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The Use of Social Networks by Pre-Service Teachers for the Design of Mathematical Activities

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Currently, the use of social networks is part of the daily life of young people in Spain and they are at the service of interaction within a group. The main objective of this work is to analyze the activities designed by pre-service teachers for learning in Primary Education in which mathematical notions are involved through the use of social networks. The sample consisted of 148 pre-service teachers in the 3rd year of the Primary Education Degree. They were asked to design an activity focused on students aged 10-11 years in which the material was extracted exclusively from social networks. From a frequency and reticular analysis, we obtain the results that there is a greater frequency of use of the social network Twitter and the absence of specific educational social networks. Likewise, the mathematical contents that predominate in the proposals are statistics and probability. It can be affirmed that the use of the proposals with social networks is not appropriate for the educational level for which it is intended. In addition, the high frequency of content on statistics and probability is attributed to their own shortcomings in previous educational levels. These results will make it possible to adapt the training of pre-service teachers, both in relation to mathematical content and to the possible social networks to be used.

Keywords: social networks, pre-service teachers, elementary education, mathematics, didactic proposals

INTRODUCTION

Currently, the use of Information and Communication Technologies, the forward ICT, is part of the daily life of students in the different educational stages, although in most cases it is still not as present in the classroom as outside it (Tirado & Roque, 2019). All the changes undergone in society during the 21st century refer to the huge amount of digitized information accessible through new digital media (Schroeder, 2018). In fact, it can be stated that a participatory society emerges from a participatory citizenship through the different digital platforms (Jenkins, 2014). One of the reasons for this growth in recent years of digitized information are broadband mobile connectivity and the massive and progressive adoption of smartphones, which have contributed to change the way of communicating, interacting, creating knowledge and sharing it (Pérez-Escoda, 2018). This allows social networks to be part of our daily lives. This also

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includes students, who have their personal and family relationships impacted, and can be connected to current news instantly (Abdelraheem & Ahmed, 2018).

In the educational field, social networks are "constructivist tools" when they are placed at the service of interaction within a given group: between students, between students and the teacher, and also within the teaching staff; all of this outside the temporal and spatial demands of a school space and environment (Hernández-Martín, 2008). Virtuality makes it possible to facilitate interaction, share an endless number of files, also of varied typology, and communicate in the most similar way to the physical one (Hernández-Martín, 2008). Moreover, social networks are fully useful if they are put at the service of advantages that have an impact on a learning methodology: increasing motivation, favoring higher levels of academic performance, improving the retention of what is learned, enhancing critical thinking and multiplying the diversity of knowledge and experiences acquired (Martín-Moreno, 2004). Other authors, such as Manca and Ranieri (2013), suggest that in order to take advantage of social networks it is necessary for students and faculty to broaden the learning context, consider a mix of information and resources, and reconstruct views on some pedagogical aspects.

However, Pascual (1999) warns that the use of the computer is not an improvement if it is not accompanied by an adequate methodological approach, and it should be the tutors who are concerned about how, what, where, when and what resources should be used in teaching, while for students, the family environment and institutional actions act as factors (International Telecommunication Union, 2018). Despite being in this familiar and habitual environment, students do not always respond to teacher expectations in this regard. In fact, Gisbert-Escofet (2018) states that even in these new opportunities to incorporate educational innovation, difficulties may arise and that is why classroom activities should be allowed to be made accessible to the world. These difficulties also come from the faculty, as many teachers do not know how to integrate technology and its potential impacts (Crook, 2012), and even find that the time spent on some social networks, such as Facebook, by university students negatively affects their grades. (Kirschner & Karpinski, 2010).

Not so familiar to society are the social networks intended for teachers, despite being quite numerous (Clipit, Docsity, Edmodo, The Capsuled, among others). Few have dared, as yet, to consider classroom training activities based on their practice (Haro, 2009). In addition, teacher training needs sufficient time to adapt to the teaching methodologies underlying ICT resources (Ertmer & Ottenbreit-Leftwich, 2010). At the other extreme are other types of social networks, whose rates of knowledge and use are particularly high (Facebook, Twitter, IG, among others), although with some reluctance to use them in the classroom by pre-service teachers. Despite this lack of confidence, pre-service teachers consider that the social networks that are best known and used in the personal sphere are those that could be better used to obtain more pedagogical performance (Espuny et al., 2011). In order to accompany these pre-service teachers, pedagogical decisions related to these resources and not only to related skills specific to ICT must be made (Tárraga-Mínguez et al., 2017).

At the institutional level, UNESCO (2014) recommends promoting the use of ICT in educational centers to foster technological competence in teaching-learning processes. ICTs grant new opportunities and make tutors engage in the use of novelties in educational trends (Pons, 2010), having to update, on many occasions, the teaching staff (Levano-Francia et al., 2019), who in recent years have had a moderate level of digital competence in the use of social networks (García-Pérez et al., 2016). In addition to UNESCO, many other organizations follow this same trend, such as the National Institute of Educational Technologies and Teacher Training (INTEF), in Spain, or the International Society for Technology in Education (ISTE), at the international level.

In Spain, where the study was conducted, and following the legislation in force until the 2021-2022 academic year, digital competence was defined until 2020 as "that which involves the creative, critical and safe use of information and communication technologies to achieve objectives related to work, employability, learning, use of free time, inclusion and participation in society" following the Organic Law 8/2013. This definition was completed with the new law, Organic Law 3/2020, which defines digital competence as not only the mastery of different devices and applications, where the digital world is a new habitat in which children and youth live more and more: in it they learn, relate, consume, enjoy their free time. Moreover, this new educational legislation considers that the approach to digital competence should be more modern and broader, in line with European recommendations regarding key competences for lifelong learning. In particular, social networks have much to do with the new active and participatory methodologies, as García-Sans (2008) states. These are being adopted within the European Higher Education Area (EHEA) and, in particular, with the so-called collaborative work aimed at achieving the same academic goals. Therefore, social networks are also contemplated within the Framework of Reference for Digital Competence in Teaching (2022), as part of area 6 of Development of students' digital competence, under the heading "Communication, collaboration and digital citizenship". In the field of research, in Spain, Gil-Fernández and Calderón-Garrido (2022) already analyzed the nature, intensity and type of educational use of these social media by pre-service teachers. This left a path open to the particularity of the didactic proposals in mathematics that prospective teachers are able to design using social networks.

Taking into account the studies described above, and with particular emphasis on the presence of ICTs both in the classroom and outside it (Tirado & Roque, 2019), a participatory society (Jenkins, 2014) and the advantages of social networks in learning (Martín-Moreno, 2004), this work has been carried out. However, the previous studies reflect certain gaps, despite the fact that Gil-Fernández and Calderón-Garrido (2002) opened a path after an arduous analysis to be able to propose activities in mathematics, few authors have dared to propose practical activities in the classroom (Haro, 2009). After the results obtained in a preliminary phase of the study (Arnal-Palacián & Julve-Tiestos, 2020; Arnal-Palacián, 2021), as well as the inclusion in teacher training of programs that simulate classroom experiences with technology (Greenhow & Askari, 2017); the objective pursued in the present work is to analyze the activities designed by pre-service teachers in which mathematical notions were involved through the use of social networks.

This main objective is intended to be achieved following the following specific objectives:

O1. To analyze the social networks used by the pre-service teachers to gather resources that will later be taken to the classroom.

O2. To analyze the mathematical content that pre-service teachers prefer to select for this type of activities.

O3. To relate the selection of social networks and the mathematical content to be taught by the pre-service teachers.

With the attainment of these objectives, the aim is to provide an answer to how teachers in training would manage social networks in their classroom practice, specifically in the teaching of certain mathematical notions.

METHOD

Research design

This work is carried out from a mainly quantitative approach, based on a frequency and reticular analysis of coincidences. The research design is descriptive, without a control group.

The Moodle platform of the course was used for data collection. Pre-service teachers had to submit a single document per group, the culmination of the course. For this purpose, they had the 4 months that this course lasted.

During the previous two academic years, partial and initial studies were carried out (Arnal-Palacián & Julve-Tiestos, 2021; Arnal-Palacián, 2020), which allowed the validation of the instrument.

Sample

Through a convenience sampling, in Spanish public universities to which access has been available, a sample of 148 students for pre-service teachers has been formed. They were grouped into 35 teams of 3 or 4 people.

The subject in which the activity has been developed is Mathematics and its Didactics III, taught in the 3rd year of the Degree in Teaching in Primary Education. This subject brings together the teaching-learning of didactic and mathematical knowledge related to the following mathematical blocks: measurement, statistics and probability.

Instructions

The pre-service teachers had to develop an activity focused on 5th-6th grades of Primary Education with content taken exclusively from social networks, without using web pages with exclusively didactic and/or mathematical content. The mathematical content to be developed (measurement, statistics or probability), objectives, methodology and evaluation criteria to be followed had to be specified.

Data analysis

For the development of this empirical study, two types of analysis were carried out: statistical frequency and reticular analysis of coincidences.

Firstly, for the statistical frequency analysis, three variables were used: type of resource, social network and mathematical block. See Table 1.

Table 1
Variables considered in the frequency analysis

Variables	Categories
Resource type	Social networks
	Newspaper
	Digital game
	Educational Web
	Traditional file
Social network	Twitter
	Instagram
	Youtube
	Pinterest
Mathematical content	Measure
	Statistics
	Probability

Subsequently, a reticular analysis of coincidences was carried out with those productions in which the type of resource was social networks.

The reticular analysis of coincidences is characterized by the presentation of the data by means of a graph. It allows observing which set of scenarios are more frequent and how they are related to other events (Escobar & Tejero, 2018). At the interpretative level of the graph, the size of the nodes is proportional to the occurrence of the graph, while the lines point to the significant relationship between the nodes. All this without offering any numerical value, only visual (Escobar, 2009).

The tool used was the netcoin library written in R, which allows obtaining coincidence matrices and their respective graphs through an SPSS or Excel file. This tool was developed by the Network Coincidence Analysis project.

FINDINGS

Frequency analysis results

First, we observed which groups followed the proposed instructions: of the 35 teams formed, 23 of them used social networks as indicated. In contrast, 4 used digital newspapers to obtain information, 3 digital games, 3 educational websites and 2 traditional worksheets. See Figure 1.

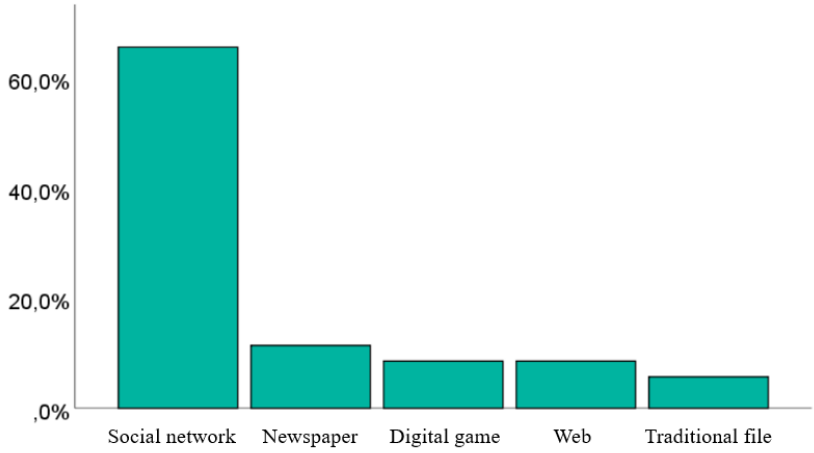

Figure 1
Type of resource used by pre-service teachers

It is striking that 34.3% of the participants do not follow the proposed slogan. This reluctance is attributed to the students' lack of confidence in using them in an academic environment, as Espuny et al. (2011) stated.

For the 23 teams that did follow the instructions, the use of each of the social networks was analyzed. As can be seen in Figure 2, more than half of the teams proposed an activity whose resource was taken from Twitter, 6 teams used Instagram, 4 used Youtube, and in a testimonial way, in only one team, Pinterest. One of the social networks most used by young people today, Tik-Tok, was not used by any of the teams.

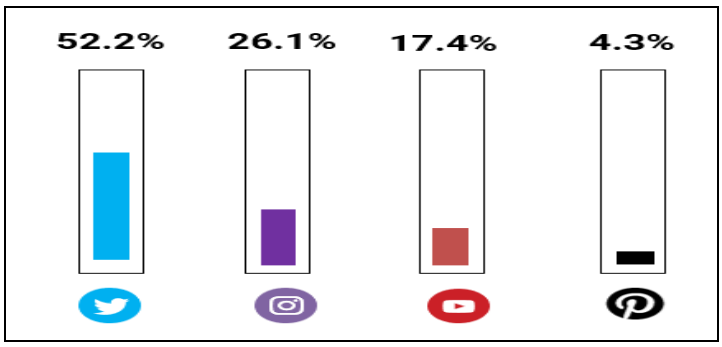

Figure 2
Social network used by pre-service teachers

Since the subject in which this proposal was made considered the mathematical blocks of measurement, statistics and probability, these are the ones taken into account in the analysis. Although in the Spanish educational legislation statistics and probability form a

single block, in the present study they have been considered as two independent categories given that in the subject they were taught in a differentiated manner and because the mathematical notions involved are different. The mathematical content predominantly chosen by the pre-service teachers was statistics (10 teams). Very close behind was probability, 9 teams, and measurement was relegated to 4 cases. See Figure 3.

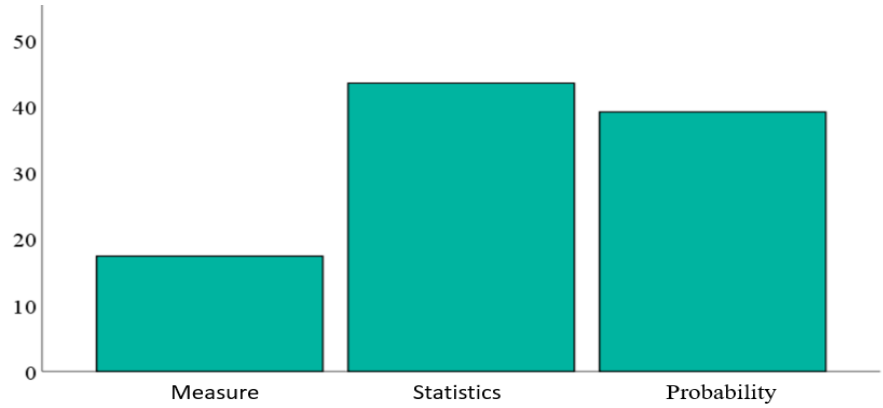

Figure 3
Mathematical content used by the pre-service teachers

Results of the reticular analysis of coincidences

Applying reticular analysis to the variables social network and mathematical block, using netcoin, we obtain the following network (Figure 4).

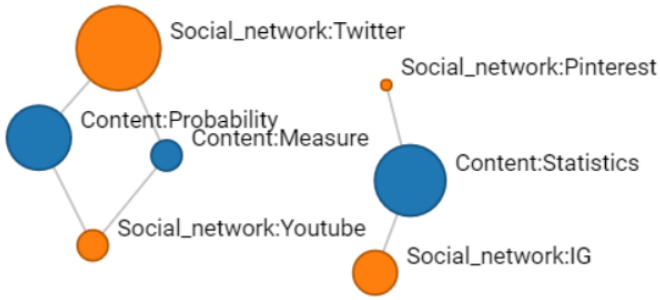

Figure 4
Matching network obtained with netcoin

As we can see, there are two unconnected networks. On the one hand, there are the mathematical blocks probability and measurement together with the social networks Twitter and Youtube and, on the other hand, the statistical mathematical block together with the social networks Pinterest and Instagram. This means that the mathematical

block to be taught is conditioned by the social network used, or the social network used is conditioned by the mathematical block selected. In addition, the previously achieved results are also observed: the largest node corresponding to social networks (oranges) corresponds to Twitter, the most used social network, while the largest node for the mathematical block (blues) is statistics. Despite not having the numerical value, which we did have in the previous analysis, we can observe the size of the node.

Next, the four matching networks are shown focusing on each of the four social networks. See Figure 5.

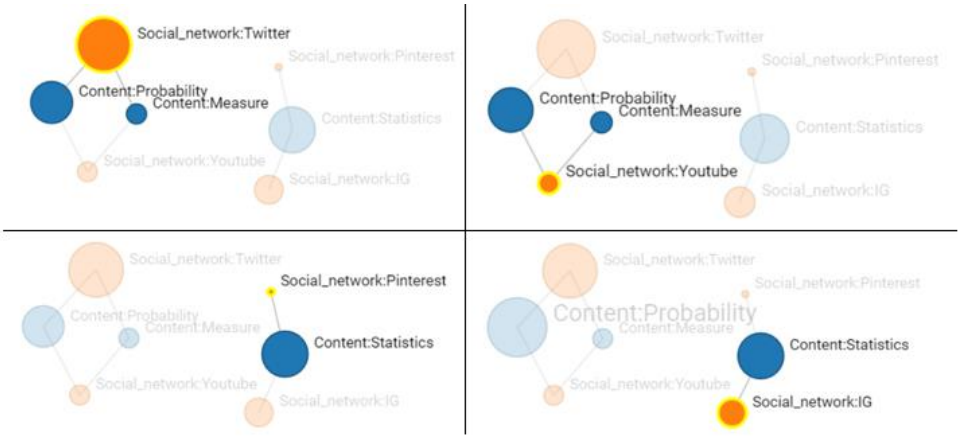

Figure 5
Matching networks with focus on each social network

The social network Twitter is used to develop notions related to measurement and probability, although more frequently for the latter. The social network Youtube, although used less frequently than the previous one, is used for these same mathematical notions. The social network Pinterest is almost insignificant in the grid, motivated by its low incidence, although its link with the statistics block is reflected. Finally, the social network Instagram, somewhat more frequent than Pinterest, is related to this same mathematical block.

Some proposals from the pre-service teachers

The following are some of the examples presented by the pre-service teachers

Figure 6 shows the information used by one of the teams. In this case, the social network is used by the link hosted in it, in which 14 mathematical cards related to different magnitudes are provided. Despite being a resource where current and real information can be collected, the pre-service teachers opt for a traditional use of the information to be provided to their students. Among this more current information, information could have been collected on: the hectares burned by a fire (area) or the rise in prices

(monetary system), among others. This is the dynamic followed by the rest of the teams using this social network.

Translation:
[Length, Weight and Capacity].
Today we leave you these 14 Mathematics documents for Primary where we will review the measures of length, weight and capacity, etc.

Figure 6
Example of the use of Twitter

In the case of the Instagram social network, there were two types of proposals: creation of their own data and use of data already generated. In the first case, the data created could have been identical to those found in textbooks or a more traditional teaching, far from a real context. See Figure 7.


Estas son las notas de cinco alumnos de 5° de primaria en la asignatura de matemáticas en 2018

	1º trimestre	2º trimestre	3º trimestre
Marisa	6	4	8
Juan	5	9	3
Belén	8	6	10
Alicia	5	7	8
Emilio	2	3	5

Translation: These are the grades of five 5th grade students in the subject of mathematics in 2018.

Translation: Which of these students has the best academic average?

Figure 7
Example of the use of Instagram: data creation

In the second case, in the activities in which the interpretation of existing data was proposed, we observed real data, more or less distant from the target students. See Figure 8.

¿Qué día es el que más hemos usado el Instagram?
¿Qué día es el que menos lo hemos usado?
¿Qué tipo de variable estamos utilizando?
Clasifica dicha variable
Calcula la frecuencia absoluta y la frecuencia relativa.
¿Cuál es el tiempo medio que dedicamos a Instagram? Para ello realiza la media aritmética simple y comprueba con el resultado que aparece en la red social.
Calcula el recorrido (rango según BOE).
Crea un gráfico de barras eligiendo una actividad que realices fuera de clase, indicando el tiempo que inviertes en esta actividad (por ejemplo, ver la televisión, jugar a la play, ir a extraescolares, jugar en el parque…)

Translation
What day did we use Instagram the most?
What is the day we have not used it the least?
What type of variable are we using
Classify this variable
Calculate the absolute frequency and relative frequency
What is the average time we spent on Instagram? To do this perform the simple arithmetic mean and check with the result that appears on the social network.
Calculate the path (range according to BOE).
Create a bar chart by choosing an activity that you do outside of class, indicating the time you spend on this activity (e.g., watching TV, playing the play, going to extracurriculars, playing in the park...).

Figure 8
Example of the use of Instagram: interpretation of data already generated

Among the 4 videos selected from Youtube, 3 of them are to promote betting and/or bingo companies, advertised by well-known people in Spain. The pre-service teachers tried to relate this content to probability; however, none of the notions involved were worked, and it was only possible to know the vocabulary, without giving voice to the possible existing risks. See Figure 8. In this same social network there is, for example, the monologue "To bet or not to bet" where Professor Manero approaches these risks through scientific dissemination.

In the opposite case we find the video selected by the team that decided to work on the measure through this social network. The components chose a video from the program "The Secret Life of Children", where children from 4 to 5 years old face different

situations. In the selected case, the comparison of the capacity of two cylindrical containers (glasses) of different radius is established, using different amounts of juice. See Figure 9.

Figure 9
Example of the use of YouTube in the classroom to present notions of measurement.

Finally, in the case of the Pinterest social network we observed an anecdotal use (see Figure 10). This team uses this social network as they could have used a shared folder with the rest of the class in GDrive, OneDrive or similar.

Para conseguir los objetivos anteriormente mencionados y trabajar los contenidos expuestos deberán crear una cuenta común, en la que cada alumno realizará una foto. En la foto aparecerá un objeto que pueda medirse con una regla como las que utilizamos en clase (30cm) y al lado un objeto similar que sea el doble de su tamaño y que subirá a la plataforma online Pinterest cuando la traiga a clase.

Translation:
In order to achieve the above-mentioned objectives and work on the exposed contents, they will have to create a common account, in which each one of them will take a photo. In the photo will appear an object that can be measured with a ruler like the ones we use in class (30 cm) and next to it a similar object that is twice its size and that will be uploaded to the online platform Pinterest when it is brought to class.

Figure 10
Example of Pinterest usage

DISCUSSION

From this research it has been possible to analyze how the pre-service teachers design activities that involve different mathematical notions and social networks.

As far as the study is concerned, considering the category *Resource type*, the pre-service teachers use social networks in 65.7% of the proposals designed, despite being one of the requirements of the proposals, i.e., one out of three does not meet the starting requirements. We attribute that 34.3% of the pre-service teachers that perform another type of task do so because of the distrust of using social networks in the classroom, already attributed by Espuny et al. (2011), as well as the lack of examples of this type of training activities (Haro, 2009). Furthermore, the pre-service teachers had not been specifically trained in social networks, so that, as Crook (2012) states, many of them did not know how to integrate them and their possible impacts. Although the new Spanish legislation, Organic Law 3/2020, considers digital competence from a more modern and broader perspective, following European guidelines, it has not yet influenced the work of pre-service teachers.

In relation to the category *Social network*, we have found didactic proposals that employ Twitter, Instagram, Youtube and Pinterest. We would highlight the absence of one of the most widely used social networks today, Tik-Tok. Also absent are social networks aimed at the educational field, such as Clipit, Docsity, Edmodo or The Capsuled, among others. And, as Espuny et al. (2011) stated, it is the social networks that are best known and used in the personal sphere that pre-service teachers believe can provide the best pedagogical performance. Nevertheless, the use of the proposals with social networks is in a good number of cases not adequate to the educational level for which it is intended, nor to an adequacy in its possible implementation. This was already warned by Pascual (1999) at the end of the 20th century, who stated that the use of the computer does not mean an improvement by itself if it is not accompanied by a good methodological approach. However, despite the shortcomings found, we consider the classroom experience simulation generated to be highly relevant, since, as Greenhow and Askari (2017) state, these simulations should be included in teacher training programs. It is in this sense where we find one of the future avenues for improvement: to provide specific training, both to pre-service teachers and to inservice teachers, on the proper use of different digital resources.

Regarding the category Mathematical content, the pre-service teachers preferred to choose, in an outstanding way (82.6%), the last of the blocks of the Primary Education curriculum "Block 5: Statistics and Probability", attributing this in their discourse to the deficiencies found when they carried out this same stage as students. We cannot provide information on what would have happened with other mathematical contents, as they were not covered in the subject in which the study was carried out.

CONCLUSIONS

After obtaining the results and the subsequent discussion of them, we can affirm that teachers should reflect on their digital training, and this should be found for teachers at all educational levels, including those who are still in their university training period. This training should include social networks, and the linking of these to the content to be taught. Sometimes, and as already reflected in the background review, these social networks serve as a means of communication between teachers and students, but a further step should be taken: taking advantage of their content to transfer it to the classroom, giving realism to teaching and learning experiences.

In addition, and specifically for university teacher training, simulations of experiences using the different social networks should be encouraged. To this end, pre-service teachers should be familiar not only with the most common social networks (Facebook, Twitter, Instagram, among others) but also with those aimed at the educational field (Clipit, Docsity, Edmodo, The Capsuled, among others). In order to carry out this training, some prejudices must be left behind, and the content of the social networks that are used by teachers themselves in their leisure time must not be left aside. Likewise, the use of social networks by teachers and pre-service teachers does not necessarily have to be related to their own use by their students or themselves, but rather a selection of information for classroom practice.

This work presents some limitations determined by the choice of the groups and by the mathematical objects worked on. For this reason, as future perspectives, larger samples and mathematical contents covering the whole of Primary Education are considered.

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