

Article

# Reflexive Skills in Teacher Education: A Tweet a Week

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**Abstract:** Social media has been broadly used in the context of higher education for educational purposes due to students' familiarity with this type of communication. As one of the most interesting cases, Twitter has often been used in teacher education for many purposes. One of the most unexplored themes is using Twitter for reflexive aims, in which discussions featuring ambiguous and contradictory results about whether the characteristics of such a short format can promote reflexive writing. This study is aimed at contributing to this research gap and explores the possibilities of using Twitter for reflective aims in teacher education, considering the reflective level of students' tweets and students' perceptions after engaging on Twitter. For the evaluation of this reflection, a content analysis of tweets texts and emojis has been carried out by coding their content and developing an instrument to assess their reflective level. Additionally, perceptions of students have been collected through an online survey. This study is embedded in a design-based research process that is already in its fourth cycle. Findings show that most tweets are descriptive or analytical, and that tweets are mainly text-based. Furthermore, the data show that low-level reflective tweets may include emojis, which are mainly positive and located at the end of a tweet. The conclusions suggest that Twitter could be more useful when reflections are made during learning rather than on learning.

**Keywords:** Twitter; teacher education; metacognition; reflection; critical approach; social networks

## 1. Introduction

Social media has been used for educational innovation in teacher education [1], and Twitter has also been integrated in early educational experiences [2,3]. Many affordances and limitations have been observed in research about Twitter from a wide variety of contexts, educational levels, and different disciplines, as shown in some recent literature reviews [4–6]. The reflective nature of social media has been described as quick, centered, on daily activity and providing a way to carry out what Schön termed “reflection in action” [7]. In more recent research, special attention has been paid to the use of pictographic characters or “emojis” for communication in many social media services, such as Twitter [8,9]. Furthermore, it seems contradictory that these platforms and services with such social potential have been mainly studied in terms of individual learning, while little research has been carried out from a social perspective [10]. Along with the need for more reflective and socially committed learning, a recent research strand has observed the need for a more critical approach to educational technology [11], and, accordingly, researchers have observed the need for more awareness of the self-control and agency of students over their social media activities as a source of data that governments and businesses are taking advantage of in the current neoliberal social and economic context [12,13]. Likewise, at present, as fake news spreads more deeply and quickly [14],

it is important to adopt this critical approach in order to enhance our skills in safely managing and verifying information and its sources.

Despite the existence of numerous studies, the need for more reflective and metacognitive approaches is still required for social media in general [15–17] and for Twitter in particular [18,19]. In the following sections, we briefly describe the state of the art. Afterwards, we present research related to Twitter by using a learning activity under a design-based research approach to produce two analyses: an analysis of the iterative process of the learning activity in which the need to include a critical approach in further implementations is demonstrated and an analysis of data on the reflective and metacognitive level of student teachers' tweets in the last iteration of the learning design using Twitter.

## 2. Theoretical Framework

Though there seems to be agreement on the potential of Twitter for multiple applications, the discussions on Twitter for metacognitive and reflective skills remain active, with ambivalent conclusions for and against its use. Thus, apart from the metacognitive debate, existing research has concluded some of the following educational benefits and uses Twitter: student engagement [20–22], collaborating to learn in communities of practice [23–26] for the design of collaborative learning activities [27,28], and support for large-scale lectures [29] using activities like backchanneling [30]. In the context of teacher education, Twitter has been very useful for the creation of professional networks to overcome isolation [31,32] and to find resources and mentorship, as well as to engage in pedagogical work, which together may have a direct impact on everyday teaching practice [6,33,34]. Likewise, there is agreement on some of Twitter's limitations, such as its overwhelming access to information, possible student resistance [27,28,35], and the recent "celebrification" evolution that has been observed by recent research [36].

Two recent literature reviews have categorized activities carried out with Twitter. These studies included reflection activities, although such reflections have garnered little attention. Firstly, Ahmad Kharman Shah, Latif Shabgahi, and Cox [5] suggested a four-group classification: formal and informal learning communities, collaborative learning, mobile learning, and reflection. The authors argued that students can engage in critical and reflective thinking when they are participating in a discussion on a microblogging platform like Twitter over a period of time; however, Twitter's length restrictions are also considered as possible barriers for reflections on complex ideas. Secondly, Tang and Hew [3] developed a classification of six groups: the most recurring ones are communication and assessment, and the other four are capture and representation, collaboration, class organization and administration, and reflection. In this case, the authors identified reflection as a part of the students' self-assessment of their own work to make decisions to enhance their progress. The students in the examples were asked to post reflections on their experience of learning through their course content or their field experience on Twitter, which was considered useful for maintaining their engagement with the course materials or objectives and for determining other important missing elements from the content of their peers' self-reflections.

The reflective usage of Twitter is relatively unexplored, and few studies have pursued this topic. Ebner and Maurer [37] stated that reflective microblogging allows students to develop personal learning processes and document them; only a year later, Wright [32] observed a greater engagement among students who tweeted as a self-reflective practice. Very recently, Luo, Shah, and Crompton [38] concluded that students showed greater engagement when reflection was carried out through learner–content and learner–learner interactions. However, for reflective and general metacognitive applications on Twitter, there have been two very important background frameworks. In the context of personal learning environments (PLEs), which are a set of strategies and tools that everyone uses to learn in their daily lives, reflection is a learning activity carried out using social media. This concept has also been connected to the educational–psychological concept of self-regulated learning (SRL) (see, for example, the model by Dabbagh and Kitsantas [39]), in which reflection is a cognitive task that is carried out in the self-assessment phase but also in the other phases of the learning cycle as parts

of tasks such as monitoring learning [40]. However, during model implementation [41], the authors observed that microblogging was more frequently used for personal information management and collaboration than for self-assessment. To improve this situation, the authors of the study called for more teacher scaffolding. On the contrary, the work by Cho and Cho [42] observed that students (in comparison to a control group) showed more frequent planning and reflection skills with Twitter.

The ability of the short format of Twitter to enhance reflective skills has also generated controversy. In the early stages of research, there were ambivalent conclusions in different studies. For example, Dunlap and Lowenthal [43] and Wright [32] suggested that the word limit of Twitter helped people think more precisely, whereas Kassens-Noor [25] observed that this limit did not help at all. Presently, this discussion remains active; while Luo, Sickel and Cheng [44] are concerned about this issue, the latest research by the authors suggested that the short format of Twitter enhances and facilitates summarizing activities, such as cognitive and monitoring abilities, as well as self-reflective and self-assessment skills [18,19]. Moreover, the findings from one of the studies in Tang and Hew's [4] literature review noted that Twitter's word limit was a relevant asset for students to sharpen their reflective thinking. In a professional context, such reflective skills have been observed to promote professional development and reflection-in-action [35,45].

Along with the short format of Twitter, hashtags are also a relevant characteristic of this social media tool that may be used to enhance one's reflective skills through connections. For instance, Twitter live chats via hashtags are one of the most well recognized methods of promoting learning based on informal work-based relationships [46] and can facilitate immediate interactions and discussions for teacher professional development [34]. These interactive relationships could generate unique possibilities to promote reflection in action in the profession and, in turn, may result in developing new innovative educational practices [31,32]. For instance, Luo, Sickel, and Cheng [44] and Hsieh [46] took advantage of the possibilities of educational live chats with US student teachers to engage them on topics regarding educational technology issues (e.g., Web 2.0 tools and online communities), mainly in pre-existing Twitter communities focused around hashtags (e.g., #Edchat). The findings suggested that most of the participants in those chats showed positive perceptions of the technology, noted the transformation of their understanding of the utility of Twitter as a professional resource, and stated their intention to participate again as a method of professional development [44,46]. However, Hsieh [46] also identified that student teachers struggled to participate in the chats and their dialogue due to either technical problems (e.g., bad timing for the chat, problems finding the chat, or privacy settings) or a lack of classroom experience.

The use of predefined graphical icons, so-called "emojis," has been considered a "potentially dramatic shift in online writing," especially in social media settings, where they are being widely used [9] (p.1). Emojis are used for conversational purposes, allowing for cheerful and unique interactions when communicating [9] and becoming an element for disambiguation [47] (Kaye, Malone and Wall, 2017). Emojis were standardized by Emoji Unicode, which has enabled their usage across several devices and platforms [48]. Beyond their technical advantages, Berard [48] stated that emojis represent elements of social inclusion or exclusion, as emojis are cultural symbols that are representative of certain cultures and societies. One of the trending topics in the research on Twitter is emoji sentiment analysis, which is the computational study of people's sentiments, emotions, opinions, and attitudes using emojis [8]. Tauch and Kanjo [49] described the use of emojis through examining the mobile notifications from diverse types of social media and observed a tendency to use more positive emojis on Twitter. It is interesting that emojis were mostly placed at the ends of messages to express a higher sentiment load and were more content related when the emojis were added at the beginning of the message. Likewise, the research by Kralj, Smailovic, Sluban, and Mozetic [8] showed that emojis were mostly placed two-thirds of the way into a tweet and that those with the greatest sentiment load, both positive and negative, were placed towards the end. Twitter sentiment analysis is a valuable tool to provide insight into public perception [50].

Building on previous studies by the authors, in which Twitter activities were conducted by student teachers, the current study is focused on the reflective thinking of students teachers when they use Twitter.

This work is the fourth iterative cycle of research conducted by the authors based on this design and is focused on the study and design of learning activities with Twitter as an educational tool, through which we have been able to develop different learning objectives and research questions, as well as to extract different valuable and insightful results for learning. The purpose of this work was to present the research done in the fourth cycle, which was focused specifically on reflection skills, as a product of the authors' continuous work on Twitter for learning aims in teacher training [19,27,28,51–53]

### 3. Materials and Methods

#### 3.1. *The Study: Context and Participants*

The Twitter-based learning activity was carried out in two programs of teacher education at the University of the Balearic Islands in two of its centers. The participants were students pursuing a primary education teacher degree who were integrated into the syllabus for the technological means and resources in the teaching–learning process in the primary education subject during the third year of their studies. The total number of students was 139, 70 of which participated (54 in Mallorca and 16 in Ibiza). The total number of tweets was 967, although this analysis was focused on the tweets that were classified as reflective (a total number of 496).

#### 3.2. *Learning Activity*

The central task of the successive cycles of the learning activity consisted of students tweeting during a relevant period in the term. They were free to decide the content of their tweets and choose their topics, their hashtags, and the users they wanted to interact with. The minimum number of tweets required in the fourth cycle was one tweet, which inspired the activity's title: "a Tweet a Week." The reflective nature of this activity was only recommended during the fourth cycle as a result of the research-based methodology described in the sections below. The activity could be chosen among a wide range of optional activities, and it was part of the assessment of the course. Thus, the learning task consisted of doing a weekly reflective tweet in which students could highlight a thought, a reading, or any other link or a multimedia resource that had been relevant during that week for their learning. They were also asked to include mentions to peers and other external people so they were extending the network out of the classroom.

#### 3.3. *Research Aims*

There were two aims in this research: to analyze the reflective level of students participating in the fourth cycle and to examine students perceptions after their participation

#### 3.4. *Methodology*

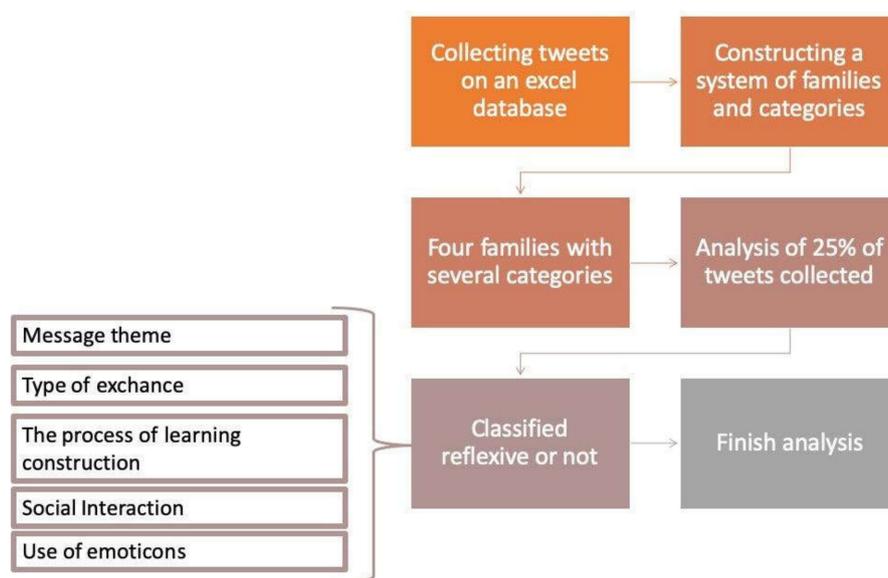
The main methodological approach entailed design-based research [54], where a total of 4 cycles were conducted for the Twitter learning activity with diverse nested research processes [55]. These successive iterative cycles were designed, implemented, and assessed, which allowed us to monitor innovations, collect data, and make improvements for practice in context and, at the same time, inform research and integrate relevant knowledge [56]. The research aims were focused on the fourth cycle of that design-based research process, which placed emphasis on the study of reflection on Twitter during the learning activity by the student teachers. Though the research methodology was mixed, adopting both descriptive and interpretative perspectives to determine and understand the nature of the analyzed Twitter-based learning activity, the research phase presented in this paper was carried out under a qualitative methodology and through a content analysis technique.

### 3.5. Instruments

In this section, the instruments for the codification of the content analysis are described.

For the first research aim, an instrument was developed in different phases of the study. For the analysis of tweets, two instruments were created based on previous work by Jalali, Sherbino, Frank, and Sutherland [45] and Tur and Urbina [57]. These instruments were adapted and adjusted to the context of the study, with the results of the codes obtained after the analysis of 25% of all tweets. After encoding 25% of the tweets, the system of categories underwent a process of discussion among researchers, which was helpful to adjust the categories while promoting the reliability of the instruments. The validity of the instruments was based on the validity of the content. These instruments were built from categories used in other work, which guaranteed the validity of the instrument based on previous results.

Based on the work by Jalali, Sherbino, Frank, and Sutherland [45], a system of codes was created in order to describe the content of reflexive tweets; it included the following elements: message theme, the type of exchange, the process of learning construction, and the social interaction. A new category was added to include data on the use of emoticons (Figure 1). This instrument was adopted and extended from the previous research stage, in which a selection of tweets was codified during the first round [53] (see Table A1 in Appendix A).



**Figure 1.** Instrument for the content analysis of reflective tweets: categories and process of content analysis.

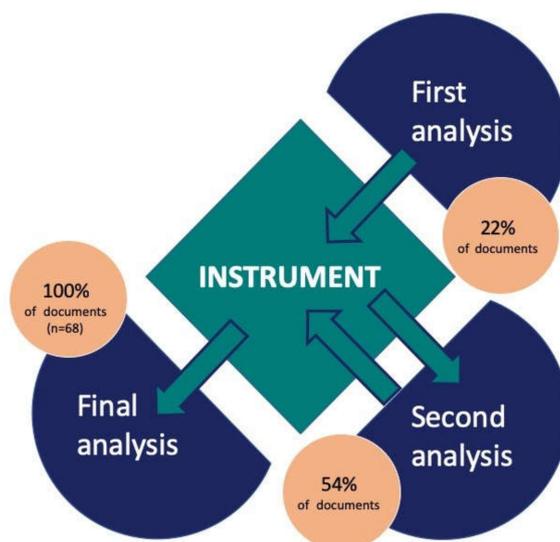
To assess the reflective level of the student participants, an adaptation of the instrument of Tur and Urbina [57] was done. That instrument (rubric) was validated and implemented in previous research projects to analyze the students' reflexive blogspots [58]. This rubric includes diverse criteria, one of which concerns the reflection process in the context of social media and suggests a four-level scale that is based on diverse frameworks on the reflection of learning. The reflective process is understood as transformational at its highest level (level 3), following Mezirow [59], which also includes the perspective of both the initial learning stages and future aims [60]. Low levels of reflection are described as being emotional and able to describe the behavioral aspects of learning (level 1) or at least as able to help users become more aware of their personal perspectives to analyze their learning and make analogies and comparisons (level 2) [7,61,62]. In brief, the original criteria of reflection in the context of blogging for reflecting on learning [57] were adapted to assess tweeting for reflection, as follows:

1. **Descriptive level:** In this level, students' tweets basically describe the activity, including the positive and negative experiences with using new tools from a technical perspective. This level

also considers the tweets where students' feelings related to the learning process and results are described.

2. Analysis of learning: This level includes the tweets that refer to the impact of the learning content from a personal approach. At this point, tweets with critical reflective texts on learning are also included (introducing examples or establishing analogies).
3. Analysis of learning concerning past experiences and future perspectives: In this level, students consider the transformational learning that they have undergone and reflect on how this new learning could have an impact on their future learning and educational approach. This level also considers students' perspectives related to the use and impact of technology as future educators.

A system of categories was developed as the instrument to analyze the data collected for the second research aim (students' perceptions). This instrument was implemented to analyze students' final reflexive submissions for the "a Tweet a Week activity." The system was created with a first round of analysis of the smaller group, which included 22% of the total number of generated documents. Next, a second round was applied by using a larger group of students who represented 54% of the participants in the activity. The instrument was then edited again and optimized with a smaller number of categories (Figure 2). Table A2 can be seen in Appendix A.



**Figure 2.** Phases of the analysis of the creation of the instrument to analyze students' final reflexive submissions for the "a Tweet a Week" activity.

### 3.6. Data Analysis

For the first research aim, the analysis of data was carried out in two stages. The first stage included the codification of all tweets and the identification of the descriptive tweets and their function. This process consisted of collecting tweets in an excel database from the different hashtags. Then, after having identified reflexive tweets, these were coded regarding the other three categories, as shown in Figure 1 (their function and their metacognitive characteristic). The next study stage focused on the reflective level of students' tweets during the learning activity. The reflective level of tweets was assessed through the implementation of a rubric adapted from Tur and Urbina [57], considering each tweet as a unique unit of analysis.

For the second research aim, students were asked to write about their learning and the impact they perceived, both from the use of the tool and from the learning design (in particular, on their ability to summarize their learning using the short format of Twitter), and the content analysis was carried out by analyzing those submissions with an instrument created for this purpose.

## 4. Results

### 4.1. First Research Aim: Analysis of Reflective Tweets. Participation, Level of Reflection, Description of Tweets and Social Interaction

The results of the analysis of the reflective tweets are organized into five sections: participation data in terms of number of tweets, level of reflection, description of tweets, social interaction depicted in the tweets, and use of emojis.

#### 4.1.1. Participation Data

The activity “a Tweet a Week” involved 70 students, 50.36% of which enrolled in the course. The students shared 967 tweets about the course content during the 14 weeks of the teaching period, using specific hashtags depending on the group-class to which they belonged.

The overall ratio of participation ratio was 13.81%, although there were important differences in the level of participation between groups (see Table 1) and between individuals.

**Table 1.** Participation data in the learning activity “a Tweet a Week.”

Group	# Hashtag	Enrolled	Participants	% Participation	Tweets	Ratio of Participation	Reflective Tweets	% Reflective Tweets	Ratio of Reflective Tweets
G1	#22122g11718	62	37	59.68%	450	12.16	277	61.56%	7.49
G2	#22122g211718	60	17	28.33%	152	8.94	48	31.58%	2.82
G3	#22122G111718	17	16	94.12%	365	22.81	171	46.85%	10.69
Total		139	70	50.36%	967	13.81	496	51.29%	7.09

For the group activity, the largest and the smallest groups were those with high tweeting activity, whereas the group in the middle, which had a similar number of students to the largest group, showed lower activity. The different levels of activity between the two larger groups does not allow us to explain the tweet production in relation to the overwhelming information generated in big groups. Thus, the differences could be better explained by individual analyses.

Based on an analysis of the individual participation of each student, three levels of participation were observed: (1) a small, very active group (5.71%) with very high participation where each member sent more than 28 tweets; (2) a group of constant and active participants (30.00%) who sent between 14 and 28 tweets; and (3) a group with low participation (64.29%), whose members sent less than 14 tweets. Half of this participation corresponded to the reflective tweets. Thus, the frequency of these tweets was 51.29%, and the ratio was 7.09.

The tweets were initially analyzed based on a system that included reflection as one of its categories. The complete initial instrument consisted of eight families of categories [53]: retweets, mentions, aims or functions, types of resources included, conceptual theme, instrumental theme, project relation, and emojis. The data analysis concluded in the selection of 496 reflexive tweets, which means that more than half of the tweets collected were reflective to some extent (51.29%). In this new research stage, we aimed to determine the level of the students’ reflections and how reflective these tweets were.

#### 4.1.2. Reflection Level

An instrument to assess the reflective level was implemented based on a previous instrument developed to analyze the reflective writing in students’ blogposts after a PLE-based activity [57]. The rubric was developed into four stages, from non-reflective to the highest level of reflective. For this analysis, the three stages of reflective interventions were used. Examples were added to each level to make the implications of each reflective level clearer. According to Table 2, the highest number of reflective tweets corresponded to the analysis of learning level (54.44%), followed by the descriptive level (43.55%). The level with the fewest tweets was the meta-analysis level (Level 3), with 2% of the total of tweets.

**Table 2.** Stages of reflective tweets.

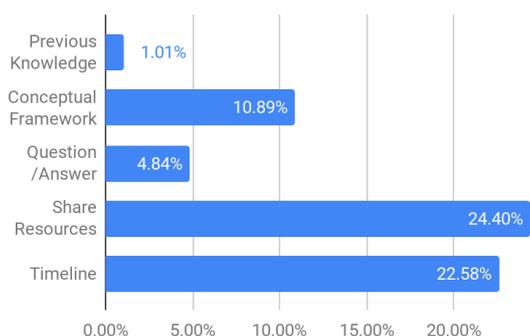
Reflection (N = 496)	Analysis	Examples
Descriptive (N = 216)	43.55% were descriptive tweets which included tools and difficulties with them.	22122G111718 #W9 Very funny week discovering augmented reality. Without a doubt a very interesting tool for education! Today's activity has been very enriching. Learning from others is a great help to improve work. Together you can #22122g31718 #w13 #w1 We have to be prepared to live, learn, and teach in a world where reality is not
Analysis of learning. (N = 270)	54.44% were about the personal perspective of the impact of the new learning.	distinguished from the virtual world. 🧑🏻 🗄️ #22122G111718 #w4 In education, technology is not enough if we do not have a suitable methodology. Little by little we can improve 🧑🏻 #22122G111718 #22122g31718 Thanks to twitter I have
Meta-analysis (N = 10)	2.02% were tweets about the transformational experience derived from the new learning.	realized that synthesizing costs a lot but with practice and patience can be achieved. Cheer up super team.

#### 4.1.3. Description of Tweets

In this third step, the content of the tweets was analyzed to identify the main purpose of the message, theme, and its distribution in the reflection level.

Some observations included the following:

- The reflections were related to sharing resources (121 tweets, 24.40%), the timeline of what was being done in the classroom (112 tweets, 22.58%) or sharing their tasks or projects (28 tweets, 5.65%), or the conceptual framework and theoretical concepts that were worked on during the course (54 tweets, 10.89%), as is shown in Figure 3
- Conceptual content was highlighted more than the instrumental content (Figure 4). The content of the tweets included (see Figure 4) conceptual topics (261 tweets, 52.62%), instrumental topics (182 tweets, 36.69%) related to the content of the course, and the student's own project (28 tweets, 5.65%).
- The main topics of the reflective tweets were as follows. Conceptual themes include the integration of Information and Communication Technology (ICT) in education (74 tweets, 28.35%), reflection models on the integration of ICT in education, (38 tweets, 14.56%), and training in the use of social networks in primary education (36 tweets, 13.80%). Among the instrumental themes, the main topics of interest for the students were educational resources (multimedia materials), (54 tweets, 29.34%), innovations in augmented reality or QR codes (29 tweets, 14.53%), and audiovisuals (23 tweets, 12.25%) for primary education.

**Figure 3.** Function of reflection tweets.

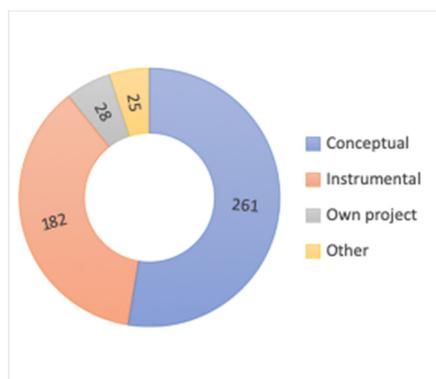


Figure 4. Topic reflection tweets.

By ordering the topics of tweets according to the level of reflection, we could observe that (Figure 5a,b):

- The main function of the reflective tweets, in the three levels, was to share resources (51.29%).
- The descriptive level (first level) included more instrumental (24.80%) than conceptual (10.08%) tweets, as well as reflections about the student’s own projects (4.44%). In addition, the main function of this level was providing a timeline of what was being done in the classroom (17.34%) and sharing resources (15.73%).
- On the contrary, the tweets at the analysis of learning level (second level) coded more conceptual content (41.94%) than instrumental (10.08%), and they referred to theoretical concepts that were worked on during the course (7.86%); including resources (8.06%).
- The few tweets of the third level (the meta-analysis level) mainly featured instrumental content and were related to the timeline of the classroom and other resources.

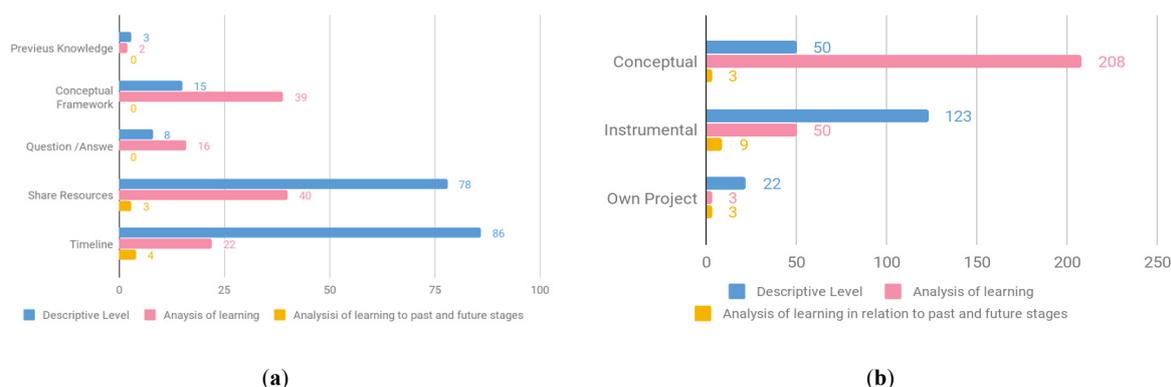


Figure 5. (a) The main function of reflective tweets by reflection level. (b) The main content of reflective tweets by reflection level.

#### 4.1.4. Interaction: Mentions and Retweets

For interactions on Twitter, we classified mentions to other users and retweets, and we considered both peers from the group and experts—mainly experts in the field or other in-service teachers.

There was a good social interaction level in the reflective tweets between the peers and experts (see Table 3). Of the 496 shared tweets, 8.06% of the tweets (N = 40) were retweets (of which 3.83% were from peers and 4.23% were from experts), and 3.43% of the tweets were mentions (N = 17) (of which 2.02% were mentions to classmates and 1.41% were mentions to experts or professors).

**Table 3.** Classification of mentions and retweets.

	Mentions			Retweets		
	Peers	Experts	Total	Peers	Experts	Total
Descriptive Level	7	7	14	13	10	23
Analysis of learning	3	0	3	6	11	17
Analysis of learning to past and future stages	0	0	0	0	0	0
Totals	10	7	17	19	21	40
%	2.2%	1.41%	3.43%	3.83%	4.23%	8.06%

Interactions were observed in reflection levels 1 and 2. The descriptive level (level 1) included 7.46% of tweets with mentions and/or retweets, with a higher level of the latter.

#### 4.1.5. Use of Emoticons and Emojis

An analysis of emoticons and emojis was also performed. A total of 41 tweets (8.27%) were counted. Curiously, these emoticons and emojis presented almost exclusively in one group (see Table 4)—the smaller group, which also had the highest ratio of tweets per student, as shown in Table 1. These data showed that the smallest group used this visual resource with higher frequency than the larger groups. This fact could be understood as an indicator of a higher emotional commitment to the task or the group, possibly as a result of the size of the group, whereas the larger groups wrote more neutral and academic tweets with few little visual symbols.

**Table 4.** Distribution of the tweets with emoticons for the groups of students and the level of reflection of the tweet.

Reflective Level	Tweets with Emoticons or Emojis				
	G1	G2	G3	Total	%
L1. Descriptive	1	2	35	38	7.66%
L2. Analysis of learning	0	0	3	3	0.6%
L3. Meta-analysis of learning	0	0	0	0	0%
Total	1	2	38	41	8.27%

The use of emojis was clearly related to the descriptive reflective level. The position of these symbols seemed to be at the end of the text in tweets, but it was usually before hashtags. When expressing emotions, faces were mostly used to represent happy feelings, including heart eyes. Only one doubtful emoji was observed, and it was included in a tweet assessed in the second level of reflection. There were other motivational symbols observed, mainly including strong arms, which was coherent with the motivational messages in the first level of reflection. Very few tweets at the second level included emojis, and the small number of tweets at the third level (with no emojis) did not allow us to suggest descriptive patterns. However, this fact itself could be interpreted as a pattern, and the usage of emojis could be related to lower levels of reflection.

#### 4.2. Second Research Aim: Students' Perceptions

Participating students were also asked to submit a reflective final written text as their self-assessment report on the impact of Twitter for their learning. A total of 68 students submitted this final task, among which a total of 220 text extracts were analyzed against the developed instrument and presented in the previous sections. These pieces of text (as a content unit) showed a narrative of general learning benefits (N = 56) along with the quite relevant impact of social learning (N = 60). Among the more concrete comments on the learning design of the “a Tweet a Week” activity, we found a total of 73 pieces of text focusing on the tool (more on advantages than disadvantages) and 31 on the summarizing activity, among which hardly any comments were about its potential benefits (N = 30), as can be seen in Table 5.

**Table 5.** Student's perception. Count by analysis categories.

Family	Learning Benefits	Twitter and Learning Activity: Summarizing				Social Learning
		Benefits of Twitter	Limitations of Twitter	Benefits of the Activity	Limitations of the Activity	
Category						
Units (N = 220)	56	42	31	30	1	60

Students' perceptions of the learning activity and their acquired learning are reflected in Table 6, which presents a selection of student' statements that are organized into the categories of analysis.

**Table 6.** Students' perceptions. Coded statements by category.

Category	Coded Statements and Frequency
Reflection on the learnings and learning processes	- This learning activity involves reflecting on concepts, searching, and extending information, and solving doubts (3); you have to understand the content that you want to communicate (5).
	- It promotes reflecting on what has been learned during the week (2).
	- To learn how to organize information (1); information management (1).
	- I list the topics I have enjoyed more (2) and check if classmates have already tweeted them.
	- To grasp the key concepts, I had to go through a reflection process and information comprehension and management (1); to think weekly on what has been most important (1); previously, you had to take notes on what you thought was more interesting (1).
Benefits of Twitter and its educational uses	- It provides material to study on (2); as a chronology (1); to see the content summarized (1); or as one's own lineal pathway (1).
	- Students perceiving Twitter as a social platform for their learning aims (2); useful for teachers and students (1); source of information and source for the teacher as a researcher (2); to follow professionals (5); to share information and resources (4); to take part in discussions (1); to generate a community (1); to retrieve and share information (1); to network with other teachers (1).
	- Educational usages (4) and an assessment tool (1).
Limitations of Twitter	- Learning how to interact with others (5); to have followers and follow others (1).
	- The length of tweets as a limitation (31).
	- Among these 31 repetitions of the limitation, 15 showed a change towards positive perceptions. 16 focused on limitations from a negative perspective, with no change from their initial perspective.
Benefits of the Learning Activity	- To reflect on what it is learned (2).
	- To learn to summarize (2); it makes you select the most suitable words (4); to summarize the information/what you have learned (27).
	- As the activity develops, it was less difficult for me to choose the right key works (3).
	- It helps understanding content better (16); reviewing the content lessons to be able to write a more accurate tweet on learning (7); to be more aware on lesson development (2); it helps realizing if content has been truly understood (2).
	- To express ideas (1); to learn new words (1).
Limitations of the Learning Activity	- To deepen my learning (1).
	- I learnt a lot.
Benefits of Social Learning and interaction	- Tweets lack reflection or it is not deep (1).
	- To compare one's own perspectives or interests with those of the classmates (8); to see if my classmates had understood the same as me (1)/to see if I had understood the content properly (1)/to see different perspectives (4)/to understand the topic through classmates examples (2)/it makes you reflect on what has been done in class (2).
	- To solve doubts (3).
	- To understand content (8)/to clarify and reinforce content (2)/to review (1).
	- To discover new tools (1)/to discover interesting content on which I hadn't paid attention.
	- To guide my own reflective process (1)/to improve my own reflection based on my colleagues' reflections (1).
	- To enrich myself (3).
	- To have a network that is relevant (1)/To read other professionals, generally teachers (4).

The narrative deduced from the students' essays on the learning activity confirmed the generally positive perception that was observable after an analysis of the survey answers [53]. However, the students' tweets offered a closer picture of their perceptions on using a short format for reflective aims. The majority of students agreed that the short format made them think carefully about what was most meaningful to their learning and to select the exact words to be accurate in the formulation of their tweets. Additionally, in order to fulfil the activity requirements, they reviewed content from their colleagues' tweets and compared it with what they themselves had highlighted. However, there was still discussion about whether the short format was a limitation or a benefit for communicating learning. It is worth mentioning that there was only a comment about information being false on Twitter, which is striking given the popularity and increasing distribution of untruthful news.

## 5. Discussion

The research presented in this current article is the newest step of an iterative cycle of learning designs based on Twitter. Here, reflexivity, which we had not studied before, received a deeper analysis. Likewise, an analysis of tweets was done for the first time in this context and provides a relevant contribution to previous knowledge on Twitter for learning and reflective aims. The international context of educational technology research has claimed to need a more critical approach [11,63]. The analysis of the iterative process of learning design with Twitter for teacher education is in line with this current trend and reveals the lack of a relevant design in earlier studies. Therefore, new implementations of this activity will have to include examples on, for example, economic interests. For instance, Williamson [64] noticed the fraudulent use of an educational social media business, in which tweets for marketing aims from false accounts were spread and retweeted endlessly. Moreover, new studies should explore the concept of fake news and safe practices to search and identify information, as well as whether comments by students provide evidence of their increasing awareness.

After working with Twitter for a long period of time, we sought to analyze the complete cycle of iterations carried out so far to collect the lessons learned, the potentials for reflexive aims, and the limitations to be overcome in new editions. The review of past iterations allowed us to achieve an alignment with international research, as our learning designs were aimed at promoting a students' network for collaboration, sharing, and interaction with other educational professionals, as well as enhancing the students' participation and engagement during school. Data collected from the students' perceptions confirmed these benefits, although there were frequent limitations that were reported on the overwhelming access to information. In the third iteration, during the research stage in which the instrument included two questions on the short format of Twitter [19], ambivalent results were obtained. We found a relevant agreement using Likert-type questions, but the final essays presented contradictory arguments. These ideas focused on the need to take care of the words chosen; at the same time, the length limit was a barrier to express and communicate one's own learning. Thus, we concluded that Twitter could have promising uses or reflexive aims, and we have included reflection aims as a research theme for the next iteration.

The short format of Twitter inspired the idea of sharing brief reflections on learning. The title of this activity, while playing with language, did aim to show students the main task of the activity: to think on their learning during the week and highlight what had been most relevant to them, whether they realized this importance during the week (in a kind of in-action answer [65]) or whether they realized it at the end of the week, in a kind of "on-action" reflection [60]. Though some students confirmed reviewing their learning during the week to properly reflect on what had been relevant to their learning process, they discussed some nuances that suggest new areas of research.

The analysis of reflection on Twitter revealed some similar patterns to reflections using other social media services. The results of the implementation of the rubric demonstrated the lack of depth of the students' reflection tweets. This is in line with previous studies, where difficulties in engaging in deeper levels of reflective processes in blogs such as e-portfolios have already been observed [58]. However, it seems that this is taken to the extreme on Twitter, as only one tweet fit the last level of the

reflective process, in which metacognition was the main focus. This allows us to suggest challenging discussions. This result is in line with previous studies for which metacognition was also a strategy, such as the work by Dabbagh and Kitsantas [41], who observed higher usages of Twitter for information management than for self-assessment. These results are also linked to conclusions by Cho and Cho [42], who observed higher usages for metacognitive aims in the groups of students trained for such uses than in the control group who were not.

The number of tweets described as reflective and the decreasing number of tweets belonging to higher levels of the rubric suggest that Twitter is particularly useful for usages other than reflection, such as the ones already detailed in earlier research and cited previously in this article. The fact that hardly any students' reflective tweets were coded as levels 1 and 2 (the descriptive and analytical levels) suggests that Twitter could be more useful when such reflections occur during learning (reflecting Schön's in-action concept) rather than on learning (reflecting Dewey's "on-action" reflection). Nonetheless, these findings contribute to the ongoing discussion on the potential of Twitter for reflective aims, and, although the findings do not allow us to take a stance on Twitter's improvement of reflexivity exercises, this discussion remains very complex, and this research contributes more detailed data. Therefore, although the data collected do not give evidence of higher level metacognitive skills, the total number of reflexive tweets showing descriptive and analytical skills confirm the potential of Twitter for reflection, which is more in line with research showing a positive impact [42]. However, if enhancing lower levels of reflection is understood as a limited practice, especially for teacher education or other professional roles that could be seen as critically reflective, then these impacts are insufficient and more in line with the results of Dabbagh and Kitsantas [41], who applied more self-assessments and metacognitive skills.

The perceptions of students reflected in their final essay submissions contribute to this challenging debate. There seemed to be agreement on the effect on learning by reviewing lessons to tweet the most meaningful elements and to summarize ideas due to the short format of Twitter, even after the extension of the word limit, which is in line with research by Tang and Hew [4] and Luo, Shah, and Crompton [38]. However, this result is not exempt from discussion, and some students changed their initial negative opinions of the limited word format. However, a significant number of students maintained that the number of words was a barrier for their reflective writing, which is in line with the conclusions by Ahmad Kharman Shah, Latif Shabgahi, and Cox [5].

A content analysis of the reflective tweets also revealed some interesting patterns. First of all, reflective tweets included resources in a relevant average of more than 24% of tweets. However, this still suggests that the majority of reflective tweets were comprised of plain text with no resources. Secondly, the themes included in the tweets seemed to reveal an underlying pattern. The descriptive level (level 1) seemed to focus more on instrumental topics, which is coherent with previous research that observed a quicker impact of technical skills on student learning [66]. The analytical level (level 2) was more related to the ability to understand and apply new learned concepts, which agreed with the fact that these tweets focused more on the theoretical content of the subject than the tools. Thirdly, the presence of emojis was limited, and their presence was mainly found in the lower levels of reflection. The sentiment analysis [8] allowed us to observe the prominence of positive feelings represented with happy faces and other motivational symbols like applauding hands or strong arms. These emojis were mainly situated towards the end of a tweet and have been related to a greater emotional load [49]. The usage for the feeling expressions of the emoji and the level of reflection observed in the tweets showed a certain coherence of meaning. In the descriptive level of the complete version of the rubric [57], it could be seen that the emotional narrative was related to lower levels of reflection, and emojis were mainly used for sentiment communication. Thus, our findings agree with the fact that emojis normally express feelings and that these emotions are normally included in low levels of reflective tweets. Furthermore, the emojis in these tweets could be interpreted as a critical approach. The awareness that emojis are cultural symbols and that they can be representative of certain dominant and powerful cultures or groups of people [48] is evidence of the non-neutrality

of technology. The students mainly used human-related symbols represented with a light skin color, which did not show awareness of diversity, although this is a concept very much extended to teacher education. Thus, the hypotheses for further studies should focus not on unfamiliarity with the diversity concept but with a lack of awareness of the cultural load of visual symbols like emojis.

## 6. Conclusions

The content analysis evoked a description of reflective tweets as being mainly text-based, particularly for higher level reflective tweets. A tweet with a low level of reflection, either descriptive or analytical, can include, with higher recurrence, resources and social interaction (with a greater probability of retweets among classmates than to other professional agents out of the formal group). The topics of these tweets can be instrumental at the lowest reflective level and more conceptual at a deeper reflective level (analysis of learning). This is an extremely interesting relationship that should be confirmed with new research, expanding the number of contexts and participants. Additionally, superficial or descriptive reflexive tweets may include emojis that show positive feelings and motivational messages. For the limitations of the study, the convenience of the participant sample and the small number of tweets collected and classified as reflexive did not allow us to offer firm conclusions. However, the observed representation appears potentially interesting and challenging for further work and suggests new research hypotheses. Another area for further research is to explore the usage of emojis as indicators of emotional commitment, both as a result or as a booster, which could be easier to develop in smaller groups.

The performance derived from the “a Tweet a Week” activity revealed very interesting practices that will help us orient new iterations of this ever-evolving cycle. Considering both the reflexive and content analysis, some recommendations can be suggested for future educational implementations and research. The more frequent recurrence of tweets at a descriptive level of reflection and the already known difficulties for deep reflection on social media suggest interesting future learning designs with reflective aims that could scaffold reflections in and on learning and could welcome both for tweeting. Moreover, a new implementation could explore the possibilities of combining social media for different reflective tasks and offer microblogging for networking, information, and reflections in learning and blogging as a metacognitive task to apply all these microtasks to meaningful learning, which would be in agreement with the uncommon learning design by Chawinga [67] or the two selves described by Cambridge when referring to the e-portfolio universe [7]. Finally, the review of learning designs in the iterative process of innovation points to the need to include, in future editions, a critical approach that offers examples of hidden commercial uses or the spread of fake news, along with a more inclusive application of cultural elements such as emojis.

There exist diverse types of technologies that can be used to enrich learning, and social media is one of them. The challenge is to design technology-enhanced learning environments that can promote high-order skills and critical thinking [68]. This study contributes to the development of reflective skills in initial teacher education and lifelong professional development. Social media has had an important impact on teacher education, but, among all the aims, reflective skills are the ones that have been the least explored. This research could be useful both for those interested in the digital skills of teachers and for those with an interest in the reflexive skills in teacher education projects designed with Twitter, which could be a possible answer to scaffolding pre-service and in-service student teachers.

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## Appendix A

**Table A1.** Categories to describe tweet's content and reflection level in a learning activity using Twitter.

Family	Categories	Student 1 Tweet 1	Student 1 Tweet 2	...
Subject message	Conceptual topic <sup>[1]</sup>			
	Instrumental topic <sup>[2]</sup>			
	Project-related			
Exchange and sharing	Interaction based on questions and answers			
	Daily report			
	Artefact-based <sup>[3]</sup>			
Learning construction	Previous learning			
	Content			
	Reflexive and Metacognitive <sup>[4]</sup>			
Social	Mentions to classmates			
	Mentions to experts			
	Retweets of classmates			
	Retweets of experts			
Emoticons	Position <sup>[5]</sup>			
	Feeling <sup>[6]</sup>			
	Theme <sup>[7]</sup>			
	Skin color <sup>[8]</sup>			
Reflexive level (if reflexive)	Descriptive Level			
	Analysis of learning			
	Analysis of learning relative to past and future stages			

<sup>[1]</sup> Codes for conceptual topics: ICT, digital competence, TPACK model, SAMR model, flipped classroom, tablet and smartphone, ethical themes, robotics, social networks, augmented and virtual reality, gamification, and good practices; <sup>[2]</sup> Codes for Instrumental topics: multimedia, augmented reality and QR codes, scratch, geolocation, Twitter, Edmodo, Web, PLE, and Digital Blackboard; <sup>[3]</sup> Codes for the artefacts included: video, image, article, tool, and didactical media; <sup>[4]</sup> The paper only presents the work with the reflexive ones; <sup>[5]</sup> Codes for position of emoticons: at the beginning, in the middle of the tweet, at the end of the text in the tweet and before hashtags, at the end of the tweet and before and after hashtags, and at the very end of the tweet (also after hashtags); <sup>[6]</sup> codes for feelings represented by emoticons included: happy faces, doubtful faces; <sup>[7]</sup> Codes for themes included: educational objects, party objects, hearts, arms and hands (showing strength, applauding, fingers for victory); <sup>[8]</sup> Codes for the skin color of human parts of the body: yellowish default color, darker color.

**Table A2.** Categories to analyze students' perceptions about the learning activity "a Tweet a Week" using Twitter.

		Student 1 Text Fragment 1	Student 1 Text Fragment 2	...
Twitter and the activity: summarizing	General themes			
	Benefits of the tool			
	Limitations of the tool			
	Benefits of the learning activity			
	Limitations of the learning activity			
	Social learning			
	Other			

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