Future Primary School Teachers' Digital Competence in Teaching Science through the Use of Social Media

Francisco Javier Robles Moral * and **Manuel Fernández Díaz**

Departamento Didáctica de las Ciencias Experimentales, University of Murcia, 30100 Murcia, Spain; manuel.fernandez2@um.es
* Correspondence: franciscojavier.moral@um.es

Abstract: The digital revolution has transformed the ways of doing, acting, and training in the university field. For this reason, as an objective of this work, social media was used to generate and share knowledge related to sustainability, classification of living beings, and the functioning of the human body. The information was collected through questionnaires, that were completed before and after the intervention program, as well as the work carried out by the students. The participants were 131 students enrolled on the Primary Education degree course of the University of Murcia. The students were well aware of social media, although initially not their educational use. This perception changed when having to make concrete proposals with Instagram and Pinterest, since students valued the wide potential of the use of these networks in teaching. As a result of this intervention, 266 images were generated on *Pinterest* related to the classification of living beings and 67 about the devices and systems of the human body. Additionally, in terms of the activity on *Instagram*, 213 publications were created, reaching 1454 followers and 7885 likes. In addition, the participants recognized social media as a source of resources for education, and therefore teachers must explore all the possibilities they offer.

Keywords: education; science; media competence

1. Introduction

The current European Higher Education Area has made it possible to adapt the learning process of students, understanding this process not only as the simple act of listening, memorization, and repetition, that is, a passive action by the students, but as an active action on the part of the students, which is based on critical reflection, problem solving, and collaboration skills among the students themselves [1,2].

Ananiadou and Claro, in 2010, Ref. [3] considered that society is based on vertiginous changes, speaking out in favor of looking for ways of working in the classroom that make it possible to be at the forefront of learning in the face of new generations, which entails the appearance of new learning and teaching environments in educational centers [4].

This initial training must be based on research of a pedagogical nature and must apply teaching techniques and learning methods for adults, adding the realization of practices, carried out during the learning process. They allow teachers opportunities to update their knowledge in relation to innovative and effective teaching methodologies, which include digital technologies [5,6].

Thus, the term innovation arises as the process that generates a change, providing added value. If it is framed in the educational field, educational innovation will develop the improvement of teaching action and, consequently, the quality of the educational system will be enhanced, which is committed to implementing educational innovation actions [7].

Digital competence (DC), according to the 2017 Higher Education Horizon Report, goes beyond understanding how to use digital technologies: It also includes the ability to understand the profound impact of technologies in a digital world and to promote

collaboration to integrate them effectively [8,9]. Based on this concept, some authors have proposed the need to define teaching digital competence (TDC), which incorporates, in addition to the technical, communicative, and multimedia literacy components, the ability to effectively use technologies in educational contexts with pedagogical criteria or, more specifically, creating environments enriched with technologies and designing and reusing digital content [10].

Girón-Escudero et al. (2019) [11] highlighted in their study the achievement of TDC, the work in the competence areas of digital content creation, focused on the development of digital content, the integration and reworking of digital content, programming, the identification of needs and technological responses, and the creative innovation and use of digital technology.

For teachers to carry out their educational work in this new scenario that society has established, training in TDC [12] is essential, being this key in two specific moments: Initial teacher training, when they must acquire all the competences for teaching performance, and in the subsequent process of continuous and permanent training, necessary for the renewal and continuous updating of teaching staff [13]. However, the way in which to approach TDC in the initial training of future teachers is still controversial [14]. In this regard, Recio-Muñoz et al. (2020) [15] pointed out that it is necessary to develop innovative pedagogical experiences whose purpose is to integrate digital technologies in the classroom.

The use of social media in the field of teaching and the recognition by students and teachers of the impossibility of ignoring the use of these digital tools in the academic field has already been described by Grover (2014) [16]. Furthermore, Hadar et al. (2020) [17] pointed out that Web 2.0 offers new creative tools for socialization, allows greater heterogeneity between groups that share activities, and offers new ways of organizing information, creating knowledge, and facilitating learning.

In 2011, Espuny et al. [18] highlighted that, although social media are very present in people's daily lives, having even changed the ways of relating to people, these networks exist separately from the educational field—specifically in university education—wasting the educational utility of these digital platforms. However, this trend is currently changing, as shown by authors such as Vázquez-Martínez and Cabero-Almenara (2015) [19] or Rodríguez, López and Martín (2017) [20], who have highlighted the positive results obtained when using social networks in the classroom as didactic tools in the field of university education.

The authors García-Ruiz, Tirado, and Hernando (2018) [21] and Manca (2020) [22] compiled various studies and works by other researchers that pointed out the strengths and opportunities of using different existing social media [23–26]. On the one hand, Tur et al. (2017) [27] showed the educational potential of these social media. In improving the academic performance of students are the works of Barajas and Álvarez (2013) [28] and those of González, Lleixà, and Espuny (2016) [29].

Said experiences of socialization through social media are largely mediated by the exchange of images, which promotes a culture toward the visual and what contributes to the transformation in the way of relating, as well as in the perception and the construction of personal identity and the sense of self [30,31].

The majority of users of social networking sites are young people (14–25 years old), who were named by Prensky (2001) [32] as "digital natives," especially represented at the moment by students in higher education. These digital natives often use social media sites to connect with their offline peers to strengthen their existing relationships, rather than building new relationships [33–35]. Social media sites might provide a potential medium to attain deeper online knowledge than conventional e-learning platforms, if educationally focused actions can be closely integrated into the use of social media sites [36]. Moreover, social networking sites allow students to highlight their experiences and talents, and to communicate and express themselves better [37].

2. Materials and Methods: Activity Design

2.1. Aims of This Work

The main aim of the study was to describe the perception of primary degree students about the acquisition of TDC through the implementation of activities in social networks. With all of this, the general objective was to identify whether students are aware of the impact that the use of these networks can have on their learning. This was concreted in the following specific objectives:

- Objective 1. Study the initial assessment of future primary school teachers of the possible educational uses of social media.
- Objective 2. Assess the changes produced among the students enrolled on the Primary Education degree program regarding the educational uses of *Instagram* and *Pinterest* after didactic intervention.

2.2. Competences

The European Higher Education Space has led to the homogenization of higher studies in Europe, establishing a homologated ECTS (European Credit Transfer System) and a competency assessment system, not rigidly restricting the autonomy of the academic world, but as a way to set benchmarks and convergence [38]. Within this framework, the aims of this work allows the development of a good number of generic key competencies (digital skills; ability to learn; communication skills; skills to work in groups; problem solving; autonomy; reflection skills; interpersonal skills; decision making; ethical commitment; critical and self-critical ability; ability to improve one's performance and learning, including the development of study and research skills; ability to analyze, summarize, evaluate, and identify problems and to propose solutions; solid knowledge of professional practice), as well as the development of the following specific competences of the area of Education Sciences [39,40]:

1. To be able to analyze educational concepts and theories and educational policy issues in a systematic way.

2. To be able to identify the potential links between knowledge and its application to educational policies and contexts.

5. To be capable of recognizing the diversity of students and the complexities of the learning process.

6. To be aware of the different contexts in which learning can take place.

7. To be aware of the different roles of those who participate in the learning process.

9. To be able to conduct educational research in different contexts.

13. To be able to evaluate educational programs and materials.

14. To be able to anticipate new educational needs and demands.

17. To be competent in various teaching/learning strategies.

19. To know the subject matter to be taught.

25. To be aware of the need for continuous professional development.

28. To be able to respond to the diverse needs of students.

29. To be able to adapt the curriculum to a specific educational context.

Although all the skills listed above were developed in this work, the focus is mainly on the acquisition of digital and media competence. This competition does not arise spontaneously with the simple consumption of media, as the vast majority of society may believe. It is especially important to develop a media education that starts from the expressive and communicative needs of students [41]. In this way, the creation and elaboration of resources allows the design and production process to be known, the functioning of information and the media to be analyzed, critical and analytical skills to be developed, creativity to be encouraged, and current technological tools to be taken advantage of [42,43].

Thus, it is necessary to develop media education through active, dialogic, creative, and playful methodologies, where students participate, while, informally contextualized and diluted among other processes, they acquire digital and media skills that allow them to develop as active and critical citizens [44–47]. However, the different research studies

carried out do not reveal the advantages and disadvantages of the development of these pedagogical models with regard to digital and media literacy in students [48].

2.3. Participants

The research was implemented with 131 students enrolled on the Primary Education degree program (University of Murcia, Spain). The students' mean age was 20.7 years (SD = 0.66) and the female gender was dominant within the sample (68.70%). Of the students, 85 were in the second grade and 46 in the fourth grade. All of the participants were studying the compulsory subjects "Teaching and Learning about the Natural Environment" (six ECTS credits) and "Nature Workshop" (three ECTS credits).

The participating pre-service teachers of the fourth grade were grouped into 15 small work teams (four to five persons), which were kept stable during the whole intervention, but the students of the second grade worked on their activity individually. Prior to the commencement of this study, the participants were informed about this research and all of them provided their approval.

2.4. Intervention Program

For the design of the intervention program, the problem-based learning approach was identified as a valuable didactic strategy, since it allows students to explore real situations—in this case, related to sustainability, the human body, and biological taxonomy.

As stated by Yin (2009) [49], the case study method is the most suitable for investigations in which it is impossible to separate the dimensions to be analyzed from their context, which is precisely what happened in this study, where the dimensions were completely contextualized.

For this reason, to determine the digital and media capacities of future Primary Education teachers that are actually students at the University of Murcia, a didactic intervention based on the use of social media was designed to address specific scientific content such as sustainability, the classification of living beings, and the functioning of the human body. These contents are a fundamental part of the official curriculum of Primary Education in the area of knowledge of the sciences for the region of Murcia. In this case, two social media networks based on the use of images were used: Pinterest and Instagram.

2.4.1. Pinterest and Educational Use

Fuente and Chaparro (2018) [50] defined *Pinterest* as a social media, which was launched in 2010 and whose use is free. These authors determined that the work of this tool allows the archiving and sharing of images and videos, accompanied by comments, the latter characteristic that differentiates it from other digital platforms, allowing the creation of an image and comment set, referred to in this application as a pin. In addition, it allows the option of cataloging or making collections of images on boards, and thus allows work more organized by ideas or themes. Additionally, a characteristic that the aforementioned authors also pointed out is the ability to develop the boards individually or collaboratively with the participation of more users who are invited to participate in the realization of these classifications.

The relationship between the educational field and *Pinterest,* according to Valdivia (2015) [51], has been developed more in libraries and universities, being in the case of the latter very limited contexts. However, in Primary Education, work proposals have been developed with this social media; thus, Grau (2014) [52] established several mathematics works in primary using this tool and justified the use of this tool due to the need to introduce the languages that schoolchildren use to today. This language is not a new language, but it is a language with a greater audiovisual load, where social media play a very relevant role. Other works that have used this social media, but in this case [53] in higher education that consisted of practicing a Social Sciences subject, used, as an element vehicle, *Pinterest* and obtained very favorable results.

In the present case, the didactic activity was carried out after developing, in the classroom, the theoretical knowledge about living beings and the functioning of the human body. To reinforce this theoretical knowledge acquired by future Primary Education teachers, it was proposed that they use *Pinterest* as a vehicle. Thus, students had to find and/or create images with which to illustrate the knowledge addressed with reference to the classification of living beings, as well as the different devices and systems of the human body and their functioning. Once the illustrations to be used had been selected, the students had to upload them to the boards created by the teacher responsible for the activity, in order to create a digital bank of images that would serve them in their future as teachers when dealing with these contents.

2.4.2. Instagram in Education

This social media network appeared in 2010 as an app for mobile phones in which users could upload and share photos and videos. Its popularization and extension of use was rapid and focused on the young population [54]. By adding the images that users want to add to their account, various tools are available to edit photos, locations can be added, and other users can be allowed access or tagged on the network. Currently, *Instagram* also allows users to send messages or publications directly to other users, in addition to recording and adding videos. In the same publication, or post, several photographs can be published—up to a maximum of 10 images—be they photographs or videos.

This work focused on the educational use of Instagram. This social network, given its eminently visual, intuitive, and simple character, is an innovative resource for education, as evidenced by works such as that of Romero-Rodríguez et al. (2020) [55]. For this reason, we used this support for the dissemination of these visual messages, complemented with texts about content related to sustainability.

The activity that was developed with *Instagram* was carried out after addressing, in the classroom, the contents related to sustainable development, environmental problems, and possible solutions. To address this issue, the students were asked to create posts for three weeks through the creation of Instagram profiles to address the issues they considered appropriate on sustainable development. In addition, to afford their posts greater visibility, they could use different hashtags to help increase the number of followers and likes.

2.5. Evaluation Instruments

In relation to objective 1, an initial questionnaire about the knowledge of the possible uses of social media was prepared and applied. For this, the students involved were given a questionnaire (Table 1) about their knowledge of social media. This initial questionnaire consisted of two blocks of questions, the first of which comprised categorization questions of the student's profile. Meanwhile, the second block addressed the students' presence and use of social media, through six closed questions. For the elaboration of this questionnaire, the one used by Alonso and Terol (2020) [56] was used as a reference, which, before being applied, was adapted to the educational environment.

In relation to objective 2, a final questionnaire was developed and applied (Table 2). This form, as per the previous one, arose from the adaptation of the questionnaire used by Robles (2020) [57]. Before its application, it was adapted to a Primary Education context and to the two social media used. The questionnaire consisted of seven closed questions in which the students had to provide their opinions on the questions asked using a Likert scale, with values from 1 (lowest value) to 4 (highest value).

Finally, we homogenized and normalized the answers in a spreadsheet, through a matrix of data that we described statistically. This allowed us to quantify and critically assess the degree of achievement of the objectives of the teaching experience, through a mixed quantitative–qualitative approach.

Table 1. Students' initial questionnaire.

1. Do you have profile on social media?	[ ] Yes [ ] No
2. If you answered yes, which social media?	[ ] Instagram [ ] Facebook [ ] Twitter [ ] Pinterest
3. Do you manage any public profile?	[ ] Yes [ ] No
4. What do you use social media for?	[ ] Information [ ] Communication [ ] Other
5. Would you use social media as an educational resource? (1 minimum and 4 maximum)	[ ] 1 [ ] 2 [ ] 3 [ ] 4
6. Are social media beneficial for the educational field?	[ ] Yes [ ] No [ ] I don't know
7. Do you follow profiles on social media about education?	[ ] Yes [ ] No
8. Do you follow profiles on social media about science education?	[ ] Yes [ ] No
9. Do you follow profiles on social media about science?	[ ] Yes [ ] No

Table 2. Students' final questionnaire.

1. Would you use the resources created in the activities?	[ ] Yes [ ] No
2. How do you value the use of social media in the classroom? (1 minimum and 4 maximum)	[ ] 1 [ ] 2 [ ] 3 [ ] 4
3. Do these activities favor your learning?	[ ] Yes [ ] No [ ] I don't know
4. Do you follow profiles on social media about education?	[ ] Yes [ ] No
5. Do you follow profiles on social media about science education?	[ ] Yes [ ] No
6. Do you follow profiles on social media about science?	[ ] Yes [ ] No
7. Do you think that it is necessary for teachers to learn to use social media for educational purposes?	[ ] Yes [ ] No

3. Results

The results obtained in the use of each of the social media were analyzed separately, as shown below.

3.1. Results Obtained in the Work with Pinterest

The activity designed for the second-year students was related to the search and/or creation of images related to the topics of classification of living beings and the devices and systems of the human body, using *Pinterest*. The results, after the three weeks of time they had to add the images to the corresponding boards, were very promising, with 333 images or "pins" were obtained, which means that the participating students contributed

an average of four pins each. These images were classified into three main groups, namely, Kingdom Animalia, Kingdom Plantae, and Human Body, as can be seen in Figure 1.
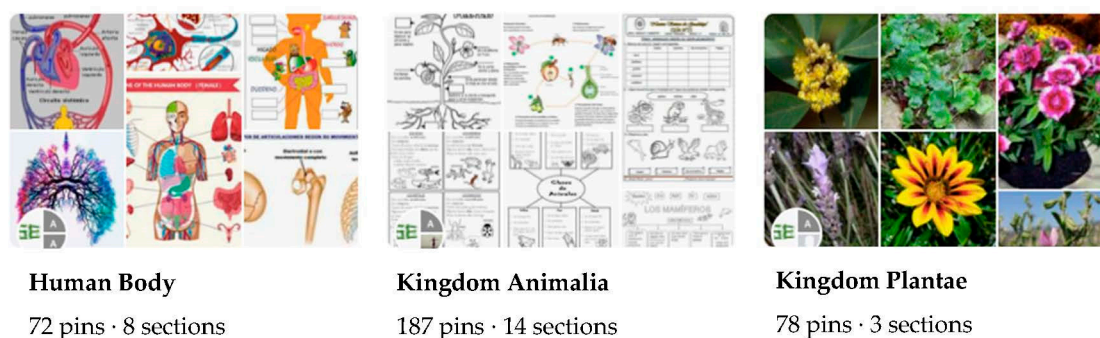

Human Body

72 pins · 8 sections

Kingdom Animalia

187 pins · 14 sections

Kingdom Plantae

78 pins · 3 sections

Figure 1. Distribution of images on boards created on Pinterest.

The group with the most contributions was that of the Animalia Kingdom (https://pin.it/2lnpNLm accessed on 12 January 2021), with 188 pins, classified into 14 sections corresponding to the taxonomies, *Phylum Porifera*; *Phylum Cnidaria*; *Phylum Nematoda*; *Phylum Annelida*; *Phylum Platyhelminthes*; *Phylum Mollusca*; *Phylum Arthropoda*; *Phylum Echinodermata*; *Phylum Chordata* (Mammalia, Reptilia, Amphibia, Aves), fishes, and autochthonous fauna. On the contrary, the group from Kingdom Plantae (https://pin.it/Y2jg9w8 accessed on 12 January 2021) had 78 images divided into three groups: *Division Bryophyta*, *Division Cormophyta,* and autochthonous flora.

The board on the human body (https://pin.it/4ShAVVE accessed on 12 January 2021) only had 68 contributions, which were divided into eight sections, which were the organs of the body, the nervous system, locomotor apparatus, the reproductive system, the respiratory system, the digestive system, the circulatory system, and the excretory system.

3.2. Results Obtained in the Work with Instagram

In the case of the fourth-year students, we worked with *Instagram*. As indicated above, these students had to generate publications related to sustainable development and possible solutions, so that when they are teachers, they can work digitally on various content. The participating students were grouped into 15 work teams (four to five persons) and for three weeks, they generated a total of 183 publications related to environmental problems. The themes most developed regarding sustainable development were those related to the textile industry, sustainable food, marine pollution, plastics, climate change, and the generation of garbage. An example of such publications is illustrated in Figure 2.

As a result of the work carried out by the students, 213 publications were generated with a total of 589 images that were uploaded to *Instagram* by the 15 work teams that were formed. These posts resulted in 7885 likes and 284 comments with a total of 1454 followers. Transferring these data to averages, we can extrapolate that a team during the three weeks of work would generate around 14 publications with an average of 39 images, assuming an average of 525 likes and approximately 19 comments and reaching an average of close to 97 followers (Table 3).

Table 3. Summary of the results of the *Instagram* posts.

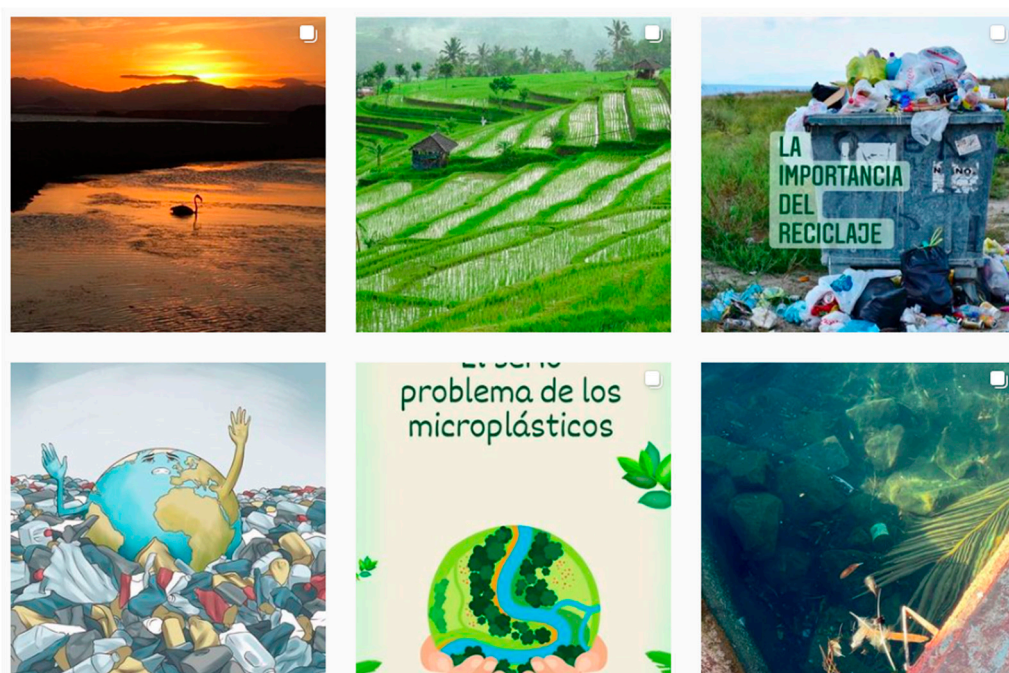|	Posts	Likes	Images	Hashtags	Comments	Followers
$\overline{X}$	14.2	525.7	39.3	108.0	18.9	96.9
Σ	213	7885	589	1620	284	1454

Figure 2. Examples of Instagram posts: #talleresnaturalezasostenible2021.

3.3. Degree of Achievement of the Objectives Based on the Knowledge Evaluation Questions

To determine if the educational intervention based on the use of social media to teach scientific content had any effect on the participants, two questionnaires were carried out. The initial one was intended to determine the starting point of this work, while the second was carried out after the didactic intervention.

As a starting point, 98.5% of the participants had an account on a social media, the most used being *Instagram*, with 87% of the participants having an account on this social media, followed by *Facebook* with 73.3%. Although, at the management level, the percentage of participants who were active on social media decreased to 79.4% of the participants. Regarding their reason for using social media (Figure 3), a large proportion of the participants (*n* = 71) recognized that their use of social media was for staying informed; meanwhile, only 33 of the participants used social media to communicate with other people.

When the participants were asked about the educational use of social media (Figure 4), a variation was observed between the moments before and after developing the activities. These variations were positive, with the perception of the educational value of social media being higher after the activities, increasing by approximately 8.4%.

Another variation that occurred between the initial and final questionnaires was the number of participants who followed an account linked to the field of education, science teaching or science itself. As can be seen in Figure 5, this variation was a positive increase, especially in the science accounts, which increased by 57 participants. There was also a positive increase of 48 participants in the followers of accounts on science education.

Finally, when asking the students if the use of social networks in this didactic intervention has favored their learning, 71.8% of the participants answered affirmatively, so there is a clear direct relationship between knowledge and the environment in which they are taught. A relationship exists between digital skills and social–emotional skills. When students were asked if they would use the created resources in future lessons, 93.9% of the participants answered that they would use them. From this, it follows that future teachers attach great importance to these materials for their future teaching practice in the field of Natural Sciences and sustainability.
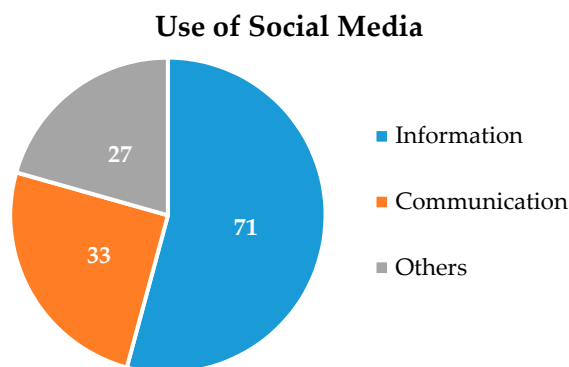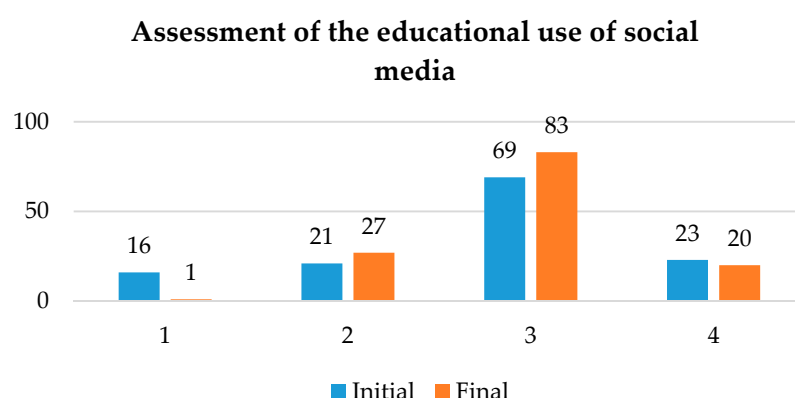
Use of Social Media

Figure 3. Use of social media by future teachers.

Assessment of the educational use of social media

Figure 4. Assessment of the educational use of social media.
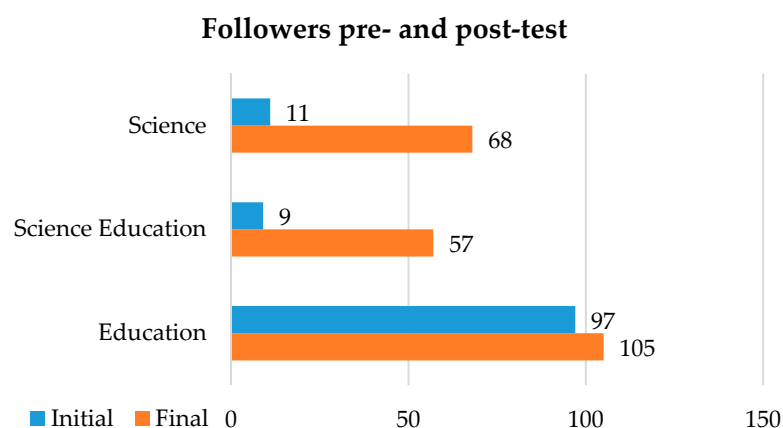
Followers pre- and post-test

Figure 5. Followers of the different profiles about education, science, and science education.

4. Discussion of an Implemented Experience

As has been seen, the involvement of the students with activity on *Pinterest* was high, but although developing this activity does not ensure learning, [58], the use of technological resources is not a sign that quality learning is being carried out, but rather depends on how teachers incorporate them into their educational environments [59], an aspect that we consider adequate in view of the results obtained.

In this regard, the students greatly valued the use of *Instagram* as a valid didactic resource, because in addition to being a highly motivating element, it manages to integrate the knowledge to be addressed with great ease. These results are in agreement with those obtained by González et al. (2020) [60], in which it was recognized, in a similar way to that

of this work, that the use of information and communication technology resources, such as social networks, is very valid for covering issues related to the teaching of science.

In addition to the positive assessment of the networks as a teaching resource, the participants recognized that in order to bring social media to the educational field, both initial and continuous training is very necessary. These data can be understood by assuming that young teachers in training belong, for the most part, to what Herrero-Diz et al. (2016) [61] called "Millennials", "Digital Natives", "Generation Y", "Generation Z", "Google Generation", "Interactive Generation", "App Generation", or "Selfie Generation". The common link between all of the different denominations of this generation, which would include people born from 1990 onward, is the fondness and interest in technology and its use in the development of everyday life [62].

Therefore, it is currently important to understand the role of prosumers (producer–consumer) that we develop in technological society and to promote digital literacy to acquire consumer strategies and the creation of information on the web [63,64], since it is insufficient to have the necessary tools to be able to produce information if the capacity to carry out this communication effectively is not acquired [65,66].

A global vision of the results leads us to agree with Esteve et al. (2014) [67] about the fact that future teachers should not only acquire TDC, but that it is extremely necessary that they develop skills associated with this competence, such as teaching digital skills to their future students [68] or how to generate digital content, especially visual, which allows them to obtain the necessary didactic strategies to carry out the teaching–learning process [69]. In this way, the use of social networks such as *Instagram* and *Pinterest* can foster creativity and the use of the image as a vehicle for expression by university students, as stated by Dumas et al. (2017) [70] and Cabero-Almenara (2020) [71]. In this aspect, we consider it very relevant that, after the work carried out with social media [72], the students of the degree involved herein were so favorable toward the use of social media as an instrument of schoolwork.

In relation to the acquisition of scientific knowledge, the students participating in this work recognized that the use of social media favored their learning, both of environmental problems and possible solutions related to sustainable development, as well as developed their understanding of the taxonomy of living beings and the functioning of the human body. This situation is related to the one defended by Van Dijck and Poell (2018) [73].

In short, we agree with the idea that generation Z [74] is a prosumer of social media but lacks the necessary tools and knowledge to be able to take advantage of the use of information and communication technologies, as well as technology for learning and knowledge [75].

5. Conclusions

To conclude, it should be remembered that, in the specific case of science teaching, the existing barrier between knowledge and its didactics must be overcome. Additionally, future primary school teachers must make use of all existing educational tools to overcome the obstacles that arise in science teaching. For this reason, Pinterest and Instagram can become didactic resources for science education and our duty as teachers is to try to explore all the possibilities of the media and resources at our disposal.

Thus, in order to make an adequate didactic use of social networks, future primary school teachers must acquire and be able to develop the TDC. Additionally, for these current students, belonging to the google generation, in their training as future teachers, they have to experiment and analyze activities in which they put this competence into practice and, therefore, interact with social media from the point of view of the education.

Therefore, in the teaching field, we propose, in future research, to continue addressing the methodologies, tools, and dynamics that allow teachers in training to improve their skills in digital, communicative, and scientific matters.

References

1. Cimadomo, G. Utilización de la aplicación Pinterest en la asignatura de Historia de la Arquitectura, en el marco del EEES. *Digit. Educ. Rev.* **2016**, *29*, 181–192.
2. Baeten, M.; Struyven, K.; Dochy, F. Student-centred teaching methods: Can they optimise students' approaches to learning in professional higher education? *Stud. Educ. Eval.* **2013**, *39*, 14–22. [CrossRef]
3. Ananiadou, K.; Claro, M. *21st Century Skills and Competences for New Millennium Learners in OECD Countries*; Organisation for Economic Co-Operation and Development (OECD): Pairs, France, 2010.
4. Bernate, J.; Vargas, J. Challenges and trends of the 21st century in higher education. *Rev. Cienc. Soc.* **2020**, *26*, 141–154.
5. Hatlevik, I.K.; Hatlevik, O.E. Examining the Relationship between Teachers' ICT Self-Efficacy for Educational Purposes, Collegial Collaboration, Lack of Facilitation and the Use of ICT in Teaching Practice. *Front. Psychol.* **2018**, *9*, 935. [CrossRef]
6. Tondeur, J.; Aesaert, K.; Pynoo, B.; Van Braak, J.; Fraeyman, N.; Erstad, O. Developing a validated instrument to measure preservice teachers' ICT competencies: Meeting the demands of the 21st century. *Br. J. Educ. Technol.* **2015**, *48*, 462–472. [CrossRef]
7. Monge, C.; Gómez, P. *Innovando la Docencia Desde la Formación del Profesorado. Propuestas y Realidades*; Síntesis: Madrid, Spain, 2018.
8. Lucas, M.; Bem-Haja, P.; Siddiq, F.; Moreira, A.; Redecker, C. The relation between in-service teachers' digital competence and personal and contextual factors: What matters most? *Comput. Educ.* **2021**, *160*, 104052. [CrossRef]
9. Cuartero, M.D.; Espinosa, M.P.P.; Porlán, I.G. Certificación de la Competencia Digital Docente: Propuesta para el profesorado universitario. *RIED. Rev. Iberoam. Educ. Distancia* **2019**, *22*, 187–205. [CrossRef]
10. Prendes, M.P.; Gutiérrez, I.; Martínez, F. Competencia digital: Una necesidad del profesorado universitario en el siglo XXI. *Rev. Educ. Distancia* **2018**, *56*, 1–22. [CrossRef]
11. Girón-Escudero, V.; Cózar-Gutiérrez, R.; González-Calero Somoza, J.A. Análisis de la autopercepción sobre el nivel de competencia digital docente en la formación inicial de maestros/as. *Rev. Electrón. Interuniv. Form. Prof.* **2019**, *22*, 193–218. [CrossRef]
12. Ministerio de Educación y Formación Profesional. *Marco estratégico Educación y Formación 2020 (ET2020)*; Erydice: Madrid, España, 2020.
13. Muñoz-Repiso, A.G.-V.; Del Pozo, M.M. Do primary school teacher graduates feel prepared to face the teaching profession? *Bordón. Rev. Pedagog.* **2016**, *68*, 69. [CrossRef]
14. Pöntinen, S.; Räty-Záborszky, S. Pedagogical aspects to support students' evolving digital competence at school. *Eur. Early Child. Educ. Res. J.* **2020**, *28*, 182–196. [CrossRef]
15. Muñoz, F.R.; Quiroz, J.S.; Marchant, N.A. Análisis de la Competencia Digital en la Formación Inicial de estudiantes universitarios: Un estudio de meta-análisis en la Web of Science. *Pixel-Bit Rev. Medios Educ.* **2020**, *59*, 125–146. [CrossRef]
16. Grover, V.K. Social Media as an educational tool: Opportunities and challenges. *Int. J. Innov. Res. Stud.* **2014**, *3*, 269–282.
17. Hadar, L.L.; Ergas, O.; Alpert, B.; Ariav, T. Rethinking teacher education in a VUCA world: Student teachers' social-emotional competencies during the Covid-19 crisis. *Eur. J. Teach. Educ.* **2020**, *43*, 573–586. [CrossRef]
18. Espuny, C.; González, J.; Lleixà, M.; Gisbert, M. Actitudes y expectativas del uso educativo de las redes sociales en los alum-nos universitarios. *Rev. Univ. Soc. Conoc.* **2011**, *8*, 171–185. [CrossRef]
19. Vázquez-Martínez, A.I.; Cabero-Almenara, J. Las redes sociales aplicadas a la formación. *Rev. Complut. Educ.* **2015**, *26*, 253–272. [CrossRef]
20. Rodríguez, M.R.; López, A.; Martín, I. Percepciones de los estudiantes de Ciencias de Educación sobre las redes sociales como metodología didáctica. *Pixel-Bit Rev. Medios Educ.* **2017**, *50*, 77–93. [CrossRef]
21. García-Ruiz, R.; Morueta, R.T.; Gómez, A.H. Redes sociales y estudiantes: Motivos de uso y gratificaciones. Evidencias para el aprendizaje. *Aula Abierta* **2018**, *47*, 291–298. [CrossRef]
22. Manca, S. Snapping, pinning, liking or texting: Investigating social media in higher education beyond Facebook. *Internet High. Educ.* **2020**, *44*, 100707. [CrossRef]

23. Fox, A.; Bird, T. Any use? What do we know about how teachers and doctors learn through social media use? *Qwerty Open Interdiscip. J. Technol. Cult. Educ.* **2017**, *12*, 64–87.

24. Greenhow, C.; Askari, E. Learning and teaching with social network sites: Adecade of research in K-12 related education. *Educ. Inf. Technol.* **2017**, *22*, 623–645. [CrossRef]

25. Rodríguez-Hoyos, C.; Salmón, I.H.; Fernández-Díaz, E. Research on SNS and education: The state of the art and its challenges. *Australas. J. Educ. Technol.* **2015**, *31*, 100–111. [CrossRef]

26. Selwyn, N.; Sterling, E. Social media and education: Now the dust has settled. *Learn. Media Technol.* **2016**, *41*, 1–5. [CrossRef]

27. Tur, G.; Marín-Juarros, V.; Carpenter, J. Using Twitter in Higher Education in Spain and the USA. *Comunicar* **2017**, *25*, 19–28. [CrossRef]

28. Barajas, F.; Álvarez, C. Uso de Facebook como herramienta en la enseñanza del área de naturales en el grado undécimo de educación media vocacional. *Pixel-Bit Rev. Medios Educ.* **2013**, *42*, 143–156.

29. Martínez, J.G.; Fortuño, M.L.; Vidal, C.E. Las redes sociales y la educación superior: Las actitudes de los estudiantes universitarios hacia el uso educativo de las redes sociales, de nuevo a examen. *Educ. Knowl. Soc.* **2016**, *17*, 21–38. [CrossRef]

30. Russmann, U.; Svensson, J. Introduction to Visual Communication in the Age of Social Media: Conceptual, Theoretical and Methodological Challenges. *Media Commun.* **2017**, *5*, 1–5. [CrossRef]

31. Kali, Y.; Baram-Tsabari, A.; Schejter, A. *Learning in a Networked Society: Spontaneous and Designed Technology Enhanced Learning Communities*; Springer International Publishing: Cham, Switzerland, 2019.

32. Prensky, M. Digital natives, digital Immigrants Part 1. *Horizon* **2001**, *1*, 1–6. [CrossRef]

33. Boyd, D.M.; Ellison, N.B. Social Network Sites: Definition, History, and Scholarship. *J. Comput. Commun.* **2007**, *13*, 210–230. [CrossRef]

34. Subrahmanyam, K.; Reich, S.M.; Waechter, N.; Espinoza, G. Online and offline social networks: Use of social networking sites by emerging adults. *J. Appl. Dev. Psychol.* **2008**, *29*, 420–433. [CrossRef]

35. Srivasa, A.; Shakya, A.K.; Kumar, A. Boronate affinity chromatography of cells and biomacromolecules using cryogel matrices. *Enzyme Microb. Technol.* **2012**, *51*, 373–381. [CrossRef]

36. EHES. European Higher Education Space. Available online: http://www.eees.es/es/eees-estructuras-educativas-europeas (accessed on 30 January 2021).

37. Chai, C.S.; Tan, L.; Deng, F.; Koh, J.H.L. Examining pre-service teachers' design capacities for web-based 21st century new culture of learning. *Australas. J. Educ. Technol.* **2016**, *33*, 129–142. [CrossRef]

38. González, J.; Wagenaar, R. *Tuning Educational Structures in Europe II*; University of Deusto: Bilbao, Spain, 2006.

39. Martínez-Hernández, C.; Yubero, C. Explaining Urban Sustainability to Teachers in Training through a Geographical Analysis of Tourism Gentrification in Europe. *Sustainability* **2019**, *12*, 67. [CrossRef]

40. Aparici, R.; Campuzano, A.; Ferrés, J.; Matilla, A.G. La Educación Mediática en la Escuela 2.0. Ph.D. Thesis, University of Valladolid, Valladolid, Spain, 2010.

41. Aguaded, J.I.; Marín, I.; Díaz, E. La alfabetización mediática entre estudiantes de primaria y secundaria en Andalucía (España) [Media literacy between primary and secondary students in Andalusia (Spain)]. *Rev. Iberoam. Educ. Distancia* **2015**, *18*, 275–298.

42. Ferrés, J.; García, A.; Aguaded, J.I.; Ferández, J.; Figueras, M.; Blanes, M. *Competencia Mediática. Investigación Sobre el Grado de Competencia de la Ciudadanía en España*; INTEF: Madrid, Spain, 2011.

43. Caldevilla, D. The Challenges of the TICs' Age: Digital Natives versus Inmigrants. *Comun. Medios* **2011**, *23*, 23–36.

44. Ferrés, J.; Piscitelli, A.; Ferr, J. Media Competence. Articulated Proposal of Dimensions and Indicators. *Comunicar* **2012**, *19*, 75–82. [CrossRef]

45. Zeng, Q.-S.; Li, C.-F.; Liu, H.; Zhen, J.-H.; Feng, D.-C. Distinction between Recurrent Glioma and Radiation Injury Using Magnetic Resonance Spectroscopy in Combination with Diffusion-Weighted Imaging. *Int. J. Radiat. Oncol.* **2007**, *68*, 151–158. [CrossRef] [PubMed]

46. Wilson, C.; Grizzle, A.; Tuazon, R.; Akyempong, K.; Cheung, C. *Alfabetización Mediática e Informacional: Curriculum Para Profesores*; UNESCO: Paris, Fracnce, 2011.

47. Díaz, M.J.S.; Martín, R.F.P. Flipped classroom para adquirir la competencia digital docente: Una experiencia didáctica en la Educación Superior. *Pixel-Bit Rev. Medios Educ.* **2018**, *52*, 37–54. [CrossRef]

48. Yin, R.K. *Case Study Research: Desing and Methods*; SAGE Publications: Thousand Oaks, CA, USA, 2009.

49. Fuente, M.M.; Chaparro, A. Uso de redes sociales en la formación inicial del profesorado. Una experiencia de innovación docente con Pinterest. In *Innovación Educativa y Formación Docente*; Escarbajal, A., López, D., Hernández, M.C., Chamseddine, M., Eds.; Universidad de Murcia: Servicio de Publicaciones: Murcia, España, 2018; pp. 121–133.

50. Valdivia, P. Usos didácticos de Pinterest en la escuela y en la Universidad. *Comun. Pedagog. Nuevas Tecnol. Recur. Didáct.* **2015**, *283–284*, 19–23.

51. Grau, C. Las matemáticas con Pinterest. *Aula Innov. Educ.* **2014**, *228*, 63–64.

52. Roig-Vila, R. (Ed.) *El Compromiso Académico y Social a Través de la Investigación e Innovación Educativas en la Enseñanza Superior*; Editorial Octaedro: Barcelona, España, 2018.

53. Hu, G.; Duan, Y. Questioning and responding in the classroom: A cross-disciplinary study of the effects of instructional me-diums in academic subjects at a Chinese university. *Int. J. Biling. Educ. Biling.* **2019**, *22*, 303–321. [CrossRef]

54. Romero-Rodríguez, J.-M.; Rodríguez-Jiménez, C.; Navas-Parejo, M.R.; Marín-Marín, J.-A.; Gómez-García, G. Use of Instagram by Pre-Service Teacher Education: Smartphone Habits and Dependency Factors. *Int. J. Environ. Res. Public Health* **2020**, *17*, 4097. [CrossRef]

55. López, N.A.; Bolinches, R.T. Alfabetización transmedia y redes sociales: Instagram como herramienta docente en el aula universitaria. *Icono 14* **2020**, *18*, 138–161. [CrossRef]

56. Robles, F.J. Didáctica de las Ciencias Experimentales y las TIC: Una experiencia didáctica con Pinterest en la formación de futuros docentes de primaria. *Univ. Tarracon. Rev. Ciènc. l'Educ.* **2020**, *2*, 7–20. [CrossRef]

57. Luján, M.; Salas, F. Enfoques teóricos y definiciones de la tecnología educativa en el siglo XX. *Actual. Investig. Educ.* **2009**, *9*, 1–2.

58. Torres, P.C.; Cobo, J.K. Tecnología educativa y su papel en el logro de los fines de la educación. *Educere* **2017**, *21*, 31–40.

59. González, F.; Castaño-Calle, R.; De Castro, R. Environmental education mediated by ICT. Towards the goals of sustainable development. *Actas Congr. Int. Virtual USATIC* **2020**, *2020*, 157–158.

60. Herrero-Diz, P.; Andalucía, U.U.L.; Ramos-Serrano, M.; No, J. Los menores como usuarios creadores en la era digital: Del prosumer al creador colaborativo. Revisión teórica 1972–2016. *Rev. Lat. Comun. Soc.* **2016**, *71*, 1301–1322. [CrossRef]

61. Kymäläinen, T.; Seisto, A.; Malila, R. Generation Z Food Waste, Diet and Consumption Habits: A Finnish Social Design Study with Future Consumers. *Sustainability* **2021**, *13*, 2124. [CrossRef]

62. Pérez-Escoda, A.; Castro-Zubizarreta, A.; Fandos-Idago, M. La competencia digital de la Generación Z: Claves para su introducción curricular en la Educación Primaria. *Comunicar* **2016**, *24*, 71–80. [CrossRef]

63. Romney, M.; Johnson, R.G. Show me a story: Narrative, image, and audience engagement on sports network Instagram accounts. *Inf. Commun. Soc.* **2018**, *23*, 94–109. [CrossRef]

64. Masanet, M.J.; Ferrés, J. La enseñanza universitaria española en materia de educación mediática. *Rev. Commun. Pap.* **2013**, *2*, 83–90. [CrossRef]

65. Triviño-Cabrera, L.; Chaves-Guerrero, E.I.; Alejo-Lozano, L. The Figure of the Teacher-Prosumer for the Development of an Innovative, Sustainable, and Committed Education in Times of COVID-19. *Sustainability* **2021**, *13*, 1128. [CrossRef]

66. Rambe, P.; Mkono, M. Appropriating WhatsApp-mediated postgraduate supervision to negotiate "relational authenticity" in resource-constrained environments. *Br. J. Educ. Technol.* **2019**, *50*, 702–734. [CrossRef]

67. Esteve, F.; Adell, J.; Gisbert, M. Diseño de un entorno 3D para el desarrollo de la competencia digital docente en estudiantes universitarios: Usabilidad, adecuación y percepción de utilidad. *RELATEC Rev. Latinoam. Tecnol. Educ.* **2014**, *13*, 35–47. [CrossRef]

68. Starcic, A.I.; Terlević, M.; Lin, L.; Lebenicnik, M. Designing Learning for Sustainable Development: Digital Practices as Boundary Crossers and Predictors of Sustainable Lifestyles. *Sustainability* **2018**, *10*, 2030. [CrossRef]

69. Dumas, T.M.; Maxwell-Smith, M.; Davis, J.P.; Giulietti, P.A. Lying or longing for likes? Narcissism, peer belonging, loneliness and normative versus deceptive like-seeking on Instagram in emerging adulthood. *Comput. Hum. Behav.* **2017**, *71*, 1–10. [CrossRef]

70. Juškevičienė, A.; Dagienė, V. Computational Thinking Relationship with Digital Competence. *Inform. Educ.* **2018**, *17*, 265–284. [CrossRef]

71. Cabero-Almenara, J.; Barroso-Osuna, J.; Rodríguez-Gallego, M.; Palacios-Rodríguez, A. La Competencia Digital Docente. El caso de las universidades andaluzas. *Aula Abierta* **2020**, *49*, 363–372. [CrossRef]

72. Barrot, J.S. Facebook as a learning environment for language teaching and learning: A critical analysis of the literature from 2010 to 2017. *J. Comput. Assist. Learn.* **2018**, *34*, 863–875. [CrossRef]

73. Van Dijck, J.; Poell, T.; Burgess, J.; Marwick, A. Social Media Platforms and Education. In *The SAGE Handbook of Social Media*; Burgess, J., Marwick, A., Poell, T., Eds.; SAGE Publications Pvt Ltd.: London, UK, 2018; pp. 579–591.

74. Fernández-Cruz, F.-J.; Fernández-Díaz, M.-J. Generation Z's teachers and their digital skills. *Comunicar* **2016**, *24*, 97–105. [CrossRef]

75. Waycott, J.; Thompson, C.; Sheard, J.; Clerehan, R. A virtual panopticon in the community of practice: Students' experiences of being visible on social media. *Internet High. Educ.* **2017**, *35*, 12–20. [CrossRef]