Didattica, riconoscimento professionale e innovazione in Università

A cura di
Loredana Perla e Viviana Vinci

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Perception on the use of tools for the teaching-learning process of mathematics during the SARS Cov-2 Pandemic

di *Ángel Alberto Magreñán, Lara Orcos, Simón Roca*

In this chapter we present a study carried out during the SARS COV-2 pandemic that is hitting the world. During this period, the classes of mathematics at University level in the Spanish territory had to be held online and, therefore, different tools had to be used to continue teaching. In this sense, based on the use made of them, we have selected different tools and students have given their perception both for teaching and for the assessment online. The results show that although students like the use of these tools and they would not mind using them assiduously in class as they are adequate tools for online teaching, they would not like to be assessed with them.

1. Introduction

Distance Education involves a learning process in which face-to-face sessions are non-existent or rare, even though there is still a supervision of a teacher, as well as activities, evaluations, bi-directional feedback and a learning sequence. Thus, this modality relies strongly on the available communication technologies. For instance, one of the first examples of a formal Distance Education course was a shorthand course provided by Sir Isaac Pitman in 1840 through the national postal service established in the United Kingdom, that was later implemented in the United States by the Phonographic Institute of Cincinnati (Casey, 2008).

Bozkurt (2019) carries on a research on the many definitions and cases of Distance Education, identifying different ages and generations of Distance Learning depending on the dominant technologies of each time, such as correspondence, broadcast radio and TV, teleconference, and lately, the

Internet and the World Wide Web. For each one of the proposed ages, several characteristics of the learning process are provided – for instance, the first distance learners were mostly adults, due to the suitability of this kind of programs for adapting to different occupational, social and family commitments.

The advent of Internet became a paradigm shift, when some institutions and universities offered open courses online, by the time others started to provide materials, resources and lately tasks, tests and classes through the web as part of regular courses. Those elements and tools that once characterized Distance Education for adults were then used to complement the learning of undergrad students, boosting new methodologies. Nowadays, these changes are present in all universities and increasingly in high schools, with fully distance courses for the first, and ICT-based resources for the second.

Distance Education in Spain has been following the same path. Bartolomé and Underwood (1998) found correspondence courses in the 1930 decade, and distinguish the relevance of Radio ECCA (1967), offering primary studies courses to adults in rural areas through radio. A few years later, the General Law of Education of 1970 was the first time Distance Education was regulated in the country. Courses offered on correspondence, radio and TV were now legally considered as an official way for adults to achieve studies up to Secondary Education that they were unable to obtain before. In 1972 the UNED (Universidad Nacional de Educación a Distancia) was founded, becoming the first university providing distance programs.

A current definition for Distance Education could be the one provided by Heedy and Uribe (2008), as the educative strategies and modalities that let the learning process overcome the limitations of time and space – e.g. asynchronous online sessions – and occupation or skills of the learners. In this direction, there is a big overlapping between this definition and the concepts of Online Education and Online Learning, since they commonly share resources, technologies, with cases in which they co-exist. Nevertheless, many other fields in Education research look for evidences on the suitability of these frameworks and resources to improve the performance of students. Some definitions and evidences are included below.

'Flipping the classroom', or most commonly, 'Flipped Classroom', is a fairly well-known methodology popularized by two high school teachers in USA (Bergmann and Sams, 2012), after experiencing with the creation and distribution among their students of short didactic videos through the Internet. Concretely, this proposal aims to let the magistral lectures be watched at home, where students may initiate their learning of a certain unit

by watching the video lectures, allowing the face-to-face lectures to be dedicated to consolidate knowledge, solving tasks and problems and being able to identify doubts and misconceptions interacting with the teacher and/or peers. A theoretical basis for this approach can be found in the concept of reverse/inverted classroom, proposed by Lage, Platt and Treglia (2000), as a framework for the Internet use in the classroom, adapting the presential sessions.

Ahmed (2016) conducts a review were many definitions related to flipped classroom are provided, and the basic characteristics of this methodology are pointed out, such as the dynamic, active and selective transference of information – typically videos, screencasts or voice records - to the students out of the class to free time at school; the educators becoming guides to knowledge instead of mere distributors, while the students become active learners who can access to resources as many times as they desire and using classes to collaborate and apply their previous knowledge; and finally, the teacher being able to focus on providing opportunities in class to develop rich higher-order cognitive skills.

Nevertheless, flipping the classroom demands effort both from teachers and students. Jordán, Magreñán and Orcos (2019) analyze the effects of providing didactic resources such as videos and tutorials weekly, together with a formative continuous evaluation. This work, carried out at university levels, allowed to compare the results from groups where Flipped Classroom or regular education were used. Weekly activities and tasks solved week after week were helpful for the experimental group, while the videos improved the interaction with teachers and made the students feel more prepared towards exams. However, if certain criteria are noy met – the teacher is engaged, providing materials at the right pace and interacting with their students, who they develop a daily work routine, becoming available and motivated to study – performance could not be better. For instance, many students will not watch videos if they do not feel pressure, they may feel the work load is excessive, or may feel marginalized if they perceive the subject as hard or they dislike the proposed methodology.

E-Learning, that is, Electronic Learning, is a term that includes several applications, methodologies and processes (Arkorful and Abaidoo, 2015). A general definition could be the use of Information and Communication Technologies to provide access to online educative resources. It is involved in different learning scenarios, such as fully online, blended learning, individual or collective learning, synchronous or asynchronous, but there is no consensus on whether if it is a field by its own or a subfield or variant of Distance Education or Computer-based Learning.

This heterogeneous field considers different technologies to be used not only as information and knowledge support, but as enhancers of social interactions or as time and study management tools. The abovementioned work identifies several advantages and disadvantages of the application of e-Learning, in which there is an evidence need of guarantee interaction, self-efficacy and self-regulated learning for students, since they gain more responsibility on their learning process as it becomes more flexible (Rodrigues, Almeida, Figueiredo and Lopes, 2019).

Whenever ICT are used, teachers have to be aware of some of their main risks, such as the Internet addiction, and cyberbullying, affecting students' performance and mental health. A detailed quantitative analysis of the usage of these technologies by young people across several countries can be found in the different reports from the European research project Net Children Go Mobile (Mascheroni, G., & Cuman, A., 2014).

Blended Learning is a relatively new concept referred to any combination of face-to-face instructive activities with online activities, in order to stimulate and support the learning with the help of ICT (Boelens, De Wever and Voet, 2017). These authors highlight that it implies a redefinition of learning, not a substitution or alternative, and makes no distinction of the used methodologies. Four main challenges when implementing blended scenarios arise after a vast review of literature was conducted – 1. Space/time flexibility favors students' autonomy and interactions, with self-pace learning and a personalized learning path. 2. Whenever there is distance learning, is harder for teachers to identify learning difficulties. Blended scenarios should still count with bidirectional communication channels between students and teachers, to prevent isolation and lack of social interaction. 3. Students' learning process, as stated before, strongly depends on skills such as self-regulation, discipline, time management, ICT usage and comprehension or self-efficacy. 4. Emotional engagement, since the lack of face-to-face activities might have a negative impact in students' emotions, decreasing motivation and increasing dropout risk. Teachers should promote empathy, sense of humor, direct support and individualized attention.

Blended learning is a methodology-agnostic term, since each blended environment may involve one or many methodologies, from an adaptation of the lecture-based regular courses, to alternatives like Flipped Classroom, Cooperative Learning or even Project-Based Learning (PBL). For the last one, Cheng and Yang (2019) conducted a metanalysis of 30 journal articles referred to the usage of PBL among different countries and teaching levels, finding a positive effect on academic performance, conditioned on variables like the schools' location, instructive hours or the technological support.

Whenever classes take place on distance, teachers should realize many risks the students may incur on. For instance, Zavarella and Ignash (2009) measured how university students on blended and distance courses showed higher drop-out rates, by the time online students had a lower retention of the taught contents. Another example is the one provided by Ardura and Zamora (2014) on a grade 12 Physics class in Spain, where the authors used the Learning Management System (LMS) Moodle for several weeks, and noticed how the students considered it an useful result, but most of them felt unprepared to base its learning process in this tool. Finally, Jiménez Villalpando et al. (2019) considered 11-12 grade Math students in México, comparing groups experiencing face-to-face teaching and a blended environment. The first ones valued the role and utility of Mathematics in learning and future careers more often, enjoying the classes more than their partners, while the blended group perceived a higher cost when working on the subject. These observations led the authors to remark the effects on motivation of teachers promoting Mathematics and its understanding in class.

It has been stated how Distance Learning, Flipped Classroom or e-Learning describe learning environments where online resources as videos are frequent. Provided by teachers or found on the Internet, students have access to a vast amount of videos explaining concepts, procedures and many other contents. However, it is uncommon that these resources have been tested about their quality to be used by students.

Didactic suitability is a conceptual tool behaving as a test to measure the optimality of a content or resource in relation to how it connects the meanings the authorities want to transmit, and the personal meanings students construct (Godino, 2014). This tool is part of the theoretical framework proposed by the same author, the onto-semiotic approach to research in Mathematics education (Godino, Batanero and Font, 2007). It considers six components or dimensions in which a resource could be suitable for teaching, such as how it can be adapted to the cognitive process of each student, as well as to its interests and motivation, how it considers and interacts with the environment and resources of the class, etc.

This construct helps the teacher to meditate about how to improve the learning process, highlights the relevance of the learning context, formalizes Math education mimicking the argumentative process of science, and illustrates how a resource can be suitable in some dimensions and not in others simultaneously.

2. Methodology

2.1 Sample

For the development of this study, we took a sample of 33 students from a public University in Spain of ages over 20 years. The subjects in which this software have been applied are related to mathematics and its teaching in different levels.

2.2 Procedure

This year 2020, due to the pandemic that is ravaging the world, we also have to face a new added difficulty associated to the online teaching and even more complicated the online evaluation.

In this study we present a series of tools that we have been using in online mathematics teaching in the last months of the 2019/2020 course that have been developed online.

The procedure has been the following:

- We have used the software online classroom.
- We have solved some questions about the material (online classroom).
- The students have asked for solving individual and group problems (outside the classroom).
- Finally, an evaluation survey has been used to know their perception of the software.

In concrete in this course we have used different software, but we have selected the following 4 software, since these are the tools used by most of the students.

- Kahoot!
- EdPuzzle
- Quizizz
- Geogebra

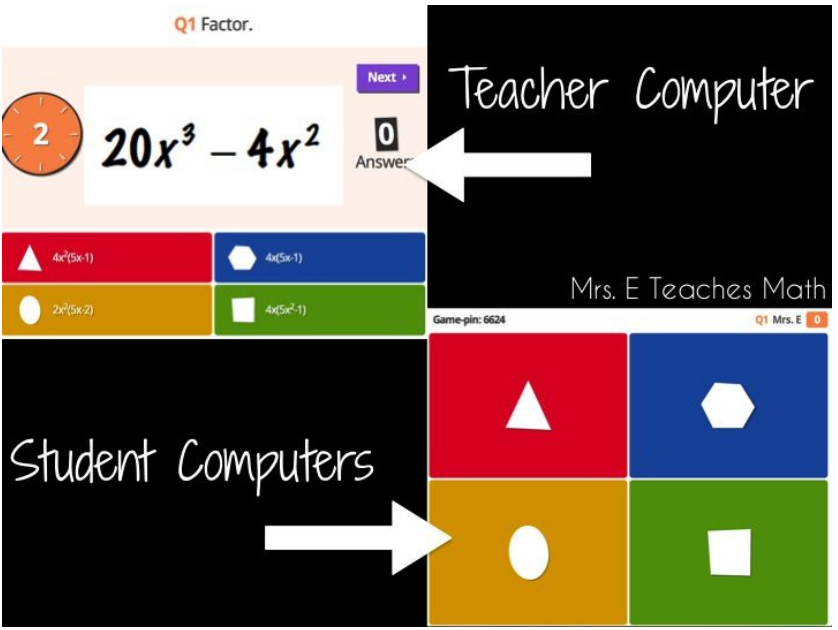
Each software has its own characteristics which explained below.

2.2.1 Kahoot!

The principal characteristics of Kahoot (https://kahoot.com/schools-u/) are:

- It is the most well-known software of the ones we have used in this study.
- It is used all over the world, by many teachers in different areas and fields.
- It allows to use different types of questions.
- It promotes the M-learning.
- It is one of the most used software to apply gamification in classroom.
- The creator of the games is the teacher.
- There exist repositories of games already created by other teachers, which also allows the teacher to adapt other problems.

Figur e1. Kahoot interfaces. Taken from:
https://i.pinimg.com/originals/0c/f0/27/0cf027741c619fa5d6360f697773b4d0.jpg



The use of Kahoot! in classroom is growing and many authors have been using it in the classroom with good results (Chaiyo and Nokham, 2017;

Palma, Tobías, Prieto, León and Ruiz, 2018; Göksün, and Gürsoy 2019; Curto, Orcos, Blázquez and León, 2019).

2.2.2 EdPuzzle

The principal characteristics of EdPuzzle (https://edpuzzle.com/) are:

- It uses videos and allows to introduce questions inside the video which students should answer to continue with it.
- The video should be completely shown.
- Rewind and forward are disabled.
- The platform has the percentage seen by each student and the time they have used it.
- All videos can be picked from well-known platforms such as YouTube or be created and uploaded by the user.
- It is really useful in Flipped Classroom methodology and in problem-solving sessions.

Figure 2.-Edpuzzle interface. Taken from: https://s3.amazonaws.com/media-p.slid.es/uploads/181354/images/2410620/video.PNG

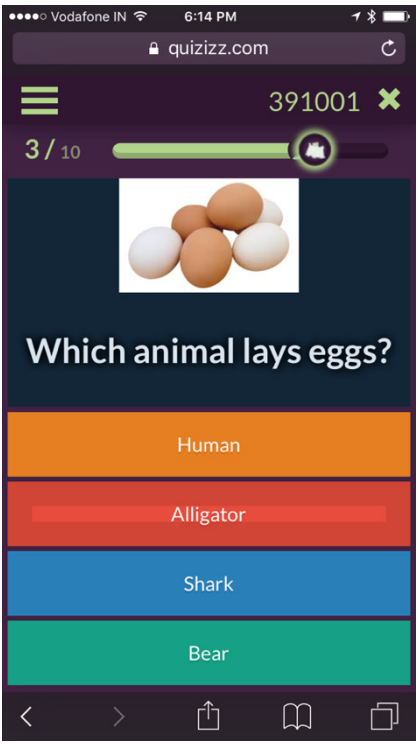
The use of EdPuzzle in classroom is growing and many authors have been using it in the classroom with good results (Palma, Tobías, Prieto, León and Ruiz, 2018)

2.2.3 Quizizz

The principal characteristics of Quizizz (https://quizizz.com/) are:

- Promotes the participation of students to use of technology.
- It has automatic assessment of the students with different options such as:
  - Instant feedback.
  - Different types of questions.
  - Shuffle answers.
- It is really useful and interactive.

Figure 3. Quizizz interface- Taken from: https://blog.quizizz.com/new-question-viewer-on-quizizz-game-an-upgrade-for-the-questions-with-images-503fe6583f17?gi=5adc9bbdf9bf



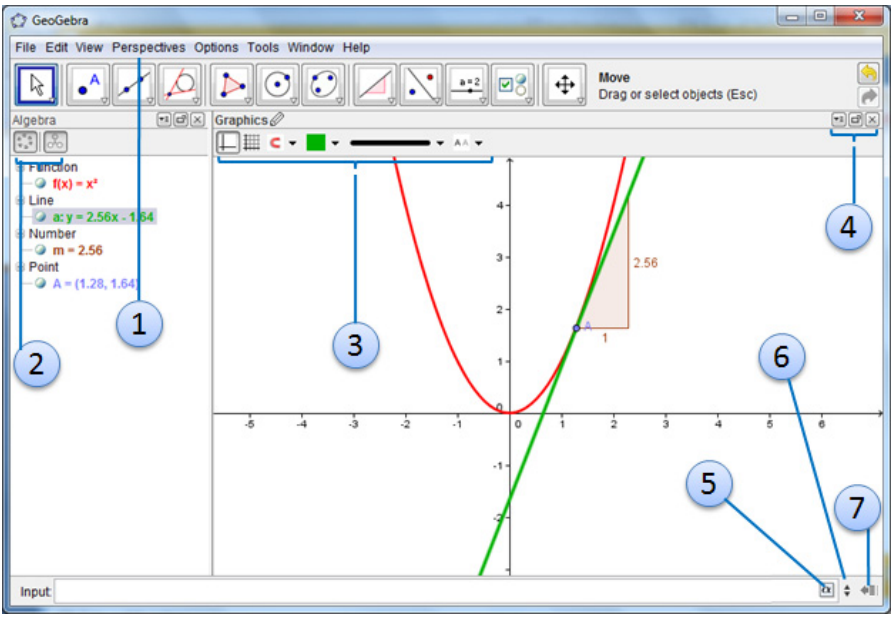
The use of Quizizz in classroom is growing and many authors have been using it in the classroom with good results (Chaiyo and Nokham, 2017; Göksün, and Gürsoy 2019).

2.2.4 GeoGebra

The principal characteristics of GeoGebra (https://www.geogebra.org/) are:

- This tool promotes the participation of students to use technology, online or offline, since it has an executable to be installed or just run in a computer, tablet or even in a mobile.
- It is really useful to understand geometry, since it is manipulative and very visual.
- There exist several repositories done by other users, including world-recognized professors and teachers all around the world.
- This tool is really intuitive and easy to develop the "learn by doing" skill.

Figure 4.- Geogebra interface. Taken from: http://mathandmultimedia.com/wp-content/uploads/2011/05/geogbra4-0window.png



The use of GeoGebra in mathematics classroom is not new. Some studies are the ones of Hohenwarter and Fuchs, (2004) and Hohenwarter and Jones, (2007).

2.3 Information Collection Tools

The data has been collected through on-line questionnaires using Microsoft Forms in which we used a Likert-Type Questionnaire, in which we have encoded negative and positive responses with the following structure:

- Questions about the usability and applicability of each tool in the classroom.
- Questions about the evaluation of the tool.
- Questions about the desire to use them in class.

The number of non-empty responses was different in each question, while for Kahoot software we obtained 33 responses, for Quizizz 29, for EdPuzzle 28 and for GeoGebra software just 21.

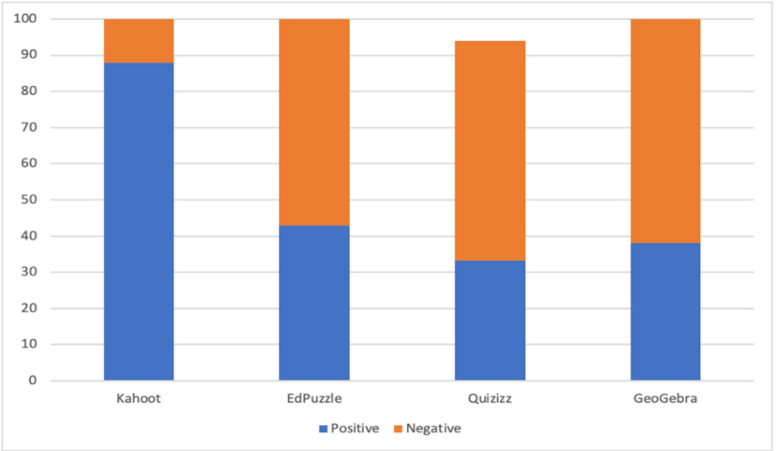
2.4 Data Analysis

We have studied the descriptive statistics of the assessments of the students of each item of the questionnaire in order to obtain the positive and negative responses and its percentage. On the other hand, we have also computed the mean of the evaluation of each tool in order to obtain an ordered list of preferences for future courses.

3. Results and discussion

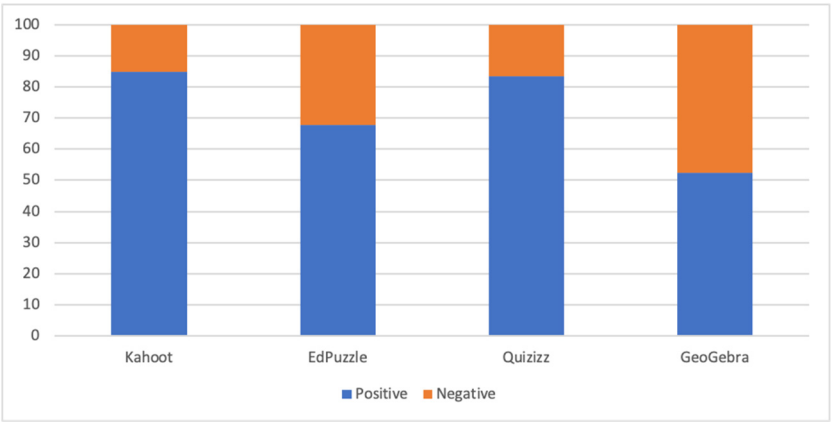
We show first which of the software used is best known among the students. This information is collected in Figure 5, where we see how clearly the software best known by students before using it in the classroom has been Kahoot, which is known by about 90% of students. On the other hand, we see how the other software used is known by less than half of the class.

Figure 5. Percentage of responses on whether or not they knew the software before using it in the course.



Another aspect that we want to assess in this study is whether or not they would like the software to be used more regularly in the classroom and the results can be seen in Figure 6. As it can be seen, the software they would most like that will be used in class regularly are Kahoot! and Quizizz, while the worst assess in this sense is GeoGebra, although more than half would like it to be used.

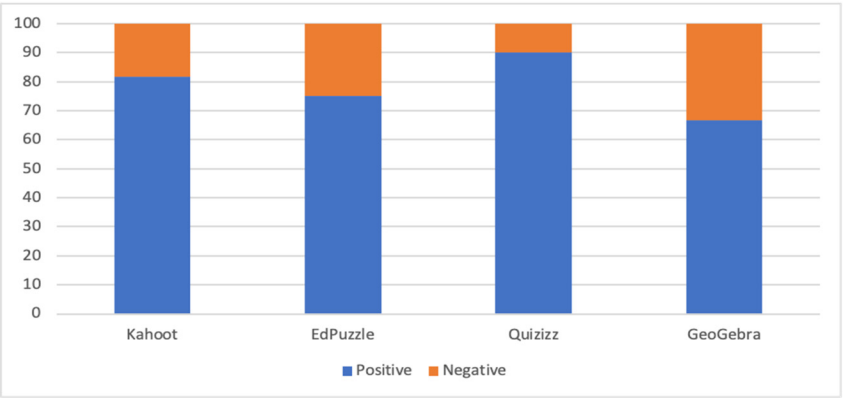
Figure 6. Percentage of responses about whether they would like the software to be used in class regularly or not.



On the other hand, we also wanted to study the perception that students have about whether these tools are good for online teaching or not. In Figure

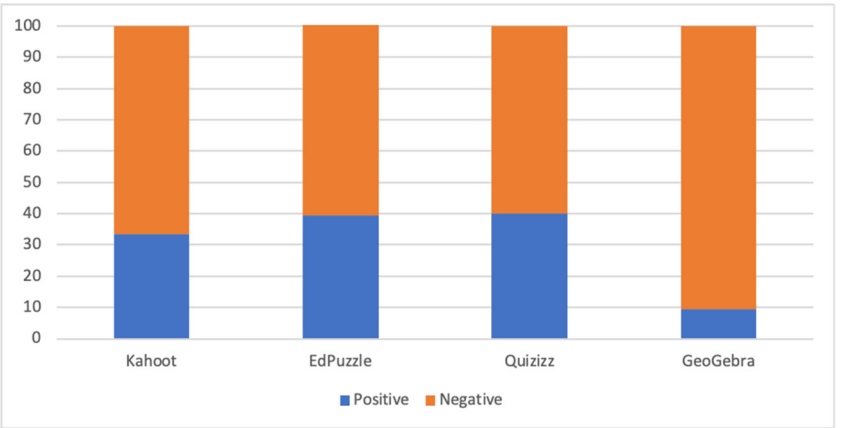
7 the values given by the students can be observed. In this case, we see how the students value the software positively in all cases, especially Quizizz, with 90% positive responses.

Figure 7. Percentage of responses on whether or not they seem good tools for online teaching.



Another aspect that we were interested in was the fact that whether or not they would like to be evaluated using these tools, and the results as we see are negative in all cases, except in GeoGebra whose results are very negative. The data can be seen in Figure 8. Although it can be seen that EdPuzzle and Quizizz, 40% of the students consider them as good tools for evaluation.

Figure 8. Percentage of responses on whether or not they would like to be evaluated using each tool.



Finally, we asked them to globally assess the tools and give them an evaluative grade. The mean data obtained can be seen in Table 1, where it is observed that the best valued tool is Kahoot followed by Quizizz.

Table 1. Average values given by students to each tool

	Kahoot!	**EdPuzzle**	**Quizizz**	**Geogebra**
Mean	6,545	5,607	6,200	5,714

4. Conclusion and future work

As conclusions of this study, we can extract that although the tools studied in this chapter are relatively attractive and new for students, in many cases, their overall assessment of them is not excessively high. On the other hand, we have seen that these tools seem generally good for online teaching but students do not like to be evaluated online with them. Also, we see how Kahoot! and Quizizz stand out as the best valued tools and almost the ones that have obtained the best marks in all the answered items, therefore, the students of the sample prefer software based on questions and with a competition format. Regarding the evaluation, the data obtained show a need to consider or design new tools that serve for this purpose, since students are still reluctant to the existing tools, so there is still a long way to go to find an online evaluation in mathematics field that is palatable to students.

Regarding future work, we have seen how GeoGebra software has not been received as we expected and, therefore, we will try to study alternatives such as DESMOS or GEOEnzo. In addition, other tools have been studied, which have not been included in this chapter due to the low participation and students´ unacknowledged, so another of the ways that remain pending will be the use and study of these tools in the classroom, since among them there are some that seem to be able to show encouraging results in the case this situation based on the online teaching and learning process remains.

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