Chapter 179

Evaluation of mathematics learning a brief study on memorization of formulas in learning verification

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ABSTRACT
In this work, we present a discussion on the subject that is frequently questioned in the classroom: "Providing pre-established expressions in the evaluation" that "simplify" the reasoning process at the time of calculation and interpretation, which are 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 basic and higher education. An evaluation was also applied in a class of school X in the city of Janaúba-MG to verify the performance of the students using the two methodologies discussed. The results show that the formulas do not matter if the student does not know how to use them, but it is a facilitators in the studies. However, some challenges in the student's life require him to "know" the pre-defined formula, such as entrance exams.

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, and compound discount, among others. Finally, learning and "memorizing" all these pre-established mathematical expressions is a challenge. Experience in teaching, it can be noticed that teachers witness several questions at the time of the learning verification test, such as "teacher, can I bring the formulas? " Or "Professor what is that formula again? ". 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 in the development of the individual, it 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 is called evaluative methodologies. Some assessment methodologies are acquired and improved by professors throughout their experience in teaching.

Some scholars state that the test is a common assessment instrument in the school context. It is used to measure students' memorization capacity, often used only to grade or classify them. Thus, in our study, we start from the assumption that the test also provides a construction of knowledge, thus being, in fact, important for the individual, making the evaluation methodology important for the student's development.

During conversations with teachers, lectures on evaluation, and in my experience as a teacher, these evaluative methodologies have been leading to several doubts about the chosen method and have motivated research on them. This work is a continuation of the research carried out by Pereira et. al. (2022).

2 RESEARCH OBJECTIVES

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

According to Hoffmann (2011), the verification process can be done using several different methods. These methods, which can be generally referred to as "methodologies for evaluating teaching and learning", are defined according to the objectives of the teacher and student. In this way, we seek to understand and discuss what are the teachers' objectives when making the formulas available and when they are 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 memorization capacity. However, this and other verification instruments are necessary means for looking for information on student performance, thus making a learning assessment.

Because of this, it is necessary, firstly, to define what evaluation is and some important factors, to then define proof and present what formulas are in mathematics teaching to clarify the object of study.

3 CONCEPT OF LEARNING ASSESSMENT

Learning assessment, according to Luckesi (2011), began to be discussed in the mid-1930s. Named for the first time by Ralph Tyler, who coined this expression to talk about the necessary care that teachers need to have with school learning, since then, learning assessment has been the subject of research with several different approaches.

The National Curricular Parameters, (PCN's 2000) assessment is part of the entire teaching and learning process, it provides a series 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 assessment has already been taken by authors such as Moretto (2005), Libâneo (2013), and Piletti (2001), who, in addition, complement the idea by saying that it is part of the teaching and learning process that was also mentioned. by PCN's (2000) previously.

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

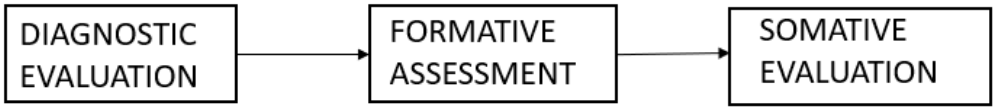
In the school context, learning assessment has the meaning of, according to Sant'Anna (2001), a continuous process through which it seeks to investigate, measure and analyze changes or alterations in the student's performance, thus confirming whether the construction of knowledge has taken place. Therefore,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

Bloom (1983) clarifies that the evaluation 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 student's development measure.

Therefore, it is understood that there are differences between evaluating and the exams and tests that are better known as proof. Assessing in education makes sense in obtaining information about student behavior, while the test only classifies 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 evaluation typologies/modalities, which are evaluations: diagnostic, formative, and summative, as shown in Figure I.

Figure I. Bloom Classification



3.1 DIAGNOSTIC EVALUATION

According to Piletti (2001), a diagnostic evaluation is used at the beginning of the teaching/learning process, which is applied at the beginning of a unit, semester, or school year. Sant'Anna (2001) completes that this type of evaluation is used by teachers who seek to make an initial diagnosis of the student's knowledge, to start new content. One of the main points of a diagnostic evaluation, 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 points out that this type of evaluation aims to verify the knowledge, particularities, and prerequisites that the student presents at the beginning of the unit.

3.2 FORMATIVE EVALUATION

Based on Bloom (1983), the formative evaluation is worked during the student's formation, informs the teacher, and the same results in the teaching/learning process. In this evaluation model, as Sant'Anna (2001) says, the selection of objectives and contents distributed in the 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 you are evaluating it and make decisions to take the desired action. That is, the actions must be during the process, which will help the student to develop.

3.3 SUMMATIVE EVALUATION

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

3.4 LEARNING VERIFICATION

It is observed that the evaluation 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 the assessment of learning, 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 verification concept emerges from the conduct determinations of intentionally seeking "to see if something is just that...", "to investigate the truth of something...". (LUCKESI 2011, p. 52). Thus, the term check comes from truth, to see if something is the same or proof. Still, in Luckesi's conception, the process of verifying comes from "observing, obtaining and analyzing data and synthesizing 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 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 whether 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 "data collection on student achievement" (Libâneo 2013, p. 217), which can be used diversified instruments where one of which's proof. Thus, it is possible to note that learning takes place with several verification instruments, for our research the instrument to be used will be the test.

3.5 EVALUATION INSTRUMENTS

Through the authors' previous definitions, it is understood that learning assessment is a continuous process that proceeds at various moments of 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 required.

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

Still in this author's conception, when “assessment instruments” are mentioned, she is 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 should be made of the students' previous conditions, 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, material recall, and formal verifications are carried out through essay tests, question tests objectives and oral argument. At the end of a didactic unit or two-month period, achievement tests are given. (LIBÂNEOP 2013, p.226)

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

For this research, the focus is on identifying the positive and negative points of each methodology using the most "common" instrument in our daily life, in this case, the test.

Because of this, the need to define proof arises.

3.6 PROOF

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

> That which demonstrates that a statement or fact is true; evidence proof; an act that gives a full demonstration of (effect, fidelity, happiness, etc.); manifestation, sign; school work, consisting 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 on 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 given content and classify it in terms of approval/failure. That is, the test/exam is just a classifier where it assigns quantitative results to its 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 ability to memorize. 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 the formulas. However, on the other hand, it can also check if the student knows or not the content worked by the teacher, that is, it shows the performance of the students.

Given the authors' definitions, it is understood that the test evaluates both the ability to memorize and the student's development, in which the student knows that 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 “Formulas are algebraic expressions that represent rules, and they need to be interpreted. Following a rule is interpreting, and interpretation requires reading and translating 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 pre-defined equations where that are applied for a faster resolution of problems.

4 METHODOLOGY

An interview was conducted with a group of five Mathematics teachers from a school in the city of Janaúba-MG, which covers elementary and high school. Classes were followed in two classes in the second year of high school, one with thirty-two students and the other with thirty-eight, on the content of financial mathematics. We separated these classes into four, two with sixteen students and two with eighteen, randomly and by drawing lots. We applied a learning verification test on the content addressed, being two parts, one with sixteen and the other with eighteen, providing the formulas and the other two parts of the same sizes, an evaluation was applied without consultation. The evaluation had five questions about the content addressed in the classroom. Some students reported on the research. The results were analyzed and presented below.

5 RESULTS

Here, we present the analysis of data referring to interviews with math teachers who work in elementary and high school and the assessments applied to students. Our interview follows the same line of ideas as Pereira et. al. (2022).

Initially, teachers were asked if they used to provide formulas in Mathematics tests. We got responses like:

Answer Teacher I: "It depends a lot on the content, it's hard not to leave a draft sheet when talking about trigonometry, but there are contents that we can demand memorization, as in more basic subjects";

Answer Teacher II: "I seldom let them look at formulas, students need to make the maximum effort to remember, in life this will be required of them";

Response Professor III: “That depends a lot on the subject”.

It can be seen that some teachers are resistant to making the formulas available, however, other teachers say that it depends a lot on the content. These results also appear in the research by PEREIRA, et al. (2022).

We asked some student volunteers what they thought about the formulas in the test:

Answer Student A: “I don't think it helps me much, I want to pass the entrance exam, there's no formula there”;

Answer Student B: “I can't form an opinion about it, but I have a lot of trouble remembering it, but I don't know if handing it in like this helps with my learning”;

Answer Student C: "I wanted to have a good memory to remember, but I can't. The formulas help me a lot to get a good grade";

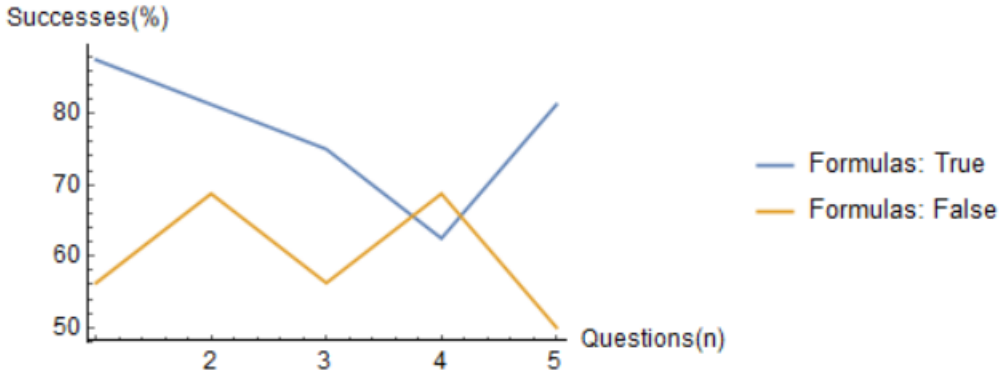
Answer Student D: “Having the formulas helps me get a good grade, but it does not define my learning, I think”.

It is noticed that the students are aware that it is necessary to know the formulas. This is mainly due to the entrance exam, such as example, ENEM. PEREIRA, et al. (2022)

The results of the tests applied to the two classes divided into 4 parts, two of 18 students and two of 16 students, present the following results:

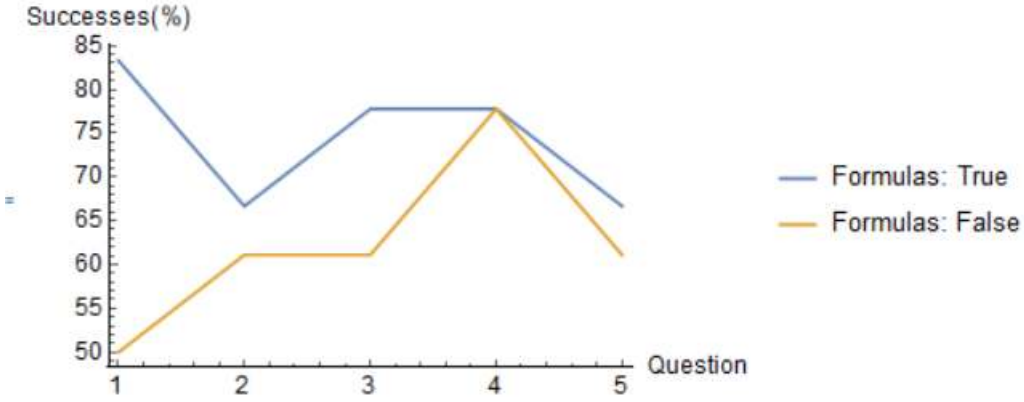
Test Results:

Figure II. Test results per question class of 32 students



Source: Authors

Figure III. Test results by question class of 38 students



Source: Authors

Note that figure II presents the results of the two groups of 16 students, making a total of 32. The groups were randomly divided, to obtain a better result in the sample. Figure III shows the results of classes of 18 students, forming a total of 38 students. Both charts show that students get better results with the formulas available.

From this result, we asked teachers and students if having the formulas in hand would guarantee better results on the tests.

Student A: “Some situations yes, others no. Look, if I know how to use them, I'll get a 10 with them, but if I don't, even more so if the letters don't make much sense, I'm going to get confused.”;

Professor II: "A calculation of financial mathematics, trigonometry, or logarithms, when you need to use more than one formula per question, if the student does not know how to use it, nothing will be achieved.”;

Professor IV: “In my experience, the result is always better when you have the formulas”.

And what is your opinion about making these formulas available in the test?

Professor I: “Very relative, it is situational, but it is a very good question to ask, especially seeing these opinions that the students said”;

Professor V: "I like to think of myself as a facilitator of the studies, but I always tell them that repeating the formula each time they solve the exercise makes them remember in situations where they cannot consult".

These results show us something similar to the research by Pereira, et al. (2022), students and teachers feel concerned about several key issues, such as learning and future needs, mainly college entrance exams. This makes us wonder: in future flexibility of entrance exams when the rigor of memorizing mathematical formulas, would we thus have a motivator for studies in the area?

5 FINAL CONSIDERATIONS

The results showed us that there is always a concern for student learning. The entrance exam itself is the biggest unknown about the availability of these formulas. Having the formulas in hand undoubtedly improves the results and students are aware of this. The concern of memorizing a set of formulas makes learning difficult for some students, however, it is necessary, according to the conception of teachers and students themselves.

For Pereira, et al(2022) citing Soistak (2014):

> Memorization can come to contribute a lot to modifying 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 improved. valued at this time. (SOISTAK 2014, P. 9)

Therefore, the methodology to be used depends on the objectives and goals of the teacher-student, one must know in depth to outline the best methodology for student learning.

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