

Article

Twitter in Initial Teacher Training: Interaction with Social Media as a Source of Teacher Professional Development for Social Studies Prospective Educators

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Abstract: The use of social media is now as prevalent as ever, and its educational ramifications still need to be fully explored, especially in initial teacher training. The aim of this study is to analyze social studies prospective teachers' perceptions regarding the usefulness of social media for teacher professional development, and to generate communication, learning and engagement. This research also has the objective of exploring the effects of an intervention during an academic semester with three different groups of university students, applying a didactic strategy based on the use of Twitter, monitoring the interventions of 122 participants. A quantitative analysis was used to process the information obtained using questionnaires as well as the data obtained using MSocial, a tool for Social Network Analysis (SNA). Results indicate that, while pre-service teachers are not necessarily skeptical of the potential of social media for educational purposes, systematic interventions that promote interaction can positively affect their perception of the usefulness of social media. Results also show that the group where prospective educators interacted among themselves the most using Twitter during the interventions was the one that showed a significant increase in prospective teachers' perception of the educational potential of social media.

Keywords: education; social studies education; initial teacher training; social media; Twitter; teacher professional development



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1. Introduction

In recent times, and all corners of the planet, thanks to the unstoppable development of technology and telecommunications, citizens have witnessed a significant change in the use of digital media. Increasingly accessible and adapted to a non-specialized public, technology has become an essential element in our daily lives, where research and development (R&D) and information technologies play a key role. In this context, social media has defined new forms of communication that are more in line with today's reality, shaping a hyperconnected world where all citizens can participate in the way they prefer, freely and equally, regardless of their personal or professional characteristics, whether they are specialists or not. In fact, that is one of its main strengths, as it allows the transmission of information in real time, connecting with the latest stories, ideas and news [1]. In this sense, Twitter and other social media have changed the way we understand and practice network communication, building upon a trend that blogs began years ago, becoming, using just a few characters (140 at the beginning and 280 today) and from our cell phones, an artifact "in which the culture of our time is distilled" [2] (p. 11).

All these transformations have given rise to interesting debates in the educational field about invisible learning [3], expanded education experiences as generators of essential skills for citizenship, such as collaboration and critical thinking [4], and the necessary adaptation of teaching developed in formal contexts to the demands of today's society. In fact, we cannot ignore that schoolchildren in the classroom are sometimes considered digital natives: this could be the case for those students currently training at university to become teachers. They constitute the net-generation, who incorporate technology into their daily lives and assume computer networks as their second home [5]. New techniques can facilitate the connection between people and, therefore, the transmission of information, but can also mobilize and adapt learning to the demands of the digital era. Although the individual is the starting point of knowledge, they can provide new potential learning to its components when they become part of a network [6], in a rapid and continuous process that requires the development of critical skills to distinguish reliable and truthful information from that which lacks enough quality.

This poses an important challenge to educational systems that teachers, researchers, academic institutions and other agents involved in education are trying to face with different initiatives. These proposals, although they have been progressively increasing since the beginning of the 21st century, were definitely boosted from the presentation, in 2013, of the European agenda to promote innovative and high-quality teaching and learning through new technologies and digital content [7,8]. Progressively, both elements have been present in the classrooms at different educational stages, including higher education, where the use of webquests, blogs, wikis, video games, augmented reality, apps and many other resources are defining new teaching strategies based on technologies.

1.1. Social Media and New Technologies: Challenges and Opportunities for Educators

This growing interest in the integration of technology in education has led to focus part of the attention on ICT training for those preparing to become teachers, giving rise to an interesting scientific production whose growth in the last decade has been exponential [9]. Some of these studies deal with prospective teachers at different specific educational stages, including Early Childhood Education, where there are also numerous possibilities for technology integration [10]. Among others, it is possible to highlight the study by Romero-Tena et al. [11], which shows how a continuous training process throughout an academic semester can improve how pre-service Early Childhood Education teachers perceive their own digital teaching competence.

Other studies address how to incorporate ICT in education in specific scientific fields and areas of knowledge. Among these, it is worth highlighting those that focus on social studies initial teacher training, including those focused on social studies Secondary Education, which signal how a systematic intervention can help prospective teachers develop their digital competence [12]. Other studies also try to explore the possibilities offered by learning environments with digital or emerging technologies [13] or, more specifically, particular resources such as augmented reality [4,14] or video games [15–17].

In this context of adaptation of teacher training to digital society, a concern about the use of social media in teaching has recently emerged among educators and researchers [18]. Although there are still many teachers who are not receptive to its use in the classroom [19], the number of global studies that have addressed the use of social media in teaching, in both formal and informal settings, has not stopped growing [20]. Such studies reveal the educational potential of these networks, and specifically of Twitter, not only for students (favoring their learning, motivation, engagement and communication), but also for teachers, who find in these tools a support for their interventions in the classroom and their own professional development [20–22].

Fostering an identity as educators is a key aim of initial teacher training, with the intention of allowing prospective educators to face their professional development with a vision of the future open to potential changes. The professional development of teachers is defined by the search for a better professionalism, and is related, among other aims, to

their own professional motivation, interest in their own training, as well as involvement in innovative projects [23]. In fact, the participation of prospective teachers in training activities that open up training perspectives and networking can improve their future teaching performance.

The research focused on the professional use of Twitter by active teachers in different contexts confirms, in fact, its potential to forge a collaborative network among teaching professionals, to share concerns and, above all, materials, resources and innovative didactic proposals that can foster the development of personal and professional learning [1,24]. Networks, therefore, reinforce an emerging model of online collaboration to improve skills, competencies and values implicit in the professionalization of teachers [25], something that has been promoted, for some years now, by different educational centers and teachers.

In the framework of higher education, the use of Twitter has been associated with an improvement in learning, based on interactions among participants, something which can be monitored and measured with tools specifically designed within Moodle [26]. In the scientific literature focused on the use of Twitter in initial teacher training, it is possible to find interesting works that have confirmed the possibilities offered by Twitter to favor trainee teachers, not only in the development of their communication skills, but also with critical and reflective learning [27–29], and generate attitudes of social commitment in social studies trainee teachers [30]. Prospective teachers, as noted by Rodríguez et al. [31], recognize that, despite the distractions they can generate, social media is a way for socialization, following websites and people who provide updated information on professional topics, and sharing and creating knowledge. Therefore, it is not surprising that many of them, particularly those in Early Childhood Education, according to this same study [31], demand specific training to know how to use them in their professional development. As confirmed by different studies [10,25], the factor that influences the most use of ICT by teachers is, above all, their training, experience and attitude towards them, and not so much the material and technological resources available.

1.2. Aims and Research Questions

After outlining the influence of social media in education, and how current research has approached this issue in different ways, this study intends to focus on initial teacher training, and specifically on social studies pre-service teachers. For this reason, the main aim of this research is to analyze the way prospective educators think about social media and its educational potential, focusing on four specific categories: teacher professional development, as well as the usefulness of social media to promote communication, learning and, last of all, engagement. The study aims to explore, using a comparative approach, the effect of specific teaching interventions in a university setting, examining the way participants' perceptions regarding social media can transform after an academic semester when a systematic didactic strategy based on the use of Twitter was implemented. To accomplish this, this study seeks to answer the following research questions:

1. What was the level of interaction using Twitter of the different groups of prospective teachers after the interventions, as monitored by the tool used for the research?
2. How do social studies prospective teachers perceive the educational potential of social media attending to four categories: teacher professional development, communication, learning and engagement?
3. What were the effects on said categories of the use of social media during an academic semester?
4. Did a higher level of interaction and systematic application of the didactic strategy based on the educational use of Twitter favor prospective teachers' perception of the educational potential of social media?

After analyzing the data that was obtained before and after the interventions with different groups, as further described in the sections below, a series of conclusions can be highlighted. Firstly, the results indicate that pre-service teachers were usually aware of the usefulness of social media for educational purposes, but all the categories analyzed

showed significant improvement after a semester in those groups in which interaction was higher. Secondly, the contrast between groups indicates that didactic strategies and the teaching approach that was used were very relevant, and improvement took place only in the group in which these strategies were systematically applied. Consequently, results show the key role that initial teacher training can have in making prospective educators aware of the potential of social media in education, and how a systematic approach can help foster teacher professional development among pre-service teachers.

2. Materials and Methods

The following study adopted a quantitative methodological approach to analyze prospective educators' perceptions and examine the potential effects of the interventions, as well as quantify the level of interaction using the social media of the different groups of participants who took part in the research. The quantitative tradition is one of the main approaches to educational research [32,33] and can be helpful in establishing comparisons between and among groups and determining potential transformations regarding their perception of different categories. For this particular study, the research followed a pretest-posttest quasi-experimental design [34] with three different groups in which a didactic strategy based on the use of Twitter was implemented, according to different conditions. In addition to the examination of potential contrast before and after the interventions, a comparison between the groups was also established to determine differences and similarities regarding the different categories that were established in this study. Finally, as previously indicated, a quantitative approach was also used to obtain information regarding the level of interaction among participants using Twitter during the semester, making use of a specific tool integrated into Moodle to generate aggregate data and detect specific connections.

2.1. Context and Participants

The fieldwork took place in the 2019–2020 academic year, with prospective teachers enrolled in the bachelor's degree in Early-Childhood Education at the Faculty of Education and Social Work in Valladolid and the Faculty of Education in Palencia, both of them part of the University of Valladolid. Participants were enrolled in the subject Social Studies Curricular Development, which is taught during the third year (sixth academic semester) of the bachelor's degree. Participants included a total of 122 pre-service teachers, distributed into three different groups: two of them in the Valladolid campus (47 participants enrolled in Group 1 and 32 enrolled in Group 3), and another one (Group 2, with a total of 43 participants), in the Palencia campus.

In order to monitor trainee teachers' interactions using Twitter, they were asked to register as users in a Moodle course specifically created for this research, and in which the MSocial tool was integrated. This tool was designed to measure and quantify user involvement and the social interactions generated in social media [26]. This tool allows the professor in charge of the course to visualize and easily analyze the engagement and participants' social interaction by tracking their activity in social media (both inside and outside Moodle), by calculating metrics for Social Network Analysis (SNA) and promptly displaying results in the Moodle course. In that course, and by making use of an activity specifically created for this purpose, participants were able to link their own Twitter accounts to the Moodle course, authorizing MSocial to track their activity in said network. This allowed us to track the activity of their accounts using a series of predetermined hashtags which were linked to this particular subject. Additionally, the number of tweets that were generated, as well as the retweets, replies and likes to other trainee teachers' tweets were also monitored, including interactions with their professors.

Prospective teachers were also asked to respond to a questionnaire to collect their opinions on the educational use of social networks, something that will be described in the following sections. Participants in all groups complimented the questionnaire at the beginning of the academic semester, before introducing the interventions, and at the

end of the semester. The questionnaire was the same at both points in time, to observe possible changes in the students' perceptions before and after the implementation of the didactic strategy. In total, 108 paired-samples responses were collected out of the 122 students participating in the study, by answering the questionnaire at the beginning and after finishing the intervention.

2.2. Description of the Interventions

The study presented here is part of the line of work that has been developed at the University of Valladolid for some years to implement social media in initial teacher training. This initiative was granted official institutional support in the academic year 2019–2020 with the concession of a Teaching Innovation Project from the University of Valladolid (Teaching Strategies and Quantification of Social Media in University Teaching) in which researchers from the Faculty of Education and Higher Technical School of Telecommunications Engineering combined efforts. This project focuses on the application and assessment of social media in social studies initial teacher training, not only as a motivational element, but also as a tool that can be used to reinforce learning and teach participants about new ways of communication that can help their professional development. With this aim in mind, the project team has focused on the implementation of a teaching strategy based on the use of Twitter, to support lessons and accompany trainee teachers in their formative path, assessing their involvement and interaction in said network using data provided by the MSocial tool. Twitter was chosen instead of other social media platforms due to the availability of application programming interface (API) tools, in contrast with other ones, making it possible for MSocial to obtain data directly from Twitter and connect participant accounts. Additionally, Twitter is one of the most widely-used platforms in Spain to create professional networks [24].

For the three groups of participants, educators oriented their lessons by adopting a similar approach, addressing the contents of the subject by analyzing current events, and the current social climate in which prospective teachers are involved in. The aim is to educate them as reflexive teachers, able to undertake professional compromises in the construction of an active citizenship. Since at the start of the academic semester and of this particular subject (February 2020), an international public health emergency had already been declared by the World Health Organization (WHO) due to the spread of COVID-19, those researchers in charge of the course selected this issue to involve prospective teachers using a service-learning approach, with the aim of engaging them as part and as creators of educational initiatives.

Pre-service teachers were asked to develop didactic designs for social studies specifically created for Early-Childhood Education, which could be shared on Twitter, and in that way, provide a social service to those people who were still confined, along with their children, at home. In order to achieve this objective, prospective teachers needed to have previously performed a search and selection of materials and didactic resources to teach social studies in this stage, analyzing the content of institutional and professional websites, something that they also had to share on Twitter. In addition to focusing on families with this task, other collectives with similar interests were also included, such as other trainee teachers (their own colleagues), but also in-service teachers, who were also contacted using this social media. Prospective teachers had to create tweets about what they were discovering and designing using the hashtags #EstrategiasCCSS and #DCSUva. Furthermore, to foster interaction, they were encouraged to engage with the content created by other participants, making comments or pushing the "Like" button. While the service performed for the community as part of the service-learning approach was clearly established, so was the learning part: it was expected for trainee-teachers to help familiarize themselves with websites and Twitter accounts connected to their professional activity in the future, to acquire strategies to analyze content, and, last of all, share and generate information over Twitter useful for different collectives interested in Early-Childhood Education.

The sanitary emergency as a result of the spread of COVID-19 led to significant differences in the intensity of the application of this didactic strategy based on Twitter. This prompted each of the groups to adapt to each of the specific circumstances that were generated between the prospective teachers and researchers in charge of the groups. In Group 1, the use of Twitter was a constant along the complete academic semester, contributing to reinforcing those contents that were addressed during online classes. This was not the case for groups 2 and 3, in which the use of social media was intermittent and sporadic at best due to the academic and personal circumstances of both teachers and students (illness, work and familiar responsibilities, etc.) in these groups. It is interesting to note that, while people usually started using social media with a higher degree of interest during the pandemic, the academic use of these platform might have been perceived as potential overload, making students less engaged.

2.3. Research Instruments and Data Analysis

The first research instrument that was used for data collection was the MSocial tool, which was used for the monitorization of social interactions. MSocial offered, besides a board with SNA metrics, a data visualization tool capable of showing the captured social activity according to the selected filtering criteria. It provided different types of data visualization graphs, such as sequence diagrams, timelines, interaction matrices and Graphviz like the ones shown in Figures 1–3. Nodes in the graph represent the social network users, while each edge is an interaction (post, replay, mention, reaction). This type of visualization allows teachers to analyze users' social activity and connectivity as well as to identify connected users and their relationships [26].

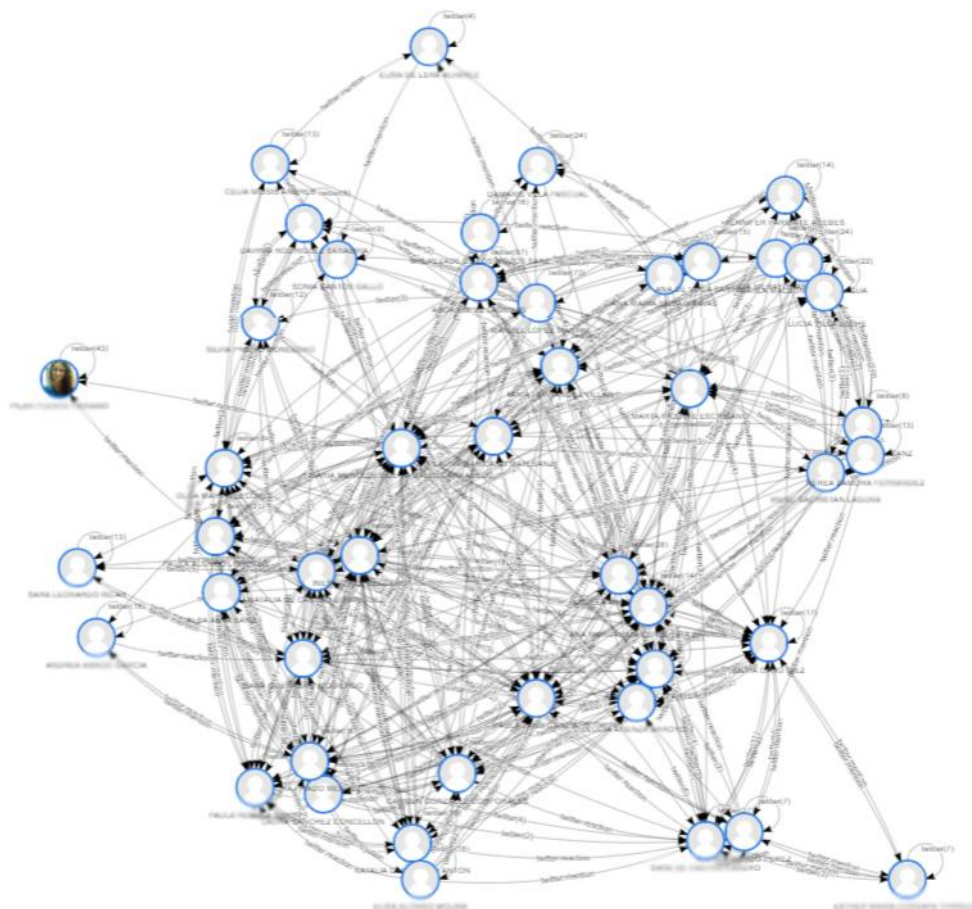


Figure 1. Interaction network for Group 1 generated by MSocial.

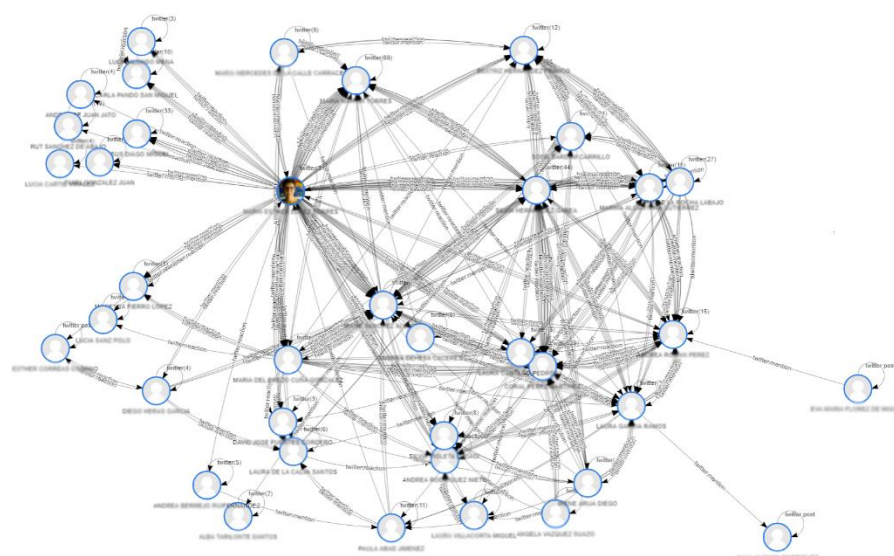


Figure 2. Interaction network for Group 2 generated by MSocial.



Figure 3. Interaction network for Group 3 generated by MSocial.

Additionally, and to determine pre-service teachers' perceptions regarding the educational potential of social media, a series of categories were established to develop a questionnaire. The first one was the perceived usefulness of social media for teacher professional development, which can be understood as part of the growth process of a trainee teacher, and which, in connection with the use of social media, implies the use of these platforms as tools to get in touch with their peers, learn more about other educational projects and activities, and disseminate their own work and ideas. The second category, related to the perceived potential of social media to promote communication among students, is a key element that is connected to interaction, as well as to the many possibilities offered

by new technologies. The third category focused on learning, and the way prospective educators believe the use of social media in the classroom, can promote better results from the point of view of knowledge retention as well as deep understanding. Finally, the last category was linked to social media as a tool of student engagement and motivation, again in connection to the current prominent use of these tools.

These categories served as a basis for the generation of one of the specific instruments in this study: a 28-item questionnaire comprised of four scales. Each item was codified by making use of a 6-point Likert-like scale (1 = Completely disagree; 2 = Disagree; 3 = Somewhat disagree; 4 = Somewhat agree; 5 = Agree; 6 = Completely agree). For the first category, teacher professional development, items such as “Social media is necessary to learn more about innovative teaching practices developed by other educators” or “Using social media offer advantages for my future work as a teacher when cooperating with other educators” were included. For the second category, communication, the items included statements such as “Incorporating social media in the classroom allows for the use of cooperative teaching strategies” or “Using social media allows me to stay in touch with my professors”. Items such as “Searching for current news in social media can help establish a connection with the contents of the subject” were used for the third category: learning. Additionally, items such as “Classes are more dynamic if you make use of social media” or “Using social media for social studies education motivates me” were used for the fourth category, focused on engagement.

Validity and reliability were a main focus during the development of the instrument [35], and different iterations of the questionnaire were created after employing exploratory factor analysis (EFA) and discarding or modifying those items with factor loadings under critical thresholds, as well as those items that were identified as not clear after an expert review. Additionally, a pilot testing of the questionnaire was applied to an additional group of pre-service teachers to identify additional changes. The final version of the instrument was deemed reliable, and before and after the implementation it was possible to detect an internal consistency measured by Cronbach’s α that is $\alpha = 0.94$ for the pretest and $\alpha = 0.96$ for the posttest. Additionally, all individual scales, in both implementations, were clearly over the acceptable thresholds of $\alpha = 0.70$, usually accepted as highly reliable in educational research [36,37].

Information was processed using IBM SPSS software for the quantitative study, while also using Jamovi software for the specific analysis. A series of paired-samples tests were employed to establish a comparison between the four different categories before and after the intervention, establishing $p < 0.05$ as the significance threshold in all cases, as well as $d > 0.40$ and $d > 0.80$ as medium and large effect size thresholds, respectively [38].

3. Results

3.1. An Analysis of the Level and Quality of Interaction in Each Group

One of the aims of the research focused on determining the level of interaction using the Twitter of trainee teachers enrolled in the three different groups, each one with a different condition, as previously described. In this case, to specifically focus on the main differences in each of the groups, and with the aim of exploring the level of interaction and effects of the different teaching practices, data was collected using the MSocial tool, including the cumulative number of interactions and the spread of said interactions over time, as well as network graphs, including the participants enrolled in the three groups.

Looking, firstly, at the cumulative data, results obtained from the tools (Table 1) indicated a notable contrast between the groups, in line with the approach that was adopted in each of them. Group 1, in which the intervention with social media was systematic and carried out during the whole of the semester, showed much higher interaction numbers than the other groups. For instance, prospective educators in Group 1 generated a total of 1642 tweets, a number that is nearly three times higher than the one generated in Group 2, and nearly eight times higher than that of Group 3.

Table 1. Number of interactions performed by each group as monitored by MSocial.

Group	Tweets	Replies	Retweets	Likes	Mentions	Total Interactions
Group 1	1642	30	203	633	1084	3593
Group 2	556	11	49	224	260	1100
Group 3	206	50	8	38	63	365

As can be observed in Figure 1, which corresponds to an interaction network graph for Group 1 generated by the MSocial tool, the raw number of tweets generated during the semester does not offer the complete picture. Among the key elements that should be taken into account when determining how participants in a group interact, the results indicated that there are additional elements to note if one aims to detect how they communicate with each other. In addition to tweets, during the interventions, trainee teachers were incentivized to respond to their peers, retweet information, or build upon the work of their colleagues. In Group 1, this allowed participants to generate 3593 total interactions, including 1084 mentions, 633 likes and 203 retweets. This also allowed for prospective teachers (each of the nodes represented in Figure 1) to actively interact among each other, while also avoiding isolated nodes as much as possible.

In contrast, and due to the implementation put into practice in Group 2, as previously detailed, the interaction numbers were noticeably different, at least in comparison to Group 1. For this second group, participants generated a total of 556 tweets. Additionally, 260 Twitter mentions, 224 likes and 49 retweets were produced, making the total number of interactions 1100. The interaction network (Figure 2) generated by MSocial showed that the fact that the intervention was not as systematic in nature produced some key differences. For instance, and while the activity and interaction in each of the nodes was not nearly as dense as with Group 1, it was still possible to detect a series of highly active participants. On the other hand, the fact that these nodes absorbed an important volume of the interactions signaled that interaction levels were not equally shared among the group, and that a significant number of nodes were detected to be isolated or merely acted as content recipients, something that was detected as a more prevalent issue in Group 3.

The last group only made use of social media in a very sporadic way, something that was reflected in the interaction figures, as well as in the network graph (Figure 3). For this group, only 206 tweets were produced by participants, in addition to 63 mentions, 38 likes and 8 retweets, although 50 replies were generated, for a total of 365 Twitter interactions during the complete academic semester. The comparatively higher number of replies, at least in contrast with the other groups, could be explained by the fact that in some of the task performed by this group, they were asked to establish a discussion or dialogue with other colleagues. In comparison with the other interaction networks, the graph showed many more dispersed nodes, barely connected in many instances due to the lack of connectivity between pre-service teachers.

3.2. Conceptions about the Potential of Social Media and Effects of the Interventions

Secondly, one of the key aims of the research was to detect pre-service teachers' conceptions about the potential of social media for educational purposes, attending to the four categories that were delineated in previous sections. In this regard, it is interesting to note that prospective teachers showed high levels of appreciation in each of the different dimensions that were examined before the interventions, something that could be detected in all three groups. For instance, and taking into account overall valuations, which were obtained using a 6-point scale, participants in the groups graded the educational potential of social media between $M = 4.53$ and $M = 4.89$ (Tables 2 and 3) out of a maximum 6.

Despite the high initial valuations that were obtained after the implementation of the pre-test, one of the main aims of the research was to explore any potential changes after the intervention, contrasting participants' conceptions before and after making use of social

media during the academic semester. In this regard, a series of paired-sample or dependent t-tests were conducted for each of the groups, differentiating between the four categories.

Focusing, firstly, on Group 1 (Table 2), which was characterized by the implementation of systematic didactic strategies utilizing social media, results of the t-test indicated statistically significant differences between prospective educators' overall valuations ($M = 4.89$, $SD = 0.54$) and those obtained after the semester ($M = 5.21$, $SD = 0.46$), while also showing a medium effect size ($t(40) = -4.78$, $p < 0.001$, $d = 0.64$). In the same way, those results obtained in each individual category also showed statistically significant differences, with notable higher levels in the final test when comparing them to the initial valuations. This was the case for trainee teachers' perception of social media for teacher professional development ($t(40) = -2.43$, $p < 0.05$, $d = 0.40$) and for fostering communication ($t(40) = -2.63$, $p < 0.05$, $d = 0.47$), where differences were noteworthy. In particular, in the other two categories (potential of social media to develop learning and engagement) it was possible to detect even higher contrasts and a marked improvement in participants' perception, not only showing statistically significant differences ($t(40) = -4.40$, $p < 0.001$, $d = 0.55$ for the third category), but also closing in on the threshold of a high effect size in the engagement category ($t(40) = -6.69$, $p < 0.001$, $d = 0.78$).

Table 2. Results of the paired-samples t-tests for the first group of participants.

Group	Category	Initial Test		Final Test		<i>t</i>	<i>d</i>
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Group 1 (<i>n</i> = 41)	Teacher professional dev.	4.89	0.58	5.11	0.51	−2.43 *	0.40
	Interaction	4.87	0.70	5.18	0.62	−2.63 *	0.47
	Learning	4.92	0.56	5.22	0.54	−4.40 **	0.55
	Engagement	4.86	0.60	5.31	0.56	−6.69 **	0.78
	Overall	4.89	0.54	5.21	0.46	−4.78 **	0.64

* $p < 0.05$; ** $p < 0.01$; Teacher professional teaching dev. = Teacher professional development.

While Group 1 was the only one that was able to fully address the initial condition regarding the systematic use of social media in the classroom, the examination of the other two groups can also shed some light on some of the effectiveness of the teaching practices in initial teacher training. Group 2, as previously indicated, also aimed to make use of Twitter during the academic semester, but the consequences of domestic confinement due to the spread of COVID-19 truncated many of the initial expectations. For this reason, as will be shown later on, when examining the interaction network obtained from the online platform data, the volume of interaction was notably lower and much more sporadic. From this point of view, it is possible to interpret the results obtained from an overall perspective, which showed no statistically significant differences when comparing initial and final data ($t(43) = 0.25$, $p = 0.80$, $d = 0.01$). These results (Table 3) were also found to be very similar for each of the four categories: teacher professional development ($t(43) = -0.11$, $p = 0.92$, $d = 0.05$), communication ($t(43) = 0.24$, $p = 0.82$, $d = 0.05$), learning ($t(43) = 0.61$, $p = 0.54$, $d = 0.15$) and engagement ($t(43) = 0.14$, $p = 0.89$, $d = 0.02$).

Group 3, in contrast to Group 2, adopted a different approach from the beginning, and intended to simply make use of social media in a very scattered and isolated manner. From an overall point of view, results showed no statistically significant differences between the initial and final prospective teachers' conceptions ($t(22) = 0.78$, $p = 0.44$, $d = 0.18$). This was also in line with all four categories: teacher professional development ($t(22) = -0.11$, $p = 0.73$, $d = 0.10$), communication ($t(22) = 0.24$, $p = 0.20$, $d = 0.03$), learning ($t(22) = 0.61$, $p = 0.47$, $d = 0.15$) and engagement ($t(22) = 0.14$, $p = 0.66$, $d = 0.10$), indicating how sporadic interventions were markedly less effective than a systematic approach, as the one that took place in Group 1.

Table 3. Results of the paired-samples t-tests for the second and third groups of participants.

Group	Category	Initial Test		Final Test		<i>t</i>	<i>d</i>
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Group 2 (<i>n</i> = 44)	Teacher professional dev.	4.65	0.71	4.66	0.83	−0.11	0.01
	Interaction	4.63	0.84	4.58	1.13	0.24	0.05
	Learning	4.68	0.75	4.57	0.75	0.61	0.15
	Engagement	4.53	0.92	4.51	1.09	0.14	0.02
	Overall	4.53	0.74	4.58	0.95	0.25	0.06
Group 3 (<i>n</i> = 23)	Teacher professional dev.	5.02	0.66	4.94	0.91	0.35	0.10
	Interaction	4.99	0.87	4.67	1.15	1.33	0.03
	Learning	4.83	0.80	4.69	1.06	0.73	0.15
	Engagement	4.71	0.91	4.61	1.04	0.44	0.10
	Overall	4.89	0.74	4.73	1.00	0.78	0.18

Teacher professional teaching dev. = Teacher professional development.

4. Discussion and Conclusions

After reviewing the results, many aspects can be further discussed. Focusing on the effects of the intervention and the differences that were found among the groups before and after the academic semester, two issues deserve special attention.

Firstly, it is worth discussing the effects that prospective teachers' participation in Twitter to communicate and learn about content specific to social studies had on the way they perceive the educational potential of social media, especially from the point of view of teacher professional development. Secondly, it is necessary to address how differences in the way of implementing the didactic strategy based on the educational use of Twitter (either systematically or sporadically) might have influenced the perception of pre-service teachers regarding the potential of social media, as well as the effectiveness of the intervention. This section will finish with a discussion about the potential of social media in initial teacher training and future directions for research in this field.

4.1. Analyzing Interaction to Assess the Perceived Educational Potential of Social Media

The results obtained indicate that prospective teachers can improve their perception of the educational and professional use of social media if, during their own training process, they do not simply learn about the potential of these tools from a theoretical perspective, but also from their own practice, participating by themselves using a specific didactic approach.

This was perceived, in fact, by the analysis that was performed of the intensity and forms of participation in Twitter, throughout the academic semester, of the participants in each of the groups that took part in the study, as well as by establishing a comparison between their ideas before and after the implementation.

Although the initial perceptions of pre-service teachers about social media signaled that participants understood its educational potential from the very beginning, these perceptions had enough margin to improve, something that was evident after examining the results of Group 1. The high scores obtained before the intervention could be interpreted in a positive light, probably due to the fact that prospective teachers were familiar with, and frequently make use of, platforms such as Twitter, Instagram and many others. We cannot ignore that trainee teachers are sometimes considered part of the Net generation, which has incorporated technology into their lives as an essential element in the digital age [5]. It is a generational characteristic that can be observed, therefore, in this sample of future teachers who, right from the start, were receptive to new learning models, connected to their natural way of communicating and interacting, and who considered social media as an interesting element for their professional development.

Of course, using social media does not necessarily have to automatically translate into a positive perception of its use as educational tools, but using it in educational contexts could promote a firm commitment to its use, as was corroborated by this research. In fact, the more

profound and higher the quality of the interaction using Twitter of prospective educators, the better their assessment of the educational potential of social networks was at the end of the academic semester. In the group with a higher level of interaction, overall ratings were higher than in the initial questionnaire, evidencing statistically significant differences in all categories, and a more profound level of interaction was detected, something that allowed the generation of strong connections among participants and even with the researcher in charge of the group, without generating isolated nodes.

Again, it is possible to confirm that offering prospective teachers the opportunity to directly experience the use of emerging technologies in initial teacher training can help them feel more empowered to use them in the classroom [11]. The higher the interconnection between participants, and ability to foster and maintain knowledge flow, the higher the impact the didactic experience can have on all the network participants. As the Siemens' theory of connectivism points out [6], information flows within an organization, such as a classroom, which is an important element for the effectiveness of the teaching process. The interdependence between participants can result in a more effective knowledge flow, helping them establish connections that might also assist in the generation of new learnings, something that can also generate positive educational feedback. As pointed out by Junco et al. [21], the use of Twitter in educational contexts can help engage students into taking a more active and participatory role.

4.2. A Systematic Implementation of the Didactic Strategy: Key to Its Educational Potential

The results that were obtained in this study make it possible to indicate that a systematic implementation of a didactic strategy based on the use of Twitter can help prospective teachers understand the usefulness of social media to foster their professional development, as well as aspects related to communication, learning and engagement. Similar to the results observed by Miguel-Revilla et al. [12], and by Romero-Tena et al. [11] regarding the self-perception of trainee teachers about their digital competence as educators, it is possible to perceive the positive effects of a specific approach during initial teacher training. If, throughout their higher education, the use of educational technologies can help trainee teachers foster their digital competence and perceive that they can make use of it in the classrooms in the future, a direct experience using Twitter can be a key element that can help them fully understand its usefulness and educational potential, while also promoting its use for professional development.

As previously described, results point to the fact that, while the use of Twitter in a sporadic or isolated way can be motivational by itself, it does not seem to be enough for prospective teachers to significantly change their perceptions about the educational potential of social media. In these cases, by not being able to fully implement a systematic approach to the educational use of social media, prospective teachers might not have been completely able to grasp the potential of Twitter for their own professional development.

The analysis of the data obtained in this research suggests that this specific didactic strategy for initial teacher training can become a powerful element that can foster motivation and engagement towards the tasks that were performed in the classroom and predispose trainee teachers towards collaborative learning. Similarly, results obtained in this research reinforce some of the conclusions derived from the work of Junco et al. [21], showing that it is possible to engage students during a semester, while also fostering communication and, at the same time, making participants adopt a participatory role.

4.3. Implications, Limitations and Future Directions

As previously indicated, the use of social media has become prevalent in our society, and it is something that can clearly influence many aspects in the educational contexts. For this reason, the information that has been examined in this research can have different implications, especially in initial teacher training. For social studies in particular, recent research [12,14] has focused on the way the implementation of educational technologies can help prospective teachers address subjects such as history or geography in the classroom.

Understanding the way social media, and in this specific case, Twitter, might become useful for fostering teacher professional development during initial teacher training, could pave the way for its implementation in higher education as powerful educational tools.

In fact, this particular study has been developed within the framework of the project Teaching strategies and quantification of social media in university teaching, which aims to explore some of the possibilities that social media offer in educational contexts. This line of research has had continuity and is still being developed within the framework of projects financed by the University of Valladolid, generating a network of collaboration between different departments and faculties, as well as with researchers from other universities.

While this particular research was only applied during an academic semester and in a specific university, the use of different groups, each with different conditions, and the fact participants were enrolled in two different faculties, aimed to offset the initial limitation. In any case, to explore the potential replication of the study, it might be of interest to carry out this type of study in other degrees and contexts, with the aim of detecting potential similarities and differences.

The results obtained in this research confirm the change in perception regarding the educational potential of social media after an implementation of a teaching strategy based on the use of Twitter. This reinforces the line of research already initiated and opens new lines of work to verify, longitudinally, to what extent the training prospective educators have received, and experienced as students, will enable them to use social media in the future. For this reason, implementing this didactic strategy in other faculties and universities in different contexts could help to assess potential differences and similarities. In this vein, for secondary education prospective teachers, the application of this teaching strategy during their training would allow, in the long term, analyzing whether it can help them integrate the use of social media into their own classroom, with their own students.

Additionally, the data obtained in this study signaled that the use of social media, and in this specific case, Twitter, can influence different dimensions, such as teacher professional development, engagement or communication, and not only learning. This was useful to establish that the potential of social media is not monolithic, so further research is needed to refine and conceptualize some of the many dimensions of its potential, possibly going beyond some of the self-report instruments that were used. To overcome this limitation, interaction has been used as a key component that has been able to shed light on the way participants connect with each other, and how they use social media in practice. The use of MSocial [26] also offers an opportunity to monitor these elements, which can provide valuable insights into research about social media.

Difficulties were found during the interventions. For instance, pre-service teachers seem to be sometimes reluctant to use social media in educational contexts, and specially Twitter. Many of them associate some of these platforms with entertainment and leisure, but not professional or academic use. Privacy and the perception of sharing personal information could sometimes hinder participant engagement. Despite all this, it is possible to implement these kinds of educational proposals.

In summary, social media seems to be here to stay, and its educational ramifications also seem inevitable. A rigorous analysis of its potential, and the way pre-service teachers perceive them might help researchers understand the most effective way to integrate them into their teaching practices in higher education, and ultimately understand the many different dimensions that might help promote social media.

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References

1. Visser, D.; Evering, L.; Barrett, D. Twitter for teachers: The implications of Twitter as a self-directed professional development tool for K-12 teachers. *J. Res. Technol. Educ.* **2014**, *46*, 396–413. [CrossRef]
2. Orihuela, J.L. *Mundo Twitter*; Alienta Editorial: Barcelona, Spain, 2011.
3. Cobo, C.; Moravec, J.W. *Aprendizaje Invisible. Hacia una Nueva Ecología de la Educación*, 1st ed.; Edicions de la Universitat de Barcelona: Barcelona, Spain, 2011.
4. Fernández, E.; Anguita, R. Aprendizajes invisibles en contextos de educación expandida. Retos y oportunidades en la sociedad hiperconectada. *Profr. Rev. Curric. Form. Profr.* **2015**, *19*, 1–16.
5. Matute, O. La Generación Net de la Era Digital. *Revenhyt* **2021**, *48*, 278–292.
6. Siemens, G. Connectivism: A learning theory for the digital age. *Int. J. Instr. Technol. Distance Learn.* **2005**, *2*, 1–9.
7. European Commission. *Opening up Education: Innovative Teaching and Learning for All through New Technologies and Open Educational Resources [COM/2013/0654 Final]*; European Commission: Brussels, Belgium, 2013. Available online: <https://eur-lex.europa.eu/legal-content/ES/TXT/?uri=celex%3A52013DC0654> (accessed on 15 October 2022).
8. European Economic and Social Committee. Opinion of the European Economic and Social Committee on the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on Opening up Education: Innovative teaching and learning for all through new Technologies and Open Educational Resources. *Off. J. Eur. Union* **2014**, *C214*, 31–35.
9. Sola-Martínez, T.; Cáceres-Reche, M.P.; Romero-Rodríguez, J.M.; Ramos, M.R. Estudio Bibliométrico de los documentos indexados en Scopus sobre la Formación del Profesorado en TIC que se relacionan con la Calidad Educativa. *Rev. Electrón. Interuniv. Form. Profr.* **2020**, *23*, 19–35. [CrossRef]
10. Wang, X.C.; Jaruszewicz, C.; Rosen, D.; Berson, I.; Bailey, M.; Hartle, L.; Robinson, L. Meaningful technology integration in early learning environments. *Young Child* **2008**, *63*, 48–51.
11. Romero-Tena, R.; Barragán-Sánchez, R.; Llorente-Cejudo, C.; Palacios-Rodríguez, A. The Challenge of Initial Training for Early Childhood Teachers. A Cross Sectional Study of Their Digital Competences. *Sustainability* **2020**, *12*, 4782. [CrossRef]
12. Miguel-Revilla, D.; Martínez-Ferreira, J.M.; Sánchez-Agustí, M. Assessing the Digital Competence of Educators in Social Studies: An Analysis in Initial Teacher Training Using the TPACK-21 Model. *Australas. J. Educ. Technol.* **2020**, *36*, 1–12. [CrossRef]
13. Miralles-Martínez, P.; Gómez-Carrasco, C.; Arias, B.; Fontal-Merillas, O. Digital resources and didactic methodology in the initial training of History teachers. *Comunicar* **2019**, *61*, 41–51. [CrossRef]
14. Sáez-López, J.M.; Cózar-Gutiérrez, R.; González-Calero, J.A.; Gómez-Carrasco, C. Augmented reality in higher education: An evaluation program in initial teacher training. *Educ. Sci.* **2020**, *10*, 26. [CrossRef]
15. Cózar-Gutiérrez, R.; Sáez-López, J.M. Game-based learning and gamification in initial teacher training in the social sciences: An experiment with MinecraftEdu. *Int. J. Educ. Technol. High. Educ.* **2016**, *13*, 2. [CrossRef]
16. McCall, J. *Gaming the Past: Using Video Games to Teach Secondary History*, 1st ed.; Routledge: New York, NY, USA, 2011.
17. Jiménez-Palacios, R.; Cuenca-López, J.M. El uso didáctico de los videojuegos: Concepciones e ideas de futuros docentes de ciencias sociales. *CLIO Hist. Hist. Teach.* **2015**, *41*, 1–44.
18. Marín, V.; Cabero, J. Las redes sociales en educación: Desde la innovación a la investigación educativa. *RIED Rev. Iberoam. Educ. Distancia* **2019**, *22*, 25–33. [CrossRef]
19. Alfadil, M.; Anderson, D.; Ámbar, V. Connecting to the digital age: Using emergent technology enhance student learning. *Educ. Inf. Technol.* **2020**, *25*, 1625–1638. [CrossRef]

20. Malik, A.; Heyman-Schrum, C.; Johri, A. Use of Twitter across educational settings: A review of the literature. *International J. Educ. Technol. High Educ.* **2019**, *16*, 36. [\[CrossRef\]](#)
21. Junco, R.; Heiberger, G.; Loken, E. The effect of Twitter on College Student Engagement and Grades. *J. Comput. Assist. Learn.* **2011**, *27*, 119–132. [\[CrossRef\]](#)
22. Luo, T.; Freeman, C.; Stefaniak, J. “Like, comment, and share”—professional development through social media in higher education: A systematic review. *Educ. Technol. Res. Dev.* **2020**, *68*, 1659–1683. [\[CrossRef\]](#)
23. Fernández, M. *Desarrollo Profesional Docente*; Grupo Editorial Universitario: Granada, Spain, 2006.
24. Marcelo, C.; Marcelo, P. Influencers educativos en Twitter. Análisis de hashtags y estructura relacional. *Comunicar* **2021**, *68*, 73–83. [\[CrossRef\]](#)
25. Austin, R.; Smyth, J.; Rickard, A.; Quirk-Bolt, N.; Metcalfe, N. Collaborative digital learning in schools: Teacher perceptions of purpose and effectiveness. *Technol. Pedagog. Educ.* **2010**, *19*, 327–343. [\[CrossRef\]](#)
26. Verdú, M.J.; De Castro, J.P.; Regueras, L.M.; Corell, A. MSocial: Practical Integration of Social Learning Analytics Into Moodle. *IEEE Access* **2021**, *9*, 23705–23716. [\[CrossRef\]](#)
27. Santoveña-Casal, S.; Bernal-Bravo, C. Explorando la influencia del docente: Participación social en Twitter y percepción académica. *Comunicar* **2019**, *27*, 75–84. [\[CrossRef\]](#)
28. Calle-Carracedo, M.; Sánchez-Agustí, M.; López-Torres, E.; Martínez-Ferreira, J.M.; Miguel-Revilla, D.; Carril-Merino, M.T.; Hernández-Sánchez, A. Las redes sociales en la enseñanza crítica de la didáctica de las Ciencias Sociales. In *Repensar el Currículo de Ciencias Sociales: Prácticas Educativas para una Ciudadanía Crítica*, 1st ed.; Bel, J.C., Colomer, J.C., de Alba, N., Eds.; Tirant Humanidades: Valencia, Spain, 2022; pp. 929–938. ISBN 9788419071095.
29. Rodríguez-Martínez, R.; Carril-Merino, M.T.; Calle-Carracedo, M. Las huellas de la guerra civil en el entorno natural de los montes de Valsain. Empatía histórica y análisis del paisaje en la formación del profesorado. In Proceedings of the Congreso XXXII Simposio Internacional de Didáctica de las Ciencias Sociales, Granada, Spain, 5–7 April 2022.
30. Calle-Carracedo, M.; López-Torres, E.; Hernández-Sánchez, A.; Carril-Merino, M.T. Futuros docentes en la red por una educación para el desarrollo sostenible. In Proceedings of the Congreso XXXII Simposio Internacional de Didáctica de las Ciencias Sociales, Granada, Spain, 5–7 April 2022.
31. Rodríguez, M.R.; López, A.; Martín, I. Percepciones de los estudiantes de Ciencias de la Educación sobre las Redes Sociales como metodología didáctica. *Pixel-Bit Rev. Medios Educ.* **2017**, *50*, 77–93. [\[CrossRef\]](#)
32. Mills, G.E.; Gay, L.R. *Educational Research: Competencies for Analysis and Applications*, 12th ed.; Pearson: New York, NY, USA, 2019.
33. Creswell, J.W. *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*, 6th ed.; Pearson: Boston, MA, USA, 2018.
34. Shadish, W.R.; Cook, T.D.; Campbell, D.T. *Experimental and Quasi-Experimental Designs for Generalized Causal Inference*, 2nd ed.; Houghton Mifflin Company: Boston, MA, USA, 2002.
35. Schumacker, R.E.; Lomax, R.G. *A Beginner's Guide to Structural Equation Modeling*, 4th ed.; Routledge: New York, NY, USA, 2016.
36. Cohen, L.; Manion, L.; Morrison, K. *Research Methods in Education*, 8th ed.; Routledge: New York, NY, USA, 2018.
37. Nunnally, J.C.; Bernstein, I.H. *Psychometric Theory*, 3rd ed.; McGraw-Hill: London, UK, 1994.
38. Cohen, J. *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed.; Erlbaum: Hillsdale, MI, USA, 1988.