CHAPTER 74

Perspectives of the assessment of mathematical learning Case study on memorization of formulas in the test

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ABSTRACT
In this work, we present the discussion on the topic that is often questioned in the classroom: "Make available the pre-established expressions in the evaluation" that "simplify" the reasoning process at the time of calculation and interpretation, known as mathematical formulas. The objective is to understand what are the positive and negative points of this evaluation methodology. The research was based on a questionnaire applied to mathematics teachers who work at different levels of education.

Keywords: Evaluation. Math. Formulas

1 INTRODUCTION

In teaching mathematics, there are several ways and formulas to solve a given problem. For example, in financial mathematics there are some formulas for calculation such as: amount, future value, present value, simple discount, compound discount, among others. Anyway, learning and "memorizing" all these pre-established mathematical expressions is a challenge. From the experience in teaching, it can be seen that teachers face several questions at the time of the learning verification test, such as "teacher, can I bring the formulas? " or "Professor, what is that formula? ". Dealing with these situations is undoubtedly a challenge for every educator.

According to Luckesi (2011), the assessment of school learning is a very important factor for the development of the individual, and has been the subject of constant research and projects with various treatment approaches. For the evaluation to take place, it is necessary to have some methods to collect the information, which are called evaluative methodologies. Some assessment methodologies are acquired and improved by teachers throughout their experience in teaching.

Some scholars declare that the test is a common assessment tool in the school context. It is used to measure students' memorization ability, often used only to grade or classify students. Thus, in our study, we assume that the test also provides a construction of knowledge, thus, in fact, important for the individual, making the evaluation methodology important for the development of the student.

During conversations with professors, lectures on evaluation and in the experience as a professor, these evaluative methodologies came to play a role in several doubts regarding the chosen method, which motivated investigation into them.

2 RESEARCH OBJECTIVES

The objective of this work is to discuss two pedagogical methodologies used in the evaluation of teaching and learning of mathematics: one if the teacher must have the mathematical formulas at the time of verification of the learning, or the second option, not have them.

According to Hoffmann (2011), the verification process can be done in several different methods. These methods, which can be generally called “teaching and learning assessment methodologies”, are defined according to the objectives of the teacher and student. In this way, we seek to understand and discuss what the teachers' goals are when making formulas available and when they do not.

The verification of learning, in the conception of Moretto (2005), is practiced through a very common instrument in our school routine, the written test. The test in turn, according to Libâneo (2013) is applied only to measure the memory capacity. However, this and other verification instruments are necessary means to search for information on student performance, thus making an assessment of learning.

In view of this, it is necessary, first, to define what assessment is and some important factors, to then define proof and present what the formulas are in the teaching of mathematics to clarify the object of study.

3 LEARNING ASSESSMENT CONCEPTS

Learning assessment, according to Luckesi (2011), began to be known in the mid-1930s. It was first named by Ralph Tyler, who coined this expression to speak of the necessary care that teachers need to take with school learning. Since then, learning assessment has been the subject of research with several different approaches.

According to the National Curriculum Parameters (PCN's 2000) assessment is part of the entire teaching and learning process. It provides a lot of information about student learning such as performance, acquisition of concepts, mastery of mathematical procedures and attitudes.

Thus, it can be said that assessment is important for student learning. This perspective on the importance of evaluation has already been made by authors such as: Moretto (2005), Libâneo (2013) and Piletti (2001), who, in addition, complement the idea saying that it is part of the teaching and learning process that also mentioned by the PCN's (2000) previously.

From Latin, “evaluate” comes from the composition “a- valere ”, according to Luckesi (2011), which means “to value ... ”. The concept “evaluation” is formulated from the determinations of conduct in the idea of “attributing” value, which, in itself, implies a positive or negative positioning.

In the school context, learning assessment means, according to Sant'Anna (2001), a continuous process by which it seeks to investigate, measure and analyze changes or alterations in the student's performance, thus confirming whether the construction of knowledge has taken place. Thus, the assessment consists of a verification of the construction of the student's knowledge. Assessment is a continuous process, because each content worked, whether practical or theoretical, has a construction of knowledge.

Bloom (1983) clarifies that assessment is a way of collecting and processing data necessary for the improvement of learning and teaching, it includes a wide variety of information that is far superior to the "final test". This information serves to clarify important educational goals and objectives in determining the measure of student development.

Therefore, it is understood that there are differences between evaluating and the exams and tests that are better known as proof. Evaluating in education makes sense in obtaining information about students' behavior, while the test only classifies in qualitative and/or quantitative results.

Piletti (2001) and Bloom (1983) understand that assessment is developed at different times, stages and levels of the teaching/learning process. Within this process, there are some typologies/modalities of evaluation, which are the evaluations: diagnostic, formative and summative .

3.1 DIAGNOSTIC EVALUATION

According to Piletti (2001), diagnostic assessment is used at the beginning of the teaching/learning process, in which it is applied at the beginning of a unit, semester or academic year. Sant'Anna (2001) completes that this type of assessment is used by teachers who seek to make an initial diagnosis of the student's knowledge, to start a new content. One of the main points of diagnostic assessment, according to Bloom (1983), is to identify the position of the student's knowledge, so that it can be placed in the most appropriate level of the teaching sequence. Piletti (2001) also emphasizes that this type of assessment aims to verify the knowledge, particularities and prerequisites that the student presents at the beginning of the unit.

Through these definitions, it is observed that the diagnostic evaluation, as the name implies, is an evaluation that verifies if the student is "ready" to start a new teaching unit. It can be verified that the prerequisites of the contents have been fulfilled.

3.2 FORMATIVE ASSESSMENT

Based on Bloom (1983), the formative assessment is worked during the student's training, informs the teacher and, at the same, the results of the teaching/learning process. In this evaluation model, as Sant'Anna (2001) says, the selection of objectives and contents distributed in teaching units must be observed. You must know what you want to evaluate and what the results are for. Establish criteria and efficiency levels to compare results. Specify what you want to evaluate and why it is being evaluated and make decisions to perform the desired action. That is, the actions must be during the process, where they will help the student to develop.

Rabelo (2004) also emphasizes that the "Formative assessment has the purpose of providing information about the development of a teaching and learning process" (RABELO 2004, p. 73) so that the teacher can help him with a pedagogical intervention related to to the deficiencies found in the process.

Formative assessment is an evaluative proposal, in which its focus on teaching and learning, similar to diagnosis, formative assessment provides information to students and teachers. This information, according to Rabelo (2004), can be used by teachers to detect learning difficulties, allowing teachers and students to adjust strategies and devices. These actions aim to quickly correct these strategies, which according to Afonso (2005) this process can mean constant control over students.

In formative assessment, several different methodologies can be applied, including the use and non-use of mathematical formulas in the assessment as stated by Afonso "When teachers practice formative assessment, the collection of information about student learning can be carried out by a plurality of methods and techniques" (AFONSO 2005, p. 38).

However, it is worth noting that this process is not necessarily based on evidence, there may be other assessment tools, as Afonso says.

> Formative assessment, often aiming at the achievement of previously defined objectives, is, only in part, a criterial assessment , in the sense that formative assessment can be based on criterial tests although it is not based exclusively on these information collection instruments. (AFONSO 2005, p. 38)

Through this argument, it is understood that formative assessment is a process that aims to improve teaching and learning through an evaluative action, which underlies our research on the use of formulas in the evaluation process.

3.3 SOMATIVE EVALUATION

Summative assessment , according to Sant'Anna (2001), is practiced and consists of classifying students at the end of a unit, according to the levels of achievement presented. This typology of evaluation according to Bloom (1983) is a general assessment of the degree to which the broader objectives were achieved during the entire teaching unit.

In the same direction as the authors Rabelo also defines that:

> Summative assessment is usually a one-off assessment, as it usually takes place at the end of a teaching unit, course, cycle or bimester, etc., always trying to determine the degree of mastery of some previously established objectives. It proposes to make a summation balance of one or several sequences of a training work. Sometimes it can be carried out in a cumulative process, when a final balance takes into account several partial balances (RABELO 2004, p. 72).

In other words, summative assessment is an assessment carried out at the end of teaching units in which it aims to provide the final results of various training sequences.

In Bloom's (1983) conception, evaluation in the past was exclusively summative in nature , in which it was applied only at the end of a unit, thus being too late to modify any process. This type of evaluation generally serves, as Rabelo (2004) says, in addition to classifying and informing, it has the function of giving certificates or title to individuals.

Thus, based on the authors' perception, it is understood that summative assessment is a classification process, whose purpose is to evaluate the broad results at the end of a unit. This process will be used for this research, as it is brief and fits into the time available for the research.

3.4 LEARNING VERIFICATION

It is observed that the assessment of learning is an action that seeks to identify changes in the behavior and performance of students, confirming whether the construction of knowledge has been processed. Verification, in turn, for Luckesi (2011) happens in most assessment processes, but it is a little different from learning assessment as Tyler (1981) said in our definition of assessment. Therefore, the definition of this process is very important for the development of the research, because it is necessary to understand these differences.

According to Luckesi , the term verify comes etymologically from the Latin – Verumfacere – and means “to make true”. However, the concept of verification emerges from the conduct determinations of intentionally seeking “to see if something is really that...”, “to investigate the truth of something...”. (LUCKESI 2011, p. 52). Thus, the term verify comes from the truth, to see if something is the same or proof. Still in Luckesi 's conception , the verification process comes from “observing, obtaining and analyzing data and synthesizing the data or information.” (LUCKESI 2011, p. 52) that makes a limitation of the object or action from which one works. In this way, verification focuses on obtaining information about the individual in order to see whether or not he has learned certain content. We can certainly say that this process happens most of the time in tests, in which the teacher only checks if the student has learned or not.

Libâneo (2013) presents that the verification of learning is one of the moments of the teaching process that consists of a “collection of data on student achievement” (Libâneo 2013, p. 217), which can be used diversified instruments where one of them it's the proof. Thus, it is possible to notice that learning happens with several verification instruments, for our research the instrument to be used will be the test.

In Luckesi ’s idea , verification ends when “The dynamics of the act of verifying ends with obtaining the data or information that is sought, that is, “one sees” or “one does not see” something . And... that's it! In itself, verification does not imply that the subject draws from it new and significant consequences. ” (LUCKESI 2011, p. 52).

The verification of learning consists only of knowing if the student has learned or not, without further benefits other than the evaluation that the teacher observes and plans a pedagogical intervention.

3.5 ASSESSMENT INSTRUMENTS

Through the authors' previous definitions, it is understood that learning assessment is a continuous process that proceeds at various moments of the work. This verification takes place at the beginning

(diagnostic), during (formative) and at the end (summative) as already defined **.** For verification according to Libâneo (2013) adequate instruments are needed.

For Hoffmann (2011), some teachers confuse assessment instruments of some units with documents used to record student performance. However, for other teachers these instruments are understood as tests/exams and applied tasks, which, when analyzed, serve as data for monitoring student learning.

Still in this author's conception, when “assessment instruments” are mentioned, they are referring to tests/exams and tasks applied to students during the teaching units.

Thus, Moretto (2005) says that the assessment of learning is done in different ways, and with various instruments that are used according to need, the most common among them is the written test. In other words, there are other assessment instruments and not just the “test”.

As an example, Libâneo (2013) cites some assessment instruments at different stages of the teaching-learning process, such as:

> At the beginning of a unit... a survey of the students' previous conditions should be carried out, through a review of previous material, correction of homework, quick tests, short dissertations, guided discussion, didactic conversation, etc. During the development of the unit, students' performance is monitored through exercises, guided study, group work, behavioral observations, informal conversations, subject recall, and formal verifications are carried out through essay tests, question tests objective, oral argument. At the end of a didactic unit or bimester, performance tests are applied. (LIBÂNEOP 2013, p.226)

It is understood then that the evaluation process takes place with diversified instruments and procedures. That is, the teacher can evaluate the knowledge acquired in the classroom, in tests, assignments, etc.

For this research, we focus on identifying the positive and negative points of each methodology using the most “common” instrument in our daily lives, in this case the test.

In view of this, the need arises to define proof.

3.6 TEST

According to the interpretation of Rocha (2005) in relation to the electronic dictionary Houaiss (2002), the proof is conceptualized in:

> That which demonstrates that a statement or fact is true; evidence evidence; act that gives a full demonstration of (effect, fidelity, happiness, etc.); manifestation, sign; school work, composed of a series of questions, whose purpose is to assess the student's knowledge; test, exam. (ROCHA 2005, p. 25).

Based on this definition, it is understood that in the test the student demonstrates whether the content worked by the teacher was developed or not.

According to Luckesi (2011), the test or exam, in school learning, aims to verify the student's performance level in a certain content and classify in terms of approval/failure. In other words, the test/exam is just a classifier where you assign quantitative results to your students.

Piletti says that “in the test, students develop a uniform set of tasks and are aware that they are being evaluated”. (PILETTI 2001, p. 196/197)

For Libâneo (2013), the tests are applied only to measure the memory capacity. However, the test and other verification instruments are necessary means for the search for information on student performance.

Therefore, the test can serve to measure the student's ability to memorize formulas. However, on the other hand, it can also verify if the student knows or not the content worked by the teacher, that is, it shows the students' performance.

In view of the authors' definitions, it is understood that the test assesses both the ability to memorize and the student's development, in which the student knows he is being evaluated.

3.7 MATHEMATICAL FORMULAS

One of the main topics of the study is the definition of mathematical formulas, as discussed in the present study.

Silveira says that “ The formulas are algebraic expressions that represent rules, and they need to be interpreted. Following a rule is interpreting, and interpretation demands the reading and translation of its signs.” (SILVEIRA 2006, p. 5/6).

Ribeiro defines mathematical formulas and algebraic equations as

> It originates from a practical problem, and the solution can be found using arithmetic knowledge. However, both the teachers and the students they investigated wrote an equation for the problem and found the solution through some known algebraic technique or algorithm. (RIBEIRO 2013, p. 67)

In this way, Ribeiro uses the term formula implicitly as an algebraic technique and algorithm that serves to solve equations for a problem. Therefore, mathematical formulas are techniques, algorithms or a pre-defined equation where they are applied for a faster resolution of problems.

4 RESULTS

4.1 RESULTS OBTAINED IN THE INTERVIEWS

In this topic, we present the analysis of data referring to the questionnaire applied to mathematics teachers who work in elementary, high school and higher education.

In order to identify whether teachers use the availability method or not during their assessment practice, the following questions were asked:

Question 1: In the verification of learning using the test instrument, you make the formulas available to the student, what do you think about it?

The results obtained were that 60% of the teachers answered that they always use this evaluative practice and 40% use it sometimes and that it depends a lot on the content worked. Responses were obtained mainly referring to remote teaching due to health restrictions that occurred during the COVID-19 pandemic, such as:

High School Math Teacher Response - "The pandemic showed me a new way of evaluating, understanding the difficulty during the resolution, for me, it is more important than the difficulty in memorizing" .

Higher Education Mathematics Teacher Answer – "I have noticed that if the student does not know how to apply it beforehand, it becomes uninteresting for him, this in engineering courses, so asking him to memorize formulas is unfeasible".

It can be seen that the way in which the learning of certain content is verified is being rethought by both parties, both teacher and student. This brings us to the following question, what about the use? Has it improved?

Question II: Does having the formulas in the test help the student to do better in the assessment?

Respondents were punctual and 20% said yes and 80% said no or sometimes. It can be seen that teachers indicate that the student's grade is not always better when they make the formulas available, as some justified below:

Elementary School Math Teacher Answer – "If you give me a physics formula of a super advanced content, I won't even know how to apply it. The same is true in mathematics, there is no point in having the formulation without knowing what you are talking about";

Higher Education Mathematics Teacher Answer – "Having the formula written in a draft does not indicate that you know how to solve the problem, so the result is not so much better unless you know at least how to solve it";

Higher Education Mathematics Teacher Answer – "Improvement for those who know how to solve".

High School Math Teacher Response – "Depending on the content, it improves significantly . As is the case with trigonometry and geometry."

High School Math Teacher Response – "It improves considerably, but I teach strategies to remember like songs and rules that are easy to memorize.".

High School Math Teacher Answer – "It depends on the content".

Through the teachers' answers, it is possible to perceive the results depending on the content and the amount of formulas that are addressed. Quite formalized content such as volume studies, area and financial mathematics, for example, requires a large amount of expressions for direct calculations.

Question III was asked with the objective of discovering the points in which the availability can help in the learning of the content.

Question III: What are the possible points that the availability of mathematical formulas can help in the learning of your students?

Justifying his methodology, the teacher says: *Answer high school mathematics teacher - "If he knows how to develop calculus, it will help him if not, no. ".* That is, for those who know how to do or develop the calculation involved, the mathematical formulas will help, and those who do not know how to develop it, will not. Since, according to our question previously discussed, teachers evaluate the development of the question, making the memorization of the formula an uninteresting subject as seen also in question I.

This agrees with the idea of the author Starepravo (2004), who asks the following question: "What is more important, after all, to know the formula [...] or to think mathematically" (STAREPRAVO 2004, p. 2), hence , according to Dante's studies cited by Pereira (2007), assessing mathematical development or thinking has greater emphasis in mathematics teaching.

Some points that the availability helps according to the teacher's speech and can assume that such a methodology helps in *Answer high school mathematics teacher - "Being a facilitator when studying"* . The availability of formulas during the evaluation generates *a response to high school mathematics teachers - "More interest in solving the question"* because *"The student is not worried about memorization, thus making him more confident in the resolutions."* . However, *High School Mathematics Teacher Answer - "The important thing is that the student understands the process that reached that formula so that he knows how to do it.".*

And what are the harmful points of the availability of mathematical formulas.

Question IV: What are the main points that the availability of mathematical formulas can harm in the teaching/learning of your students?

The teachers' answers can be seen as a common concern, especially with high school teachers:

High School Mathematics Teacher Answer - "Lack of memorization skill".

High School Mathematics Teacher Answer - "At the time of competitions and/or entrance exams.".

High School Mathematics Teacher Answer - "Day to day, contests and entrance exams.".

Higher Education Mathematics Teacher Answer - "It can be harmful when trying a contest, such as in the engineering area, where he will not have any formulas available".

Elementary School mathematics teacher response – "I don't see any negative points, as long as learning is well consolidated".

That is, the main points in the teachers' conception that the availability can harm are in the contests or entrance exams that the student will not have the formulas available at all times, and that the student may become dependent on the formulas as an "addiction" cited by a student. of teachers: *High School Math Teacher Response - "I believe the only negative point is the addiction that can occur. The student may become dependent on formulas to solve the test".*

Question V: What is your opinion on the availability of mathematical formulas in the verification of learning?

Elementary School Mathematics Teacher Answer - "I think it is a valid practice, as it can contribute a lot to arouse student interest in the content, and in most questions what matters is not the formula itself, but its application and how to use it. ".

Justifying the use of formulas, the teacher says that it can help the student to become more interested in the mathematical content. However, it is observed that some who agree with the availability, however highlight some points that can be harmful such as:

High School Mathematics Teacher Answer - "I'm in favor, I don't see any problems, because the student who doesn't know the content, just the formulas in just doesn't help much".

High School Mathematics Teacher Answer- "It is interesting, however, as it helps the students by "memorizing", the student is also harmed, because, for example, "ENEM", "contests" are not facilitators like that".

High School Mathematics Teacher Answer- "The student will not be firm or confident when performing another assessment that requires memorization, but I see that the general perspective of the test has been changing, the contextualization, application and how that is approached in everyday life. day is increasingly being charged. This idea of here is the equation and solve it has been outdated for a long time".

Higher Education Mathematics Teacher Response – "The pandemic brought this new vision of evaluation, I believe that this plastered idea of decorating will become less and less usual, but, however, you should be careful and not generalize so much.".

High School Mathematics Teacher Answer - "I like to make the formulas available to students, I feel that it brings more security for them to learn and not worry so much about memorizing, but I think that at the time of an entrance exam and/or contest it can harm them. it, as these selection processes often require decorating.".

High School Math Teacher Answer - "I like the practice of making formulas available, but memorization also helps to stimulate students.".

As can be seen, teachers realize that memorization has been less and less used, but there is a caution in this type of practice. Today, some selection processes, which are common in student life, address this type of requirement and are of great concern to teachers.

5 FINAL CONSIDERATIONS

Based on these statements, it can be concluded that teachers are inclined to support the availability of formulas during the evaluation practice. They are concerned with learning the method, problem-solving reasoning and learning the process, but they do not fail to highlight the points that harm this evaluative practice with selective processes that somehow require the memorization of content. It can be seen that the

pandemic moment that occurred from 2019 brought new experiences and visions to teachers, reflecting on the learning verification process.

However, as some teachers mentioned, memorization can also serve as a stimulus to studies and cannot be a discarded methodology. As Soistak (2014) says:

> Memorization can contribute a lot to the modification of these negative concepts, because from the moment that the student masters the basics through memorization, he can come to understand and learn mathematics, performing activities with pleasure, in addition to his self-esteem being valued at this time. (SOISTA K 2014 , P. 9)

Therefore, the way in which the verification of mathematical learning is approached must be analyzed according to each class. The analysis of the profile that the student has, the goals of the teacher and student can change the way to evaluate learning.

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