Frequency of use of online assessment by higher level teachers during confinement due to the COVID-19 pandemic

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A B S T R A C T

The purpose of this research was to review how often mathematics teachers use technological tools to assess their students and, the relationship established with the reliability, ease of use, and usefulness that teachers find in them; in order to offer them courses or workshops that allow them to use different tools that help them in the evaluation process, as well as, to show them different options of use for the different moments in their class, such as in diagnostic, formative or summative assessment. Under the paradigm of quantitative research, a questionnaire was applied to a random sample of 12 teachers from a public institution of higher education in Mexico City. All teachers were invited (N=14), but only 12 were able to participate; therefore, there was an 8% margin of error. The application of the questionnaire was during the period of confinement. The reliability of the questionnaire has been validated and Pearson correlation analyzes have been carried out, based on the variables: frequency and ease of use, usefulness, and reliability. The results showed that in the category of medium use, more than half of the teachers in the sample have shown a frequency of regular use of the online assessment tools. A comparison was made with the authors of the reviewed literature and coincidences were found with the answers given by the teachers. For example, there are authors who showed that teachers use ICT more frequently in their classes when they have all the necessary technological skills. Due to the above, various alternatives were proposed that encourage teachers to use it. The higher the frequency of use of online platforms, the greater the utility they find in them. With the results obtained, it is concluded that the frequency of use of online platforms positively influences the development of confidence that teachers must work with these tools.

1. Introduction

In our society, the use of ICT (information and communication technologies) is more evident and frequent every day in all areas of human activity, and in the educational field, a great incidence of its use can also be observed. And the educational technology has served to enable and promote communication between teachers and students (Molinero Bárcenas and Chávez Morales, 2019).

However, during the COVID-19 pandemic, teachers at all educational levels were forced to observe distance learning platforms, without adequate prior training in their use (Revilla-Cuesta et al., 2021). Consequently, this caused many teachers to feel stress, frustration, and impotence in the face of not knowing how to handle the platforms to interact with their students (Navarro-Espinosa et al., 2021). In particular, it was observed that higher education teachers, in general, had little experience in the use of educational platforms to teach their classes and much less in their use to evaluate their students. The aforementioned was particularly observed both in the subjects of basic sciences and mathematics.

Teachers in the area of basic sciences need to review the resolution of mathematical problems and exercises, for which they indicated that they were unaware of the existence of any platform to take exams, specifically in mathematics. However, some of the benefits of using platforms for online assessment have been found to be the support they

provide teachers for manual grading, as well as the fact that teachers can submit both grades and assignments electronically (Heinrich et al., 2009; Chukwunonso and Oguike, 2013).

It is common to think that the introduction of automatic evaluation web systems results exclusively in a download of the teacher's task, at the cost of using more rudimentary evaluation methods than the personalized correction of assignments and exams. There is an added fear that the online evaluation could open the door to the impersonation of the author of the work and, therefore, that this loses the reliability of the face-to-face exam. That is why automatic evaluation is a challenging field that has been studied by the academic community from different points of view.

Regarding the higher level, particularly in schools of the National Polytechnic Institute (IPN, 2022), the careers that are mostly offered are engineering and the mathematics learning units that are taught are in greater quantity than those of the humanities areas.

Before the confinement due to the COVID-19 pandemic, 100% of the teachers in the surveyed academy used written exams per departmental period, which are three per semester, which have been defined by the institution. The percentage of the total qualification per departmental period constituted between 80% and 100%, the remaining 20% contemplated tasks and works in general (Huerta et al., 2020).

During the period of the pandemic, teachers continue to teach their classes remotely and in the academy meetings they have held, they have commented that managing technology to evaluate their students is not entirely easy today because the classes are remote. Teachers do not consider the tests to be reliable, due to several factors such as the fact that students may find themselves checking the Internet for solutions to problems, whether they have downloaded the solutions from the textbooks that the teacher uses for giving their classes, or that they have downloaded videos where their resolution is explained, or that they communicate with their classmates via WhatsApp or another network.

Ignorance of the characteristics and functionalities of technological tools form a priori judgments that prevent assessing the use that can be given to online evaluation platforms (Mercader and Gairín, 2020).

Educause notes that teachers use digital technologies in their personal lives, but that, when applied in classrooms, they encounter serious technical, logistical, and pedagogical problems (Johnson et al., 2016). Accordingly, a researcher infers that the technological competency level of teachers is intermediate or low (Cuhadar, 2018).

Due to the above, the purpose of this article is to investigate the use and frequency of use of technological tools for assessment by mathematics teachers. For this, two hypotheses were proposed. With the first, the relationship between the frequency of use variable with reliability and usefulness is sought. The second hypothesis aims to find the relationship between ease of use reliability and usefulness.

- More frequency of use of digital tools leads to more reliability and usefulness of teachers to use them for their assessment.
- The easier it is to use, the more reliable and useful it is.

1.1. Background

Evaluation is a fundamental process for all members of an educational institution, although in a different way and considering different perspectives. Students receive feedback on the errors or successes obtained and also obtain a grade derived from a scale based on a rubric proposed by the teacher (Reiners et al., 2011). The evaluation also helps the educational institution to improve its institutional effectiveness (Suurtamm and Neubrand, 2015).

Reiners et al. (2011) pointed out "The word evaluation is derived from the French word *evaluar*, in English to value. This is defined as the process of classifying, selecting, and labeling. This process includes qualifying, ordering, etc., and is done for the purpose of reporting the progress of students, compared to an external norm, standards, and/or the performance of their peers."

The evaluation of the teaching and learning processes represents a dynamic aspect of both, which is essential for decision-making, so it is necessary to evaluate the student in an integral way, that is, their training and cognitive skills.

Assessment is the measure of the student's achievement and progress with respect to the established learning goals and objectives (Suurtamm and Neubrand, 2015).

Until now, traditional paper-and-pencil tests have not been fully effective in measuring students' intellectual performance (Clarke-Midura and Dede, 2010).

Online assessments are defined as the learning assessment process through the use of technology and include everything from the design of tasks to be assessed, to the storage and sending of results (Reiners et al., 2011).

Educational technology plays an important role that uniting both student learning and teacher teaching in a useful link to create new schemes and opportunities that improve and enhance learning.

It has been found that teachers who teach mathematics use digital tools less than teachers of other academic disciplines (Bray and Tangney, 2017). Mathematics teachers are interested in being able to assess the different strategies used by students, rather than the answers alone. When the teacher assesses, he provides testimony of his appreciation of the student's work and uses this testimony to adjust his teaching and more appropriately guide the students' work.

It is common to consider that the introduction of automatic evaluation web systems results exclusively in a download of the teacher's task, at the

cost of using more rudimentary evaluation methods than the personalized correction of assignments and exams. There is an added fear that online evaluation opens the door to impersonation of the author of the work and, therefore, this loses the reliability of the face-to-face exam.

For the criteria of students, it was found that both the authorities, teachers, and classmates (considered as a social influence), as well as the conditions that facilitate technological resources, are the main point for the acceptance of online exams, so it should encourage communication between all those involved and maintain the technological infrastructure in the best (Acosta-Gonzaga et al., 2018).

When technological platforms are implemented for teaching, one of the indicators of success is the frequency of use of the system, since students have a more favorable attitude towards the platform they use most frequently (Hernández-Ramos et al., 2014).

Additionally, it has been proven that the most used platforms are those that do not require much theoretical or technological complexity, that is, teachers are more inclined to use ICTs that are more in line with their knowledge and skills (Amador, 2015).

García et al. (2015) analyzed the frequency of use by students of two e-learning platforms, Moodle and Sakai. The results show that factors such as perceived usefulness, ease of use, and social influence are important in determining the use of these platforms.

Amador (2015) analyzed the technological tools that university teachers use the most. Their findings showed that teachers use ICT more frequently in their classes when they have all the necessary technological skills; The results also revealed that teachers have a positive attitude towards the use of ICT and are aware of using these tools for the future development of their students.

In line with the above, in a study carried out on university professors on the way in which they use ICTs, the frequency of use, and the factors related to use, Martin et al. (2020) found that the frequency of use of ICT is low, managing to link this result to factors such as lack of technological competence, age, and experience.

Regarding the use of platforms or digital tools for teaching mathematics to high school students, Vaillant et al. (2020) showed that the frequency of use of technological platforms and tools by teachers is low. It is also noted that smartphones are the devices most used by teachers for teaching mathematics.

Teo (2014) in a primary and secondary school examined the factors that explain teachers' technology acceptance. The results showed teachers have a generally positive level of technology acceptance, Although, on the use that mathematics teachers give to the Moodle platform, he found that teachers infrequently use the interactive tools of the platform, such as questionnaires, multimedia resources, etc., this, due to the lack of technological training.

In a study looking at teachers' attitudinal factors toward online math tests, Acosta-Gonzaga et al. (2015) found that teachers are not totally convinced or willing to take math exams using digital platforms, that is, they still harbor the idea that it is more effective to do math exercises and exams on paper and pencil.

Regarding the use of technological platforms for the evaluation of mathematical concepts Ocaña et al. (2019) found that students who agreed to use online exams improved their performance and appropriation of mathematic concepts.

The successful integration of technologies in teaching-learning processes occurs when teachers focus their attention not so much on the technological resources but on the experiences of learning that they design and for which technologies are suitable (Marcelo et al., 2015).

In another study, Hernández-Ramos et al. (2014) emphasized that the frequency of use of technology is consistent with their practices or with the activities that the teachers regularly carry out; such as the use of slides through an editor such as PowerPoint, text editors, spreadsheets such as Excel.

2. Materials and methods

The present investigation is a quantitative study. The descriptive type and the methodological instrument used was a questionnaire. A group of professors in the physical-mathematical sciences area of a higher education school of the National Polytechnic Institute was surveyed. The sample obtained was 12 teachers, who used some online platforms during the confinement period. All of them, answered a questionnaire of 13 questions through a form using the Google tool.

The total number of teachers who teach mathematics in the school where the study was carried out is 14. All teachers were invited to participate by solving the questionnaire, but only 12 were accepted, so there was a margin of error of 0.08, as can be seen in Eq. 1 (Bujisic et al., 2018). Also, the participation in this survey was voluntary and the data obtained were anonymously processed, aspects that were communicated to the teachers before the start of the study.

$$n = \frac{N * Z^2 * p * q}{e^2(N-1) + Z^2 * p * q} \tag{1}$$

where,
n= sample size sought
N= Population size
Z= Statistical parameter that depends on the Confidence Level
e= maximum accepted error
p= Probability of the studied event occurring
q= Probability that the studied event will not occur.

Substituting the values in Eq. 1 yields the study sample size, as presented in Eq. 2.

$$n = \frac{14 * 1.96 * 0.5 * 0.5}{0.08(14-1) + 1.96^2 * 0.5 * 0.5} = 12.8 \qquad (2)$$

Rounding n=12, with a margin of error of 0.08.

The questionnaire was designed by the authors of the study based on the guidelines followed by a similar study (Marcelo et al., 2015).

The 13 items had a specific purpose, according to the factor that was intended to be reviewed. Four factors were considered, whose codes are as follows: FR=frequency of use, FA=easy to use, UT=utility and RL=Reliability.

Tables 1, 2, 3, and 4 show the questionnaire items and the factor to which they refer.

The frequency of use refers to the use of platforms in general and digital tools to evaluate.

Easy to use refers to how intuitive a tool can be. The utility corresponds to the support that a digital tool represents for the professor in his academic work. Reliability has to do with the security of using a digital tool to carry out subject assessments.

Table 1: Items about the frequency of use

FR=Frequency of use
1. How often do you use online platforms?
7. How often have you used an online platform to assess your students?
9. Have you used online assessment platforms like Moodle, Socrative, or Kahoot?

Table 2: Items about ease of use

FA=ease of use
2. If you use any platform, is it easy for you to use it to teach your class?
5. Has the online evaluation of the student represented a challenge for you?
6. How safe do you feel in using a platform to take your exams online?
10. I know that I can use technologies even if I have not used them in the educational field.
12. I can use online platforms for my class, even if there is no one to help me

Table 3: Items of utility

UT=utility
3. Do you think it is useful for you to use the platform in order to give your classes online?
11. I am able to design didactic activities and exams that make use of online technologies

Table 4: Items of reliability

RL=Reliability
4. Do you consider that these tools are reliable to evaluate the student?
13. I feel distrustful of the use of technology to take exams to evaluate my students

The data was collected during the months of April to September 2020 during the period of the COVID-19 pandemic. The teachers were teaching-learning units such as probability and statistics, discrete mathematics, and differential equations. All teachers decided to participate voluntarily. For data analysis, IBM SPSS Statistics version 23 software was used.

Likewise, it was verified that the data had a normal distribution, through the Shapiro-Wilks test. Pearson's correlation analysis was performed to determine the relationships between the frequency of use of online platforms with usefulness and reliability. The categories shown in Table 5 were used. The basic elements of a paper are listed below in the order in which they should appear:

Table 5: Categories used to measure the frequency of use of online platforms for assessment

Category		Value
Very high usage	Daily	5
High usage	Weekly	4
Medium usage	Monthly, fortnightly	3
Low usage	Semi-annually	2
Null	Never	1

3. Results

This section shows the results obtained from the questionnaire applied to teachers. Regarding teaching experience, the results of the sample obtained are shown in Table 6.

Table 6: Teaching experience of participating teachers

Years of teaching experience	Sample percentage
1 to 5 years	8%
6 to 10 years	23%
11 to 15 years	23%
16 to 20 years	15%
More than 20 years	31%

It is observed that the highest percentage of the teachers in the sample has been teaching for more than 20 years, which may imply that they are more accustomed to using the blackboard and the textbook to teach their classes and do their evaluations.

Table 7 shows the obtaining of the average of each of the questions formulated in the questionnaire, as well as the code used to locate the item to which the question corresponds.

The results showed that the average use those teachers had of online platforms as a way to organize their educational materials and as a means of communication with their students, during the pandemic was 2.8, on a scale of 1 to 5, being 1 null, 2 low, 3 medium, 4 high and 5 very high. This means that teachers had a medium frequency of use of digital platforms because not all of them are up to date in the use of educational technological tools. Despite this, they consider that the use of these technological tools was high, obtaining an average of 3.9, and they also pointed out that the ease of using them was medium (3.2).

The frequency with which they have used an online platform to assess their students is 2.7, which is equivalent to an in-between use, which implies that they do not have much knowledge of the digital tools that exist, scoring this aspect at 3.2, as shown in Table 3. Half of the sample has used some technological tool, such as Moodle, Kahoot, or Socrative, to assess their students.

The confidence that teachers showed in the use of digital tools was at a medium level (3.0), which implies that they are not entirely convinced of evaluating their students using this type of resource.

Table 7: Average number of questions used to survey teachers during lockdown

Questions	Average	Standard deviation
1. How often do you use online platforms?	2.8	0
2. If you use any platform, is it easy for you to use it to teach your class?	3.2	0
3. Do you think it is useful for you to use the platform in order to give your classes online?	3.9	0
4. Do you consider that these tools are reliable to evaluate the student?	3.5	1.41
5. Has the online evaluation of the student represented a challenge for you?	3.7	0
6. How safe do you feel in using a platform to take your exams online?	3.5	0.7
7. How often have you used an online platform to assess your students?	2.7	0
8. Do you know of any online tools for mathematics teaching and assessment?	3.2	0.7
9. Have you used online assessment platforms like Moodle, Socrative, or Kahoot?	3.2	0
10. I know that I can use technologies even if I have not used them in the educational field.	4.5	0.7
11. I am able to design didactic activities and exams that make use of online technologies	4.5	0.7
12. I can use online platforms for my class, even if there is no one to help me	3.9	1.41
13. I feel distrustful of the use of technology to take exams to evaluate my students	3.0	0

Table 8 shows the Pearson correlations obtained from the variables presented in the questionnaire. The first column shows the codes of the questions of the previously shown questionnaire.

Based on the results in Table 8, it can be said that the higher the frequency of use of online platforms, the greater the utility they find in them. It was also found that the frequency of use of online platforms positively influences the development of confidence that teachers have to work with technological tools.

Table 8: Pearson correlation values

Code	Correlation values
FR, UT	0.684
FR, RL	0.687
FA, UT	0.698
FA, RL	0.711

The results showed that there is a linear correlation between frequencies of use and usefulness, which means that if a teacher uses more technological tools to assess, it is because he finds them more useful. Likewise, it was found that the frequency of use has a linear correlation with reliability, which implies that when the teacher has developed greater confidence in digital tools to take exams, he uses them more frequently.

The correlation between the ease of use of digital tools with the usefulness that teachers have found to organize their class materials and be able to evaluate their students, is observed to be directly proportional, which means that the greater the ease with which they find, the greater is also the usefulness it represents, implying that the teacher to consider the use of a tool easy should have taken a course or workshop or seen tutorials, with which the teacher was able to review each of the elements of the digital tools, finding the usefulness that these components represent for their academic work.

A linear correlation was also presented between the ease of use and the reliability that the digital tool represents to the teacher, which means that when the teacher finds the use of a tool easy, it is because

he reviewed what the tool is useful for and this It gives you confidence in its use.

4. Discussion

The study confirmed the fact that when teachers use digital tools more frequently, the greater the reliability they have in them, as well as the usefulness attributed to them. In this regard, it can be said that technologies are required to accompany other forms of the evaluation carried out by the teacher, and not only for the application of written exams, that is, that they support a process of appropriation of knowledge by the students, to through activities that allow diagnostic, formative and summative evaluations, which coincides with that indicated by Marcelo et al. (2015).

In addition, the ease of its use was reflected in the reliability that they managed to have in carrying out the evaluation of their students, which implies that they had to review the usefulness of the components of the digital tools to formulate forms of evaluation that were reliable, although they recognize that online assessment has been a challenge for them, so they do not feel completely confident about using an online platform to take their exams, which coincides with what was mentioned by Cuhadar (2018).

The prolonged use of digital tools increasingly helped them to find their usefulness. In relation to what the teachers of the sample point out, about the use of technology in the classroom, it coincides with what was said in EDUCAUSE (Johnson et al., 2016), about the teachers use digital technologies in their personal lives, but that, when applied in classrooms, they encounter technical, logistical, and pedagogical problems. The recommendation is to propose good practices that help teachers successfully integrate ICT into their classes (Martin et al., 2020).

According to what was pointed out by García et al. (2015), one of the indicators of success in the implementation of these platforms is the frequency of use they have, since when users have a more favorable attitude towards the platform they use it

more frequently, which was reflected in our study since the teachers of the sample as they found more and more usefulness in them, the more they used them. The findings found to show that the pedagogical use in the classroom of Mathematics of the resources, tools, and platforms examined is of low and moderate levels. To enhance this impact, it is necessary to create new disruptive models of techno-pedagogical teacher training (Vaillant et al., 2020). Based on what was obtained, it is suggested that workshops be given to the teacher related to the use of technological platforms both to organize and develop digital material and to evaluate the activities of their students, so it is up to the school authorities to organize this type of workshop and courses.

5. Conclusion

An important reflection to point out is that the willingness shown by teachers to adopt and use innovative forms of evaluation using technology will undoubtedly make a difference in student learning (Acosta-Gonzaga and Gordillo-Mejia, 2015).

Another reflection is that although knowledge of technology is necessary, it is not enough if teachers do not perceive themselves as competent in its use (Ertmer and Ottenbreit-Leftwich, 2010). The fact that general beliefs of teachers, as well as their pedagogical beliefs, and attitudes have a decisive influence on the use of ICT in the classroom (Krücken, 2014). According to Hue and Jalil (2013), the frequency of use of technology in the teaching-learning process is associated with the attitudes towards the integration of ICTs in the curriculum to improve teaching. The truth is that in order to explain why teachers decide to use technology or not, we have to take into account the practical knowledge and beliefs that teachers develop.

In relation to other ways that mathematics teachers can use to evaluate their students, in addition to exams, are the development of research where they use the knowledge seen in the class, the development of predictive mathematical models related to an event in a sector such as health, physical or social. To evaluate these products that students obtain, there are technological tools that teachers can use. Indeed, the teacher must prepare the corresponding rubric to be able to evaluate if the student applied the knowledge of the subject.

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Compliance with ethical standards

Conflict of interest

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