the contents worked on	4	4	4	4	4	4
7. I enjoy Gen-AI lessons so much that I would like to know more about it.	3	3	4	4	4	4
8. Successfully completing a Gen-AI lesson is important to me	4	4	4	4	4	4
Block 2—Design appropriateness						
9. I can design a Gen-AI project without help	2	2	4	3	4	4
10. I can design a Gen-AI project if I have the time to do the task	3	3	4	4	4	4
11. I have enough resources to create Gen-AI projects in my future work as a teacher	3	3	4	4	4	4
12. I can design a Gen-AI project with help (tutorial, people. . .)	4	4	4	4	4	4
Block 3—Resource attractiveness						
13. The use of Gen-AI for learning is a good idea	4	4	4	4	5	4
14. Gen-AI makes learning more interesting	4	4	4	4	5	4
15. The use of Gen-AI for learning is fun	4	4	4	4	5	4
Block 4—Suitability as a study tool						
16. Using Gen-AI in the core units would improve my performance	3	4	4	4	4	4
17. I would like to use Gen-AI as a tool for study	4	4	4	4	5	4
18. Using Gen-AI during classes would make it easier for me to understand certain concepts	4	4	4	4	4	4
Block 5—Possible difficulties						
19. Using Gen-AI somehow intimidates me	3	3	4	3	3	4
20. I feel insecure when using Gen-AI	3	3	4	3	2	4
21. There is so much information that I find it difficult to recall key information	3	3	4	3	3	4

As shown, the students' acceptance level improved in all the items presented in posttests with scores around 4, indicating a high degree of approval in terms of using Gen-AI. The most highly valued items were the ones linked to the use of Gen-AI as a tool for study (Mo = 5) and to making learning more interesting and fun (Mo = 5), which demonstrated their commitment to these knowledge-organizing technologies.

According to the Kolmogorov–Smirnov test, the distributions of the sample analyzed were different ($p < 0.01$), so it was necessary to apply non-parametric tests to find out if there were significant differences between the independent variables (gender, participation, and previous knowledge). Wilcoxon's signed-rank tests were applied to assess whether their mean ranks differ with respect to learning acquired (see Table 3).

Table 3. Wilcoxon's signed-rank test with respect to learning acquired through the use of AI.

Learning Acquired in AI-Powered Program	Negative Rank			Positive Rank			Test Statistics		
	n	Mean Rank	Sum of Ranks	*n*	Mean Rank	Sum of Ranks	Ties	z	*p*
Block 1—Resource efficiency									
1. I would recommend it for the teaching-learning process	102	143.98	14,685	203	156.07	31,370	102	−5.663	<0.001
2. I find that can be useful for learning knowledge	100	128.24	12,823	180	147.31	26,516	127	−5.263	<0.001
3. I intend to use it when I become a teacher	89	144.72	12,880	199	144.40	28,735	119	−5.776	<0.001
4. It allows students to acquire knowledge more quickly	89	149.20	13,279	207	148.20	30,677	111	−6.112	<0.001
5. I would like my university professors to use Gen-AI for my training	110	151.47	16,207	201	156.11	31,379	96	−4.985	<0.001
6. It facilitates the learning of the contents worked on	90	131.41	11,827	190	144.81	27,513	127	−5.995	<0.001
7. I enjoy so much that I would like to know more about it.	105	139.63	14,242	195	153.91	30,010	107	−5.499	<0.001
8. Successfully completing a Gen-AI lesson is important	107	136.65	13,938	181	145.02	26,248	119	−4.616	<0.001
Block 2—Design appropriateness									
9. I can design it without help	73	129.38	9445	270	183.52	49,551	62	−11.080	<0.001
10. I can design a Gen-AI project if I have the time to do the task	62	117.44	7281	232	155.53	36,084	113	−10.084	<0.001
11. I have enough resources to create Gen-AI projects in my future work as a teacher	76	127.4	9682	236	165.87	39,145	95	−9.443	<0.001
12. I can design a Gen-AI project with help (tutorial, people…)	71	132.24	9389	224	153.01	34,271	112	−8.771	<0.001
Block 3—Resource attractiveness									
13. The use of Gen-AI for learning is a good idea	94	142.97	13,439	200	149.63	29,926	113	−5.861	<0.001
14. It makes learning more interesting	103	142.15	14,641	188	148.11	27,845	116	−4.778	<0.001
15. The use for learning is fun	87	134.76	11,724	191	141.66	27,056	129	−5.972	<0.001
Block 4—Suitability as a study tool									
16. Using Gen-AI would improve my performance	105	142.41	14,668	201	157.67	31,692	101	−5.707	<0.001
17. I would like to use it as a tool for study	106	143.78	16,679	187	157.10	29,377	104	−4.314	<0.001
18. It would make it easier for me to understand certain concepts	110	134.48	14,792	178	150.69	26,823	119	−4.402	<0.001
Block 5—Possible difficulties									
19. Using Gen-AI intimidates me	165	168.75	27,843	156	152.81	23,838	86	−1.226	0.220
20. I feel insecure when using it	172	155.91	26,815	138	152.73	20,771	97	−1.974	0.048
21. I find it difficult to recall key information	142	149.32	21,203	157	150.62	23,647	108	−0.837	0.403

A Wilcoxon signed-rank test was applied to analyze whether the students' learning developed in the AI program was perceived more positively than at the beginning of the term. The results indicated statistically significant differences in most statements between the pre- and post-tests ($p = 0.001$). Based on these results, it could be assumed that the use

of AI-based resources during the program significantly improved the perceptions of the student teachers who participated in the study and minimized the possible difficulties faced.

In addition, a Kruskal–Wallis H test was conducted to determine whether there were significant differences among participants in terms of age (see Table 4).

Table 4. Results of the Kruskal–Wallis test in relation to the opinions of student teachers on the learning acquired and their levels of motivation.

Learning Acquired in AI-Powered Program	18–19 Year-Old Students		20–21 Year-Old Students		+22 Year-Old Students		Test Statistics		
	n	Mean Rank	*n*	Mean Rank	N	Mean Rank	H	gl	*p*
Block 1—Resource efficiency									
1. I would recommend it for the teaching-learning process	247	213.5	123	186.7	37	185.6	5870	2	0.053
2. I find that can be useful for learning knowledge	247	217.1	123	183.2	37	179.6	9834	2	0.007 *
3. I intend to use it when I become a teacher	247	212.3	123	191.4	37	184.5	4169	2	0.124
4. It allows students to acquire knowledge more quickly	247	215.2	123	181.6	37	197.5	7678	2	0.022 *
5. I would like it to be used for my training	247	207.7	123	198.1	37	182.7	1903	2	0.386
6. It facilitates the learning of the contents worked on	247	210.9	123	186.7	37	203.3	4011	2	0.135
7. I enjoy so much that I would like to know more about it.	247	212.5	123	192.1	37	181.2	4445	2	0.108
8. Successfully completing a Gen-AI lesson is important	247	210.6	123	195.9	37	170.6	4840	2	0.089
Block 2- Design appropriateness									
9. I can design it without help	247	211.6	123	194.3	37	185.1	3046	2	0.218
10. I can design a Gen-AI project if I have the time to do the task	247	208.7	123	195.1	37	190.6	1704	2	0.427
11. I have enough resources to create Gen-AI projects in my future work as a teacher	247	224.1	123	178.3	37	149.6	22,535	2	<0.001 *
12. I can design a Gen-AI project with help (tutorial, people…)	247	215.1	123	192.3	37	163.2	8705	2	0.013 *
Block 3- Resource attractiveness									
13. The use of Gen-AI for learning is a good idea	247	209.7	123	194.8	37	196.2	1741	2	0.419
14. It makes learning more interesting	247	210.0	123	195.1	37	193.7	1866	2	0.393
15. The use for learning is fun	247	209.9	123	191.2	37	201.2	2439	2	0.295
Block 4- Suitability as a study tool									
16. Using Gen-AI would improve my performance	247	215.6	123	182.1	37	198.5	7514	2	0.023 *
17. I would like to use it as a tool for study	247	215.1	123	184.8	37	193.9	6481	2	0.039 *
18. It would make it easier for me to understand certain concepts	247	211.3	123	184.3	37	214.7	5304	2	0.071
Block 5- Possible difficulties									
19. Using Gen-AI intimidates me	247	194.9	123	206.1	37	252.6	8457	2	0.015 *
20. I feel insecure when using it	247	197.2	123	203.4	37	245.6	6021	2	0.049 *
21. I find it difficult to recall key information	247	205.8	123	200.3	37	204.1	0.205	2	0.903

According to the results shown in Table 4, there were significant differences between participants of different ages (* = $p \leq 0.05$), with the youngest being the most willing to use these web-based tools in class for learning purposes (H = 17.930, $p = 0.001$) and in their future work as teachers (H = 22.535, $p = 0.001$). Furthermore, the results reveal that older students were the most intimidated by these digital resources (H = 8457, $p = 0.015$).

From a qualitative perspective, participants reported the benefits related to accessing and using these knowledge organization technologies, and these were visually represented in a word cloud (see Figure 2).

Figure 2. Benefits of Gen-AI self-reported by student teachers.

As can be seen, the most repeated words were 'speed' (53), 'ease' (32), 'creativity' (25), and 'innovation' (20). Alongside these, other words appeared, which, although less numerous, drew respondents' attention as they were related to previous studies on Gen-AI, such as 'understanding' (3), 'motivation' (3), 'accessible' (2), 'efficiency' (2), 'fun' (2), 'feedback' (2), and 'development' (2), which were also relevant.

Consistent with the word cloud results, most respondents perceived Gen-AI as an effective resource with multiple advantages, specifically for learning and teaching purposes.

4.2.1. Learning Enhancement

When students encountered difficulties during the completion of assignments, Gen-AI was able to provide them with some learning aids, becoming a virtual tutor and offering them immediate personal support during their learning processes that favored the understanding of complex ideas. One student felt that '*It facilitates the comprehension of certain contents.*' Two respondents remarked, '*By using Artificial Intelligence it is possible to approach the same content through different resources, which makes it possible for students to understand the concepts in a more enjoyable and significant way*' and '*I think that using AI makes it much easier to understand some of the concepts, because you can ask it to explain things in a much simpler way and it is as if it were a teacher or a person explaining it to you and trying to give you examples*'. In addition, they found that Gen-AI could provide a deeper understanding, thus furthering their aspirations and achievements: '*It improves understanding and performance*'.

They also stressed the importance of getting immediate feedback from these digital tools as they go about their tasks, which makes learning processes fun: '*Quick understanding of the contents, facilitates the teaching-learning process, motivating*'. Another respondent stated, '*The advantages of using Artificial Intelligence projects in Education include personalization of learning, immediate feedback.*' Another student teacher commented, "*It can make it easier for students to understand the content, as well as being more fun and dynamic for them*'.

4.2.2. Student Engagement

These innovative solutions can also be adopted to engage students. Students found it stimulating to participate in digital tasks involving the use of Gen-AI because it was an alternative way to grasp the meaning of academic content, e.g., '*They can be very useful especially to capture the students' attention and make them see the contents in a much more playful way, in this way I think they will be much more motivated*'. Another student stated that '*It is a creative way of approaching content, and the student is more motivated because it is a more*

innovative method', which was similar to another student who considered Gen-AI to be '*More innovative and motivating*'.

They also emphasized the importance of collaborative tasks, where they worked cooperatively to achieve class objectives: '*It fosters creativity as well as teamwork*'; another participant commented, '*The advantages of using artificial intelligence in education are that students can understand information in a more entertaining and fun way, while at the same time being dynamic and promoting teamwork as this activity can be done in groups*'.

4.2.3. Teaching Efficiency

As the participants were student teachers, they reflected on the benefits of Gen-AI in their future teaching practice. Among the benefits pointed out, they highlighted the diversification of resources as very inspiring and interesting, e.g., '*Variety of resources, many resources can be created easily and simply*'. In this line, some responses focused on its effectiveness and suitability for different types of pupils: '*It provides a wide variety of activities, resources. . . for all ages and characteristics of the students, it can be adapted to many situations and thus helps the teacher to be able to clarify it better.*' Another student commented, '*It attracts students' attention, makes it easier to find information and is a good method for making resources*'.

In addition, respondents also highlighted time optimization as one of the most relevant benefits as it improved not only the way time was spent in class but also the way tasks and assignments were planned in advance, e.g., '*It saves teachers time on many tasks*' and '*It offers additional activities or support material, and this maximizes time and resources.*' Another respondent remarked, '*They free up time for teachers to focus on activities of greater pedagogical value*'.

4.2.4. Content Management

In relation to the previous benefit, student teachers also pointed out that content management was advantageous for students and educators. In fact, they stressed quick information access, efficient information synthesis, and clear content organization, among the most relevant academic activities favored by Gen-AI, e.g., '*It allows the contents to be quickly schematized and summarized*'. Two teacher training students reported that '*It is quicker to find and group information in the classroom*' and '*Concept development. Summary of contents. Translation and proofreading*'. Two other respondents indicated, '*They allow to see the possibilities from a broader point of view and thus to be considered in a more simplified way*' and '*It can be used as a tool to search for information or to organize information, which makes everything much easier*'.

Indeed, they highlight the role of Gen-AI as a writing assistant: '*we learn to use grammar in a better way, and it is easier for us to carry out our work.*' In addition, they highlighted how effective a time-saving resource can be for learning: '*You do more things in less time*' and '*Rapid information processing*'.

4.2.5. Technological Innovation in Class

Participants also focused on the effectiveness of Gen-AI as a technological innovation in the classroom and on decision-making processes about its use for pedagogical purposes in terms of digital competency development: '*It is an innovative way of carrying out a project using technology*'. Another student remarked, '*The advantages of using artificial intelligence projects are many and varied, as they allow students to make pragmatic use of new technologies to carry out the activities set out for them, and teachers should not limit themselves to assessing students through direct observation, but should encourage discipline in this area of technology fundamentally so that they acquire digital competence and also citizenship skills. They should be governed by interactivity and students should have the opportunity to design their own activities, obviously governed by guidelines so that they become accustomed to what will be required of them*

soon'. Another respondent pointed out that '*It is a form of innovation in education which will make the content of this new form of teaching much more attractive to pupils*'.

In addition, participants stressed task automation as one of the most relevant benefits of this educational innovation, e.g., '*They also automate repetitive tasks*' and '*The speed and immediacy of finding definitions, explanations and content*'.

4.2.6. Accessibility and Inclusion

Apart from the above-mentioned benefits, student teachers also paid attention to the support for diverse learning needs it may provide, e.g., '*In my opinion, one of the main advantages of AI is the fact that many activities or plans can be adapted to each child's interests and needs.*' Some comments focused on students with special educational needs, especially those who may have learning difficulties and find it more difficult to acquire knowledge and develop skills: '*It also allows equal access to information for all, including students with special needs*' and '*Attention to diversity, motivation*'.

In addition, respondents focused on the opportunities provided by Gen-AI to customize the learning experience, e.g., '*Personalization of learning*'. Two students remarked accessibility and inclusion as two of the most important benefits '*AI projects in education personalize learning and facilitate inclusion*' and '*They can also facilitate access to quality educational content, making it more inclusive and accessible to all*'.

Furthermore, clusters were identified within the data that demonstrated co-occurrence networks and revealed more detailed information. In particular, four clusters were identified, as shown in Figure 3.

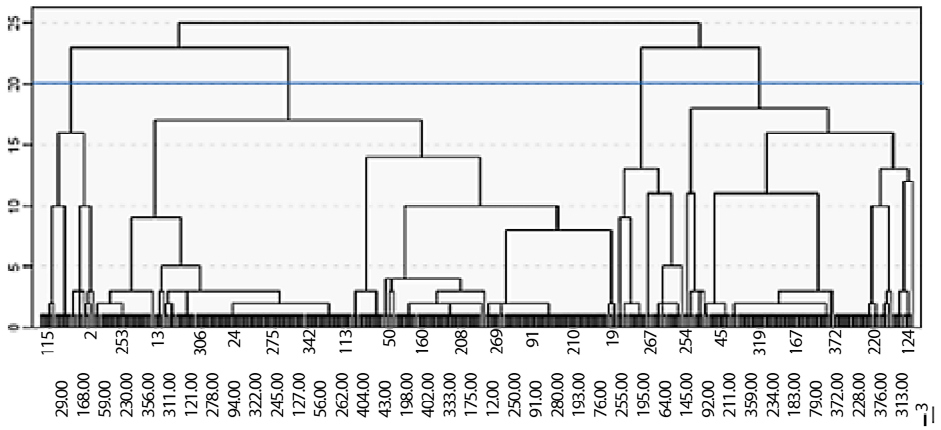

Figure 3. Dendrogram with clusters related to the benefits of Gen-AI.

Cluster 1: The smallest group focused on student engagement and teacher efficiency. It emphasized the importance of digital teaching and learning processes.

Cluster 2: The largest group. Members believed that AI-powered content management could improve student engagement. They took a more practical view of social studies classes that engaged students in interesting AI-based activities.

Cluster 3: They believed that technological improvement could optimize content management by increasing the quality of knowledge acquisition processes through the adoption of new AI-powered resources.

Cluster 4: They believed that student engagement could be enhanced by technological innovation, which makes learning engaging through new AI-powered applications.

4.3. What Are the Potential Challenges and Concerns Raised by University Student Teachers in Relation to the Use of Gen-AI-Based Resources?

Regarding the third research question, student teachers found some challenges associated with the adoption of these web-based classroom materials that were visually described in the next word cloud (see Figure 4).

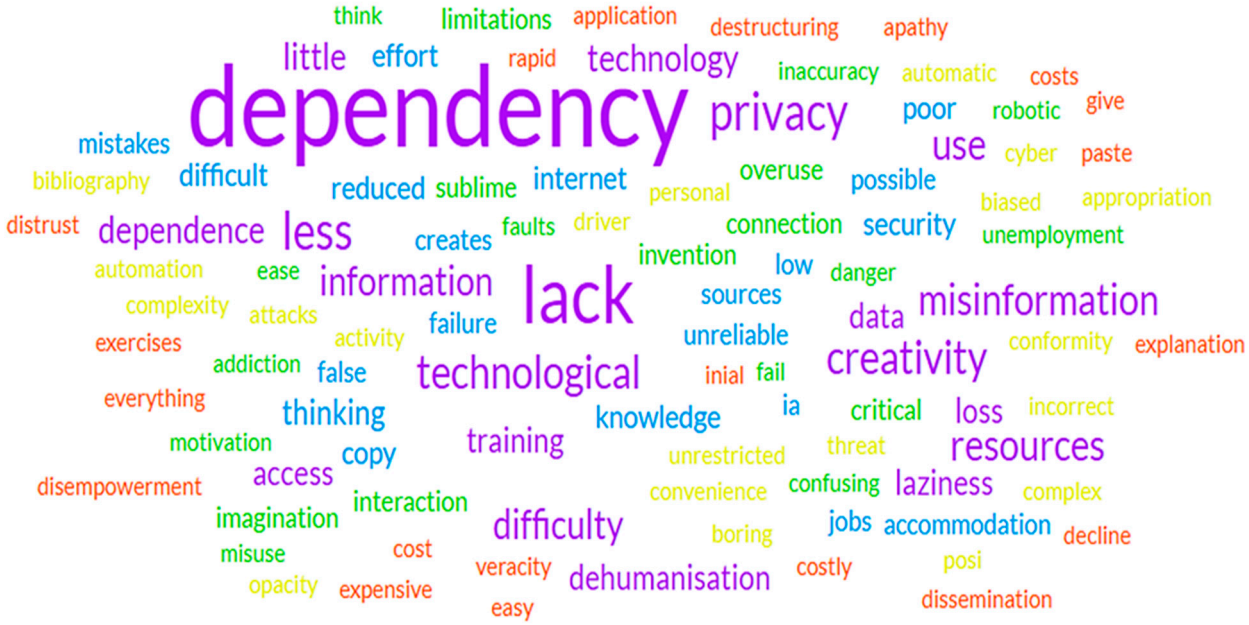

Figure 4. Challenges regarding the use of Gen-AI self-reported by student teachers.

As shown, the most repeated words were 'dependency' (42), 'lack of resources' (28), 'privacy' (22), 'creativity' (20), 'misinformation' (18), and 'less information' (16). Alongside these, other ideas emerged, which, although less frequent, could be related to potential difficulties encountered by student teachers, such as 'dehumanization' (3), 'laziness' (3), 'difficulty' (2), 'access' (2), 'effort' (2), 'training' (2), and 'resources' (2), which were also important.

In line with these ideas, student teachers reported some relevant challenges when answering the open-ended question about the potential problems these online platforms could bring.

4.3.1. Dependency and Overreliance

Participants highlighted dependency and overreliance as two of the most important challenges in relation to the use of these web-based resources, as one commented on '*The overreliance on these tools.*' In fact, they pointed out that there might be a constant need to make use of them in class: for example, '*Students may constantly resort to AI and lose their creativity and critical capacity*'. Another student commented, '*One drawback could be the dependence on it for any work or activity and the constant use of technology*'. This overconfidence can lead to comfort-seeking behavior and a lack of interest in all the possibilities that Gen-AI can offer., as some student teachers pointed out '*Not learning enough or conformism on the part of the learner*' and '*That we can be satisfied with what the AI gives us without taking a deeper interest in it*'.

4.3.2. Reduced Learning and Critical Thinking

Such technological dependence may be associated with the development of more limited learning and critical thinking skills. In this sense, respondents put the spotlight on less critical analysis and decreased reasoning capacity, noting '*That students may see artificial*

intelligence as a method of doing homework and assignments without thinking and reflecting, so they would not learn'. Another student commented, '*They don't reason*'.

This attitude may cause less intellectual effort on the part of students, as one participant remarked: '*Misuse of this can lead to disadvantages such as laziness when it comes to doing the work, so that you don't think so much for yourself*'. Another participant put it this way: '*In my opinion, if learners are not aware that they must be critical in checking what artificial intelligence gives them, learning does not take place. It would still be copy and paste*'.

4.3.3. Loss of Creativity and Original Thinking

A related challenge is the decline in innovative thinking and original ideas expressed by learners. In this sense, one participant remarked, '*They can be misused, stifle students' creativity, and simply copy information provided by the AI*'. Other student teachers commented, '*It takes creativity away from the teacher when devising a game or activity in the classroom*' and '*There is a lack of imagination, and work*'.

In this vein, some participants pointed out that this tendency to copy can lead learners to develop less independent thinking: '*They often give you homework and don't give you something to think about*'. Another respondent indicated, '*We get used to use artificial intelligence for all projects, without using the thinking and knowledge of those contents.*' Thus, while Gen-AI becomes a source of inspiration, some students reported how easy it was to use it without maximizing its effectiveness and exploring their own creativity, noting '*That it can become too easy. We use less imagination and creativity*' and '*In the end they will have no creativity to develop their projects and will just focus on having artificial intelligence do everything for them, and that's a big problem*'.

4.3.4. Reduced Human Interaction

The misuse of Gen-AI can have an impact on social skills and cause a reduction in interpersonal interaction and a decline in communication skills, e.g., '*It limits the development of interpersonal skills*' and '*Loss of human interaction*'. Some participants stated that it may affect the role of the educator in class: '*It has possible limitations in human interaction, which may affect social skills and the role of the teacher*' and '*It can lead to less direct contact between students and teachers.*' The above ideas suggest a change in classroom dynamics and a reduction in direct interactions, e.g., '*Drawbacks of using artificial intelligence in education include the lack of direct contact between students and teachers, which can affect personal relationships*' and '*One of the drawbacks of this may be that the use of AI may limit students' ability to interact with other students*'.

4.3.5. Technical and Resource Limitations

Reduced direct interaction can affect collaborative work and enhanced learning, which can also be influenced by the digital divide, unequal access, and lack of availability of devices, e.g., '*It can be costly and require advanced technical infrastructure, which can make it difficult to access in low-resource settings*' and '*The digital divide. Overcoming these problems is crucial for effective and ethical implementation*'. Two student teachers remarked '*That there are insufficient resources*' and on '*The economic cost of resources*'.

In this respect, participants also indicated that technical complexity can be a challenge for some learners who have difficulties in using it because they lack digital literacy: '*Lack of resources and knowledge about artificial intelligence*'. Another student commented, '*To use AI you have to be proficient in technology and have technology at home, which not everyone can afford*'.

4.3.6. Information Quality Concerns

Participants expressed concerns about the quality of the information provided by these web-based learning materials, mainly due to outdated content, factual errors, or contextual

mismatches; for example, '*You don't know if sometimes what it says is true and you can trust it*', and '*Possible false information (Chat GPT sometimes gets it wrong)' and 'Errors may occur as it is not checked against official documents*'. Two respondents pointed out '*That it may not be correct and cannot all be used with artificial intelligence*' and '*The possibility of misinformation*'. In fact, some students doubted whether the information provided was substantiated or not: '*The information provided by the AI may not be fully substantiated, i.e., however much information the AI may provide, it may be made up' and 'This information may be fake. We must be critical*'.

4.3.7. Privacy and Security Issues

As mentioned above, students raised questions about the quality of information and about privacy and security in terms of data protection, system security, and personal information, e.g., '*Data privacy concerns*' and '*That some may not be secure*' and '*Security threats.*' One student also remarked on '*Insecurity, exposure and danger*'.

In the same vein, participants also raised concerns about ethics in the use of data, the right to privacy, and content issues that can lead to misuse of information and plagiarism, e.g., '*The disadvantages of using AI in education are mainly plagiarism of projects because you may be asked to do all their work and not learn from them. Thus, they must be taught to use them safely.*' Another student pointed out that '*The information given may be considered plagiarism, it may not help you at all*'. Another learner stated that '*Sometimes using this method as a study aid is considered plagiarism and you find it easy and quick and therefore you do not think or learn*'.

To reduce data complexity, a dendrogram was generated to group similar data points and detect clusters that emerged after analyzing the variables (see Figure 5).

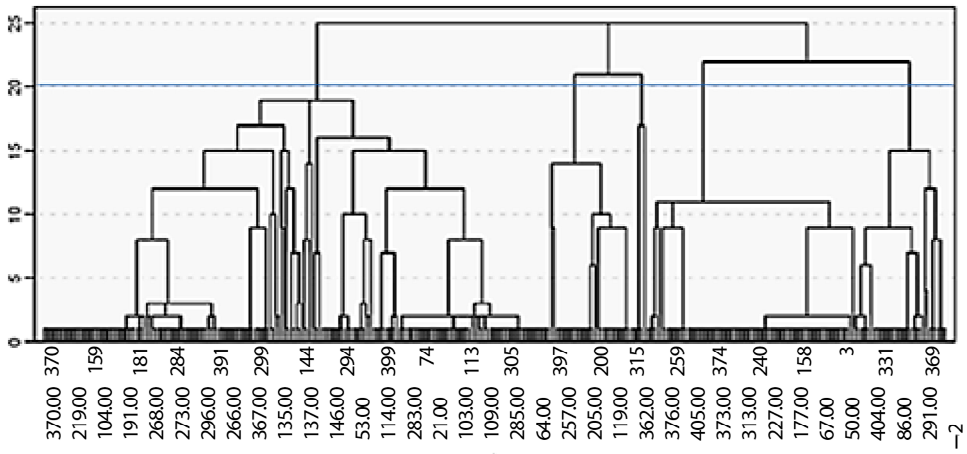

Figure 5. Dendrogram and clusters related to the challenges of Gen-AI.

Based on the information provided by the dendrogram, five main clusters were identified:

Cluster 1: The largest cluster. Participants believed that students may not fully benefit from AI-based resources due to their lack of digital literacy, which can reduce the quality of the learning process.

Cluster 2: Overreliance on these digital resources can lead to poor learning and a loss of critical thinking.

Cluster 3: The smallest cluster focused on technical and resource limitations, which could lead to misinformation due to their inability to verify and review information.

Cluster 4: They primarily focused on privacy and security issues, as well as on concerns about information quality, as the main related challenges.

Cluster 5: They believed that overreliance could lead to less human interaction and the poorer development of socialization skills.

5. Discussion

Research on Gen-AI, according to university students enrolled in social science studies, shows a detailed and comprehensive picture of the application of these web-based solutions in higher education. The results reveal a good understanding of the potential benefits and gains of Gen-AI, along with positive thinking about the capabilities it presents for educational purposes. However, some respondents commented on privacy concerns, potential misuse, and the degree of reliability of these tools.

Regarding the first research question, seven out of ten participants had not been involved in any Gen-AI-based project before, which reinforced the idea that participants' frequent exposure to Gen-AI in this program positively influenced their acceptance and levels of execution in the tasks presented. This finding went in line with previous studies that concluded that practical experience may facilitate a more extended use and application of these technology-driven classroom materials [10]. In this sense, a deeper understanding of Gen-AI together with the adoption of digital programs that include a high level of exposure to multiple and varied tasks can be correlated and constitute a priority to improving students' digital competencies.

In this respect, it is pivotal to adjust the curriculum and integrate these knowledge organization technologies for students to achieve complex learning objectives along with research. Kadaruddin [8] highlights that a profound adaptation is required in the implementation of this paradigm shift by enhancing personalized learning experiences and encouraging educators to progressively replace uniform approaches with more learner-centered proposals that involve digitally generating contextually relevant resources for their learning. In this sense, the development of evidence-based proposals, such as AI literacy modules or hybrid assessment frameworks, to translate findings into practice seems particularly relevant.

In reference to the second and third research questions related to the different perceptions on the benefits derived from the use of Gen-AI, participants highlighted learning enhancement as one of the most relevant gains, which aligned with some findings identified in previous studies [8,32]. They highlighted their strategic guidance that facilitated a better understanding of content and a more personalized learning experience, along with immediate feedback that encouraged interaction and the development of varied instructional strategies that promoted knowledge retention. All of these self-reported benefits can help ensure the exploration and acceptance of these web-based tools by students in the higher education environment.

Another benefit revealed by participants was the increased engagement of learners. The new digital learning framework increased their motivation and interest by encouraging active participation in new and dynamic learning situations and by expanding opportunities for collaborative work and interactive communication. These self-reported learning gains were consistent with those identified by Essel et al. [7], who analyzed learners' opinions on the use of Gen-AI and found that participants had positive attitudes due to its effectiveness. In this line, Lee et al. [8] also concluded that the application of a Gen-AI initiative could improve both students' motivation and their academic review performance.

In a similar vein, students pointed to time optimization and simple task automation as some of the main benefits for planning activities and creating content efficiently. In this sense, Bender [10] found that these web-based proposals could accelerate content generation, which improved the mutual understanding of the objectives to be achieved.

Another advantage reported by participants was accessibility, which reinforced the idea of adopting more inclusive digital approaches in higher education. Within a Gen-AI-based framework, the promotion of personalized learning paths can be assured because the multiple ways of generating content produced by technology-driven tools aligns with

the principles of high-quality inclusive education that emphasize the need to promote accessibility using diverse and customizable classroom materials. In this sense, according to Binhammad et al. [12], catering to individual needs and demands by providing alternative resources to absorb information and grasp the meaning of new content is crucial for learners to reduce cognitive challenges. Specifically, some learning aids commented on by the participants were the change from text to images, the integration of subtitles to videos, and the creation of avatars, which helped learners make content more accessible and interesting.

However, despite these advantages, participants also reported some challenges linked to the third research question. In particular, concerns were raised about a possible decrease in reasoning and learning capacity due to their reduced intellectual effort, which may have affected the proper development of their analytical processes. This may give the impression that students learn new content efficiently in a short time, but this may hide a potential threat to the quality of learning that may result in unskilled students unable to cope with the cognitive load administered and to adequately develop the competences needed in their future professional practice [19].

Students also stated that overreliance on these technology-driven resources could cause a high degree of dependency and comfort-seeking behaviors. In fact, students' responses pointed to their excessive predisposition to seek quick solutions without working autonomously and to their repeated need for web-based support. This finding was consistent with that found by Chan & Tsi [28], who even explored a possible replacement of educators by AI, although their research participants rejected this theoretical scenario. As Anderson et al. [29] argue, it is crucial to stop opting for the easy way out, thus overestimating the learning support it can provide, and to reinforce students' problem-solving skills for the sake of cognitive development.

Another concern raised by respondents was related to creative limitation. Although they indicated in the word cloud that these online initiatives sparked their creative interest (see Figure 1), they also stated that Gen-AI might limit their own original ideas and imagination. The fact that these classroom materials provide novel ideas based on the suggested prompts made respondents reflect on the quality of innovative thinking they could develop in class. The cognitive challenges identified in this study coincided with those found by Chan & Hu [16], whose participants highlighted a possible negative effect on creativity when using these digital tools because they tended not to think for themselves.

In this vein, they also reported some connectivity problems related not only to technical failures but also to economic barriers. In particular, the digital divide caused by the disparity between affluent students with greater access to ICTs and those without it can have a negative impact in terms of learning opportunities for students with more limited access to these technologies. In addition, this disparity in resources can increase technical complexity in completing proposed tasks, which can ultimately lead to academic failure for those who are disconnected. Carter et al. [33] explored the relationship between the digital divide and AI and proposed a socio-technical research agenda to conceptualize this phenomenon and delve deeper into AI-related inequalities.

Participants also commented on issues related to information quality. They addressed some challenges related to verification processes and difficulties encountered in fact-checking once AI-based content has been collected. In this regard, source validation seems to be a serious problem identified in previous studies as it can cause factual errors and lead to value tensions on the possible use of incorrect information [34].

6. Conclusions

All these concerns described above can make the academic community more aware of students' needs, which is in line with the adoption of integrity-based solutions that enhance

responsible teaching and learning practices. In this regard, it seems essential to design and improve viable frameworks for AI literacy by evaluating pedagogical interventions and identifying the extent to which higher education students are digitally literate. Consequently, to improve the effectiveness of these technologies for learning, it is essential to better understand students' academic experiences, their self-reported benefits and challenges, their effects on classroom interactions, and their wider educational implications in higher education.

The incorporation of such tools in new online proposals that foster adaptive and personalized learning and integrate constant information processing updates could be a viable option to respond to the needs and demands of students in different digital learning scenarios. With this aim in mind, AI-driven programs should be proposed to help bridge the digital skills gap, increase participation, and progressively nurture learners with AI-based skills.

The combination of learner interests and pedagogical knowledge should be taken into account in the design of AI-based initiatives, which may involve the development of different digital competences on the part of both learners and educators. It should be noted that to accomplish this, every educational administration should develop its own specific policy regarding its implementation in a responsible way [35,36].

One limitation of this study lay in the fact that a full psychometric validation of the instrument was not performed. While internal consistency was assessed through Cronbach's alpha, other important indicators of construct validity—such as convergent and discriminant validity—were not examined. Similarly, advanced statistical procedures like Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), or tests for common method bias (e.g., the Unmeasured Latent Method Variable approach) were not conducted as the primary aim of the study was exploration in nature and focused on perceptions rather than instrument development. Future research should incorporate these analyses to further validate the instrument and enhance the robustness and generalizability of the findings.

In addition, this study employed descriptive statistical analyses to provide an initial exploration of pre-service teachers' perceptions of generative AI in higher education. While this approach allowed us to map general trends and identify key themes, it limits the depth of theoretical contributions that can be drawn. Advanced statistical techniques, such as MANOVA or fuzzy-set Qualitative Comparative Analysis (fsQCA), could uncover more complex relationships and interactions among variables. Future research should consider applying these or other sophisticated methods to deepen understanding and enhance the explanatory power of studies in this area.

This cross-sectional study provided information at a single point in time, reinforcing the importance of further quantitative and qualitative research on larger samples, along with more in-depth analyses at later points in time as perspectives and beliefs about the benefits and challenges of Gen-AI may evolve over time. Moreover, the research context was restricted to a specific area of Spain and to education degrees, which limits the generalizability of the results to other areas or with participants enrolled in other degrees. In this sense, replicating the study in diverse geographic or socio-economic settings (e.g., rural vs. urban institutions) or comparing results with non-faculty students (e.g., STEM students) would strengthen generalizability and enhance external validity. Additionally, expanding the scope to vocational training or adult education could demonstrate scalability beyond teacher-training contexts. Furthermore, although Gen-AI proved to be effective in promoting social studies teaching and learning, the next step in Gen-AI research should be to analyze critical questions such as the causal relationships between AI use and academic performance or the implementation of scalable strategies to mitigate dependency risks. This

should consider students' long-term attitudes and learning outcomes through longitudinal assessments (e.g., following students over several semesters). Furthermore, it would also be relevant to consider educators' views on their new roles or the extent to which a digital curriculum is implemented.

Author Contributions: Conceptualization, J.M.C.-F. and A.L.-G.; methodology, J.M.C.-F.; software, A.L.-G.; validation, J.M.C.-F., A.L.-G. and P.M.-S.; formal analysis, P.M.-S.; investigation, P.M.-S.; resources, P.M.-S.; data curation, J.M.C.-F.; writing—original draft preparation, J.M.C.-F., writing—review and editing, A.L.-G.; visualization, P.M.-S.; supervision, J.M.C.-F.; project administration, P.M.-S.; funding acquisition, P.M.-S. All authors have read and agreed to the published version of the manuscript.

Funding: This research is the result of the research project 'Methodological concepts and active learning methods for improving teaching skills' (Ministry of Science, Innovation and Universities and EU ERDF funds), grant number PGC2018-094491-B-C33, and the INNOSOCIALES innovation group. The APC was funded by this same innovation group.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, approved by the Ethics Committee of the University of Murcia (protocol code 2082/2018, 22 December 2018) for studies involving humans.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data is contained in the article.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Baidoo-Anu, D.; Ansah, L.O. Education in the era of generative artificial intelligence (AI): Understanding the potential benefits of ChatGPT in promoting teaching and learning. *J. AI* **2023**, *7*, 52–62. [CrossRef]
2. Peñalvo, F.J.G.; Ingelmo, A.V. What do we mean by GenAI? A systematic mapping of the evolution, trends, and techniques involved in Generative AI. *IJIMAI Int. J. Interact. Multimed. Artif. Intell.* **2023**, *8*, 7–16. [CrossRef]
3. Kampa, R.K. Combining technology readiness and acceptance model for investigating the acceptance of m-learning in higher education in India. *Asian Assoc. Open Univ. J.* **2023**, *18*, 105–120. [CrossRef]
4. Ayuso-del Puerto, D.; Gutiérrez-Esteban, P. La inteligencia artificial como recurso educativo durante la formación inicial del profesorado. RIED. *Rev. Iberoam. De Educ. A Distancia* **2022**, *25*, 347–358. [CrossRef]
5. Aleixo, A.M.; Leal, S.; Azeiteiro, U.M. Higher education students' perceptions of sustainable development in Portugal. *J. Clean. Prod.* **2021**, *327*, 129429. [CrossRef]
6. Han, S.; Zhang, Z.; Liu, H.; Kong, W.; Xue, Z.; Cao, T.; Shu, J. From engagement to performance: The role of effort regulation in higher education online learning. *Interact. Learn. Environ.* **2024**, *32*, 6607–6627. [CrossRef]
7. Essel, H.B.; Vlachopoulos, D.; Tachie-Menson, A.; Johnson, E.E.; Baah, P.K. The impact of a virtual teaching assistant (chatbot) on students' learning in Ghanaian higher education. *Int. J. Educ. Technol. High. Educ.* **2022**, *19*, 57. [CrossRef]
8. Lee, Y.-F.; Hwang, G.-J.; Chen, P.-Y. Impacts of an AI-based chabot on college students' after-class review, academic performance, self-efficacy, learning attitude, and motivation. *Educ. Technol. Res. Dev.* **2022**, *70*, 1843–1865. [CrossRef]
9. Bailey, D.; Southam, A.; Costley, J. Digital storytelling with chatbots: Mapping L2 participation and perception patterns. *Interact. Technol. Smart Educ.* **2021**, *18*, 85–103. [CrossRef]
10. Bender, S.M. Coexistence and creativity: Screen media education in the age of artificial intelligence content generators. *Media Pract. Educ.* **2023**, *24*, 351–366. [CrossRef]
11. Kadaruddin, K. Empowering education through Generative AI: Innovative instructional strategies for tomorrow's learners. *Int. J. Bus. Law Educ.* **2023**, *4*, 618–625. [CrossRef]
12. Binhammad, M.H.Y.; Othman, A.; Abuljadayel, L.; Al Mheiri, H.; Alkaabi, M.; Almarri, M. Investigating how generative AI can create personalized learning materials tailored to individual student needs. *Creat. Educ.* **2024**, *15*, 1499–1523. [CrossRef]
13. Chan, C.K.Y.; Hu, W. Students' voices on generative AI: Perceptions, benefits, and challenges in higher education. *Int. J. Educ. Technol. High. Educ.* **2023**, *20*, 43. [CrossRef]
14. Mittal, U.; Sai, S.; Chamola, V.; Sangwan, D. A comprehensive review on generative ai for education. *IEEE Access* **2024**, *12*, 142733–142759. [CrossRef]

15. Shahzad, M.F.; Xu, S.; Zahid, H. Exploring the impact of generative AI-based technologies on learning performance through self-efficacy, fairness & ethics, creativity, and trust in higher education. *Educ. Inf. Technol.* **2024**, *30*, 1–26. [CrossRef]
16. Marrone, R.; Taddeo, V.; Hill, G. Creativity and artificial intelligence—A student perspective. *J. Intell.* **2022**, *10*, 65. [CrossRef] [PubMed]
17. Chien, C.C.; Chan, H.Y.; Hou, H.T. Learning by playing with generative AI: Design and evaluation of a role-playing educational game with generative AI as scaffolding for instant feedback interaction. *J. Res. Technol. Educ.* **2024**, *57*, 1–20. [CrossRef]
18. Romadhon, R. Ai in language learning: English for specific purposes students' perspectives on using chatgpt for business emails. *Lingua* **2024**, *20*, 173–188. [CrossRef]
19. Lee, S.S.; Moore, R.L. Harnessing Generative AI (GenAI) for Automated Feedback in Higher Education: A Systematic Review. *Online Learn.* **2024**, *28*, 82–106. [CrossRef]
20. Cotton, D.R.; Cotton, P.A.; Shipway, J.R. Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innov. Educ. Teach. Int.* **2024**, *61*, 228–239. [CrossRef]
21. Kamenskih, A. The analysis of security and privacy risks in smart education environments. *J. Smart Cities Soc.* **2022**, *1*, 17–29. [CrossRef]
22. Giannakos, M.; Azevedo, R.; Brusilovsky, P.; Cukurova, M.; Dimitriadis, Y.; Hernandez-Leo, D.; Järvelä, S.; Mavrikis, M.; Rienties, B. The promise and challenges of generative AI in education. *Behav. Inf. Technol.* **2024**, *44*, 2518–2544. [CrossRef]
23. Lee, V.R.; Pope, D.; Miles, S.; Zárate, R.C. Cheating in the age of generative AI: A high school survey study of cheating behaviors before and after the release of ChatGPT. *Comput. Educ. Artif. Intell.* **2024**, *7*, 100253. [CrossRef]
24. Akkaş, Ö.M.; Tosun, C.; Gökçearslan, Ş. Artificial Intelligence (AI) and Cheating: The Concept of Generative Artificial Intelligence (GenAI). In *Transforming Education with Generative AI: Prompt Engineering and Synthetic Content Creation*; IGI Global: Hershey, PA, USA, 2024; pp. 182–199. [CrossRef]
25. Chan, C.K.Y.; Tsi, L.H. Will generative AI replace teachers in higher education? A study of teacher and student perceptions. *Stud. Educ. Eval.* **2024**, *83*, 101395. [CrossRef]
26. Anderson, N.; McGowan, A.; Galway, L.; Hanna, P.; Collins, M.; Cutting, D. Implementing Generative AI and Large Language Models in Education. In Proceedings of the 2023 7th International Symposium on Innovative Approaches in Smart Technologies (ISAS), Istanbul, Turkiye, 23–25 November 2023; IEEE, Catalog Number: CFP23JZ6-ART. pp. 1–6. [CrossRef]
27. Simkus, J. Convenience sampling: Definition, method and examples. *Retrieved Oktober* **2022**, *6*, 2022. Available online: https://www.simplypsychology.org/convenience-sampling.html. (accessed on 14 April 2025).
28. Bisquerra, R. *Métodos de Investigación Educativa: Guía Práctica*; Ediciones Ceac: Barcelona, Spain, 2000.
29. Kircher, R. *Research Methods in Language Attitudes*; Zipp, L., Ed.; Cambridge University Press: Cambridge, UK, 2022.
30. Costello, S.; Roodenburg, J. Acquiescence response bias—Yeasaying and higher education. *Educ. Dev. Psychol.* **2015**, *32*, 105–119. [CrossRef]
31. Mastrobattista, L.; Rico, M.M.; García, J.A.C. Optimising textual analysis in higher education studies through computer assisted qualitative data analysis (CAQDAS) with ATLAS.ti. *JOTSE* **2024**, *14*, 622–632. [CrossRef]
32. Sumakul, D.T.Y.; Hamied, F.A.; Sukyadi, D. Students' perceptions of the use of AI in a writing class. In Proceedings of the 67th TEFLIN International Virtual Conference & the 9th ICOELT 2021 (TEFLIN ICOELT 2021), Padang, Indonesia, 9–11 September 2021; Atlantis Press: Paris, France, 2022; pp. 52–57. [CrossRef]
33. Carter, L.; Liu, D.; Cantrell, C. Exploring the intersection of the digital divide and artificial intelligence: A hermeneutic literature review. *AIS Trans. Hum.-Comput. Interact.* **2020**, *12*, 253–275. [CrossRef]
34. Wolfe, R.; Mitra, T. The Impact and Opportunities of Generative AI in Fact-Checking. In Proceedings of the 2024 ACM Conference on Fairness, Accountability, and Transparency, Rio de Janeiro, Brazil, 3–6 June 2024; Association for Computing Machinery: New York, NY, USA, 2024; pp. 1531–1543. [CrossRef]
35. López-Garcia, A.; Campillo-Ferrer, J.M.; Zaragoza-Vidal, M.V.; Miralles-Sánchez, P. Analysis of an Artificial Intelligence Training Program in University Students: Perspectives and Horizons. In *Artificial Intelligence and Education: Enhancing Human Capabilities, Protecting Rights, and Fostering Effective Collaboration between Humans and Machines in Life, Learning, and Work*; Díaz-Noguera, M.D., Hervás-Gómez, C., Sánchez-Vera, F., Eds.; Octaedro: Barcelona, Spain, 2024; pp. 31–49. [CrossRef]
36. Campillo Ferrer, J.M.; Miralles Martínez, P. El uso de recursos digitales enfocados a la investigación y su efectividad en los niveles de motivación del alumnado en contextos de educación superior. In *Tecnologías Emergentes y Alfabetización Digital Para Enseñar Historia*; Sánchez-Fuster, M.C., López-García, A., Monteagudo-Fernández, J., Eds.; Octaedro: Barcelona, Spain, 2024; pp. 14–22. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.