

External Evaluation of the Educational Process and Learning Evaluation in Mathematics Classes: Notes from an Investigative Practice

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*Received for publication on 25 July 2018. Accepted, after revision, 12 Nov. 2019.
 Designated Editor: Claudia Lisete Oliveira Groenwald*

ABSTRACT

Anchored in an evaluation perspective in the service of learning, this article brings a discussion of the relationship of external evaluation of the educational process and evaluation of learning in the classroom context from an analysis of written productions of students in dealing with routine issues of written math class exams and external evaluation questions. This is a qualitative research of an interpretative nature, in which, through an investigative practice in a 2nd grade high school class of a public school in which the students solved four questions about the study of sequences - Arithmetic Progression (A.P.). We sought to highlight the potential of using external evaluation questions to feed pedagogical actions that favor reflection on the curriculum developed in the classroom, and vice versa. In this research, it was possible to show that the difficulty of the students to understand the statement of the questions and the fact that they cannot relate the content to the daily practices can be aspects that influence the Brazilian students' performance in external mathematical evaluations; as can be presumed that students have shown poor performance in external tests not because they are unaware of mathematical knowledge, but because the type of problem to which they are exposed differ substantially from those of their classroom teaching and evaluative practices.

Keywords: Mathematics Education; Learning Evaluation; External Evaluation; Mathematical Tasks.

Avaliação Externa do Processo Educacional e Avaliação da Aprendizagem em Aulas de Matemática: Apontamentos a partir de uma Prática Investigativa

RESUMO

Ancorado em uma perspectiva de avaliação a serviço da aprendizagem, este artigo traz uma discussão da relação da avaliação externa do processo educacional e da avaliação da aprendizagem em contexto de sala de aula a partir de uma análise de produções escritas de alunos ao lidar com

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questões rotineiras de provas escritas de aulas de matemática e questões de avaliações externas. Trata-se de uma pesquisa qualitativa de cunho interpretativo, na qual, por meio de uma prática investigativa em uma turma de 2º ano do Ensino Médio de uma escola pública em que os estudantes resolveram quatro questões sobre o estudo de sequências - Progressão Aritmética (P.A.). Buscou-se destacar o potencial da utilização de questões de avaliações externas para alimentar ações pedagógicas que favoreçam à reflexão sobre o currículo desenvolvido em sala de aula, e vice-versa. Nesta pesquisa, foi possível evidenciar que a dificuldade dos alunos em compreenderem o enunciado das questões e o fato de eles não conseguirem relacionar o conteúdo com as práticas do cotidiano podem ser aspectos que influenciam o rendimento de estudantes brasileiros em avaliações externas de matemática; assim como pode-se presumir que os alunos têm apresentado baixo rendimento nos testes externos não por desconhecerem os saberes matemáticos, mas porque o tipo de problema a que são expostos a resolver se diferenciam, substancialmente, daqueles de suas práticas de ensino e avaliativas de sala de aula.

Palavras-chave: Educação Matemática; Avaliação da Aprendizagem; Avaliação Externa; Tarefas Matemáticas.

INTRODUCTION

The preponderant role that evaluations play in people's lives is undeniable. Many of those who are attending or have attended a school may cite at least one episode related to evaluations that marked them positively and/or counterproductively.

The purpose of an evaluation is to analyze, identify, investigate and weigh a given fact and/or a situation. However, educational evaluation does not have a simple definition, it is a constituent and permanent element of the teaching process.

Thus, the aim of this paper is to discuss the difference between the types of evaluations in the educational process, highlighting the potential of using external evaluation questions to feed pedagogical actions that favor reflection on the curriculum developed in the classroom, and vice versa.

To encourage a reflection about the school evaluation of mathematics teaching and the external evaluations carried out, we chose to investigate a 2nd-grade high school class from a public school in the state of Paraná. The research was conducted by one of the authors of this proposal, through an evaluative activity that exposes questions about the study of sequences - Arithmetic Progression (A.P.) presented in two ways: the first, bringing the approach of textbooks (routine in the context of the classroom), and the second, as presented in the external evaluations.

Firstly, we present a brief discussion of a school evaluation perspective that is at the service of student learning, an action beyond verifying and measuring school performance. In the following sections we present a distinction between internal and external evaluation of the educational process and a brief synthesis of Brazil's result in the 2015 Pisa test. Next, the text presents the methodological procedures and the presentation of the discussion of the results, to finally present final considerations and references.

SCHOOL EVALUATION: LEARNING X PERFORMANCE

The greatest concern of educators has always been centered on the quality of education, which many seek it in the results of evaluations, although they do not always reflect reality. It is common to confuse evaluating with examining, which focuses only on classification and exclusion, therefore the importance of establishing the difference between evaluating learning and evaluating performance.

For Professor Luckesi (2000), learning evaluation is a useful and necessary pedagogical resource that assists both the teacher and the students in the search for their self-construction and better way of living.

Thus, it is understood that the practice of learning evaluation should be geared to meet the individual needs of each student, so the diagnosis of the situation in which the student is in is essential to trace paths that can supply and/or heal the difficulties they present. In this way we see how important it is to create a favorable environment for learning.

Luckesi (2000) states that the learning evaluation should be an instrument of inclusion that “brings [something] inside”. For this reason, it needs to be coherent, dynamic and constructive, that is, making possible students’ development. On the other hand, the evaluation cannot be used as an oppressive object in educational practice, one that threatens and subjects everyone to punishment, as in the case of exams, considered exclusionary, classifying, marginalizing.

Evaluation is, in fact, a continuous process of building knowledge and should therefore be an inherent action in all pedagogical, didactic and learning management practice. In this sense, there is neither a fixed evaluation model nor more suitable instruments, everything depends on what one intends to investigate. Thus, to have a solid foundation that supports the practice of school evaluation, there must be a harmonious mediation between pedagogical theory, teaching practice and evaluative practice.

Basic education guiding documents, such as the National Curriculum Parameters - PCN (BRAZIL, 1998), emphasize that classroom evaluation should be a unique and continuous process that enables the student to actually learn; besides, it should not be just an evaluative instrument whose objective is the sole verification of errors and hits.

An evaluation process that seeks only to measure students’ achievement by benchmarking their learning does not allow for an improvement in the teaching-learning process, developing in the students the fear of failure. For Luckesi (2011), evaluation is a diagnosis of the quality of the intermediate or final results, and verification is a configuration of partial or final results. This author also points out that the evaluation is dynamic, and the verification is static.

Mendes and Buriasco (2018) assume evaluation as a process resulting from valuable information that can support the necessary decisions for the teaching and learning processes. For the authors, a didactic evaluation that is useful to build knowledge implies

recognizing the student as a unique subject, and the existence of multiple possible ways for both teaching and learning.

For Buriasco, Ferreira and Ciani (2009), mathematical learning evaluation is seen as a research process that aims to analyze and discuss the register of processes, resources and strategies used by students when in contact with mathematics.

Many hold to the myth that evaluating comes down to applying a written test, and to the accuracy of a grade. However, the biggest problem is not in the written test, but in how they investigate the results. Figure 1 presents a comparison between evaluation and verification in the classroom context.

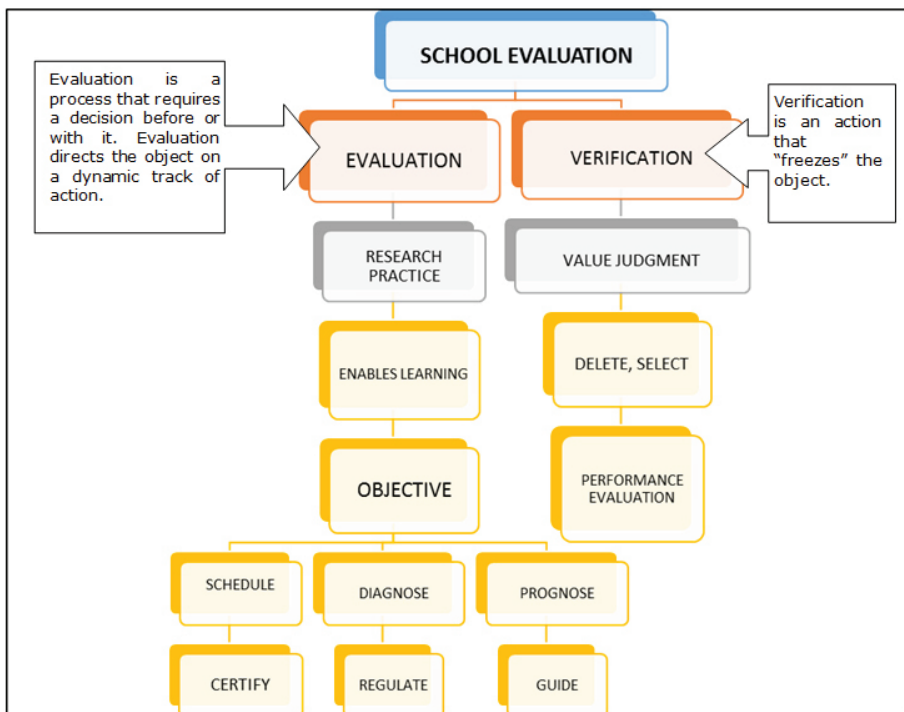


Figure 1. School Evaluation

Therefore, the learning evaluation should be understood as a practice that intends to show the teacher the students' learning process, thus, is considered diagnostic and formative, as it contributes to the improvement of learning, informing the teacher about the conditions under which this learning is happening. Performance evaluation, on the other hand, aims to select, classify, thus it is considered exclusionary.

INTERNAL AND EXTERNAL EVALUATION

The word evaluation, in its various contexts and purposes, is rarely associated with anything positive, says Hoffmann (2013). According to the researcher, the “evaluationphenomenon” is today an undefined fact that leads teachers and students to associate the term with meanings related to the constituent elements of a traditional evaluative practice: test, score, concept, report card, catch-up, failure.

Aiming to ensure the quality of the results we are building, we cite Luckesi (2011), who sees evaluation as a qualitative appreciation of relevant data from the teaching-learning process that assists the teacher in making decisions about student learning.

According to SEED/PR’s “Formação em Ação”/Training in Action (2016), evaluation can present two approaches. The first, the Internal Evaluation, is conducted by the classroom teacher to verify his students’ learning, and, for that reason, is often defined as Learning Evaluation. This approach also contributes to the definition of the pedagogical times required to organize the contents to be worked on in each teaching stage, and its results are used as a form of student promotion. The second approach concerns external evaluations, which allow the diagnosis and monitoring of the educational system, and subsidizes the work of education professionals, being an additional tool available to the teacher to monitor and improve the teaching -learning process, as they are applied to measure students’ knowledge, establishing a comparison between the expected performance and the performance presented. For this reason, it is also called Performance or Yield Evaluation. These evaluations focus on the application of tests to measure Portuguese language and mathematics competences and abilities to obtain results.

Machado (2012) defines external evaluation as the whole process of evaluating school performance, triggered and operationalized by subjects outside the school routine. The researcher states that considering the results of external evaluations is to put the data obtained on the foundation of new opportunities to teach all students.

Taking the results of external evaluations into account means understanding them not as an end in themselves, but rather as an opportunity to link them to the transformations needed to strengthen a democratic public school that is organized to ensure everyone’s learning.

It is well known that evaluation is a controversial topic and generally produces a great deal of displeasure among those involved in the educational process. We believe that part of this dissatisfaction is due to the coexistence with external evaluation systems and accountability policies that try to attribute teachers, principals and schools the poor results obtained in education. There are also discontents arising from the methodological processes used in those evaluations. As they are carried out through tests only, they can be seen a “synonym” for learning evaluation, misleading teachers to think that “evaluating is applying a test” (ORTIGÃO, 2017).

On the other hand, large-scale evaluations go beyond the quantitative factor, they are performance and yield assessments, whose results serve as parameters for the implementation of public policies aimed at improving teaching.

However, what can be seen in the school context today is that internal evaluations fall short of their real goal, because they do not enable effective learning and present problems of mechanical reproduction of content, not mentioning when they focus on training students to take the external evaluations.

EXTERNAL MATH EVALUATIONS

The media divulges alarming reports about the lag in mathematical knowledge due to students' poor results in external evaluations. This failure of education is a real and current fact that causes much concern among those involved with the issue, as they consider it threatens the possibility of forming critical and conscious citizens, capable of transforming society.

The indexes published reveal that mathematics, besides being the discipline with the highest percentage of failures, is also the one with the lowest student performance. For example, Brazil ranks 66th in math according to results released by the Program for International Student Assessment (PISA), in a test coordinated by the Organization for Economic Cooperation and Development (OECD), applied in 2015 in 70 countries. This evaluation takes place every three years and presents a basic profile of students' knowledge and skills, gathers information on demographic and social variables from each country, and provides indicators for monitoring educational systems over the years.

The Brazilian sample for PISA consisted of 23,141 students from 841 schools, which represents 73% coverage of students aged 15 years. According to data from an OECD report, math proficiency levels range from 1 to 6 on a scale where the minimum level expected is 2, considered basic for learning and full participation in the social, economic and civic life of modern societies in a globalized world. In Brazil, more than half of students were below level 2.

The mathematical contents evaluated in the PISA test are related to quantity; data uncertainty; changes and relationships; space and shape. According to the evaluation by the National Institute for Educational Studies and Research Anísio Teixeira (Inep), Brazilian students find it easier to deal with the mathematics directly related with their daily activities, with their family or peers. Besides, handling with money or living experiences with facts that generate arithmetic accounts or proportions is closer to students' reality than, for example, space and form.

Given this example, can the poor results of external evaluations be attributed only to the school boundaries, to the classroom context? How can a teacher, in the classroom context, make use of those results to enhance their students' development? How to deal with these outcomes in the classroom context is a question that needs to be recurring and investigated.

METHODOLOGICAL PROCEDURES

The methodological procedures shown here were the basis for a qualitative interpretative research. The problem was to investigate an activity with questions that required the use of concepts about sequences, specifically about Arithmetic Progression (A.P.), the wordings of which were presented in two ways: the first, as questions are currently addressed in textbooks (Question 1 - context free); and the second, as commonly stated in the external evaluation tests (Questions 2, 3 and 4 - contextualized). Our first aim was not to compare, but to gather evidence on how students deal with those two modes of wordings, and may be an opportunity to rethink teaching tasks as well as evaluation tasks.

The subjects of the research were the teacher (1st author) and 19 students enrolled in the 2nd grade of high school of a State College in the northern region of Paraná, in 2018.

The students answered the activity individually in the classroom. The mathematical content addressed in the questions was known to the students, since the teacher had already worked it in the 1st grade of high school.

The questions, involving different statements required students to use strategies to calculate the general term of an A.P., a specific term of an A.P., and the sum of a finite number of terms. The first question required the student to perform each of these actions in their routine format, as presented in the textbooks. Each of the other questions (2nd, 3rd, and 4th) requested one of those actions and were taken from the 2012, 2010 and 2011 tests of the National High School Exam (ENEM), respectively.

A 50-minute class was allocated for the activity, while two others focused on the discussion of the resolutions presented. After developing those activities, we conducted the analysis of the set of the students' productions and audios of the discussions of the resolutions presented, in which the students had the opportunity to express perceptions regarding the strategies, the ease and the difficulties they had to complete the four questions.

DISCUSSION AND RESULTS

Figure 1 presents the statement of each of the questions and the production of a student who solved all the questions correctly.

In this production, we observe that the student solved Question 1 using formulas, while in Questions 2, 3 and 4, he did not. This may indicate how formulas are usually presented in the school context, that is, not prompting students to recognize them as tools to solve contextualized problems. From this perspective, De Lange (2003) suggest that teachers should provide students with situations in which mathematics is seen as a knowledge that assists them in solving problems.

ATIVIDADE 1
Cada questão deverá ser justificada com cálculos ou explicações escritas de forma organizada e com um traçado legível da letra;

QUESTÃO 1 – Em relação à progressão aritmética (10, 17, 24, ...), determine:

a) o termo geral dessa PA:
 $a_5 = 20$ $a_n = a_1 + (n-1) \cdot r$
 $r = 7$ $a_n = 10 + (n-1) \cdot 7$
 $a_n = 10 + 7n - 7$
 $a_n = 7n + 3$

b) o seu 15º termo:
 $a_n = a_1 + (n-1) \cdot r$ $\frac{14}{7} = 2$
 $a_n = 10 + (15-1) \cdot 7$ $\frac{14}{7} = 2$
 $a_n = 10 + 98$
 $a_n = 108$


c) a soma dos 10 primeiros termos.
 $a_n = a_1 + (n-1) \cdot r$ $S_n = \frac{(a_1 + a_n) \cdot n}{2}$
 $a_n = 10 + (10-1) \cdot 7$ $S_n = \frac{(10 + 73) \cdot 10}{2}$
 $a_n = 10 + 63$ $S_n = \frac{83 \cdot 10}{2}$
 $a_n = 73$ $S_n = \frac{830}{2} = 415$


QUESTÃO 2 – (ENEM-2012) Jogar baralho é uma atividade que estimula o raciocínio. Um jogo tradicional é a Paciência, que utiliza 52 cartas. Inicialmente são formadas sete colunas com as cartas. A primeira coluna tem uma carta, a segunda tem duas cartas, a terceira tem três cartas, a quarta tem quatro cartas, e assim sucessivamente até a sétima coluna, a qual tem sete cartas, e o que sobra forma o monte, que são as cartas não utilizadas nas colunas. A quantidade de cartas que forma o monte é:


a) 21
b) 24
c) 26
d) 28
e) 31

$1 + 2 + 3 + 4 + 5 + 6 + 7 = 28$

QUESTÃO 3 – (ENEM – 2010) Uma professora realizou uma atividade com seus alunos utilizando canudos de refrigerante para montar figuras, onde cada lado foi representado por um canudo. A quantidade de canudos (C) de cada figura depende da quantidade de quadrados (Q) que formam cada figura. A estrutura de formação das figuras está representada a seguir:


Figura I


Figura II


Figura III

Que expressão fornece a quantidade de canudos em função da quantidade de quadrados de cada figura?

a) C = 4Q.
b) C = 3Q + 1.
c) C = 4Q - 1
d) C = Q + 3.
e) C = 3Q + 4

$r = 3$ $a_1 = 4$
 → cada 3 canudos após a primeira quadrado, se tem mais 2 quadrado

QUESTÃO 4 – (ENEM – 2011) O número mensal de passagens de uma determinada empresa aérea aumentou no ano passado nas seguintes condições: em janeiro foram vendidas 33.000 passagens; em fevereiro, 34.500; em março, 36.000. Esse padrão de crescimento se mantém para os meses subsequentes. Quantas passagens foram vendidas por essa empresa em julho do ano passado?

a) 38.000
b) 40.500
c) 41.000
d) 42.000
e) 48.000

$J \ 33$
 $F \ 34,5$
 $M \ 36$
 $A \ 37,5$
 $M \ 39$
 $J \ 40,5$
 $J \ 42$

Figure 1. Activity of a student who answered correctly all the questions

For Buriasco, Ferreira and Ciani (2009), rather than just understanding, the student also needs to interpret the statement to be able to seek a strategy to solve it, considering that the interpretation is directly linked to action. This can be evidenced in what the students answered when asked what they thought of the questions in the activity. For example, one student wrote: *“I think the statements of ENEM questions are easier to understand, because it is something more present, and I can solve some without using formulas”*.

“Solve without using formulas”? Many students see formulas as distant objects to be taken only when handling situations that are contextualized in external evaluations, or any other context where they are deemed necessary. This often happens because those formulas are presented as ready and finished, and the students are entitled to just apply them. In another direction, this object (formula) can be recognized as a tool if students are given the opportunity to develop it from work in different situations. Thus, the problems of national and international external evaluations can be part of a task base to be organized by the teacher towards this end.

Figure 2 presents two questions asking the students to calculate the sum of the terms of an A.P.

c) a soma dos 10 primeiros termos.

$$a_{30} = 30(30-1) \cdot 7$$

$$a_{30} = 30 + 9 \cdot 7$$

$$a_{30} = 30 + 63$$

$$a_{30} = 93$$

$$S_n = \frac{(a_1 + a_n) \cdot n}{2}$$

$$S_{10} = \frac{(30 + 93) \cdot 10}{2}$$

$$S_{10} = 83 \cdot 5$$

$$S_{10} = 415$$

QUESTÃO 2 - (ENEM-2012) Jogar baralho é uma atividade que estimula o raciocínio. Um jogo tradicional é a Paciência, que utiliza 52 cartas. Inicialmente são formadas sete colunas com as cartas. A primeira coluna tem uma carta, a segunda tem duas cartas, a terceira tem três cartas, a quarta tem quatro cartas, e assim sucessivamente até a sétima coluna, a qual tem sete cartas, e o que sobra forma o monte, que são as cartas não utilizadas nas colunas. A quantidade de cartas que forma o monte é:

a) 21.
 b) 24.
 c) 26.
 d) 28.
 e) 31.

The diagram shows a patience game layout with 7 columns of cards. The first column has 1 card, the second has 2, the third has 3, the fourth has 4, the fifth has 5, the sixth has 6, and the seventh has 7. To the right of the columns is a pile of 8 cards. The total number of cards used in the columns is 28 (1+2+3+4+5+6+7). The total number of cards in the deck is 52. The number of cards in the pile is 52 - 28 = 24.

Figure 2. Sum of the terms of an A.P.

The chart shows that the student answered correctly, although he used the formula in only one of the two questions. When asked why he had solved in such different ways problems that required the same line of thought, he replied: “Because I did not know that I could use the formula to add; I didn’t realize it was an A.P.”. This may indicate that classroom math is closely linked to the reproduction of algorithms, and students do not recognize those algorithms as tools to help them solving contextualized situations. Thus, according to Mendes (2014, p. 28), the teacher must plan the learning environment and develop “mathematics flexibly, based on tasks that are meaningful to them [students] and that such tasks be the means through which the teacher teaches and gives learning opportunities to the students”.

Figure 3 presents questions in which students did not answer the calculations and/or interpretation correctly.

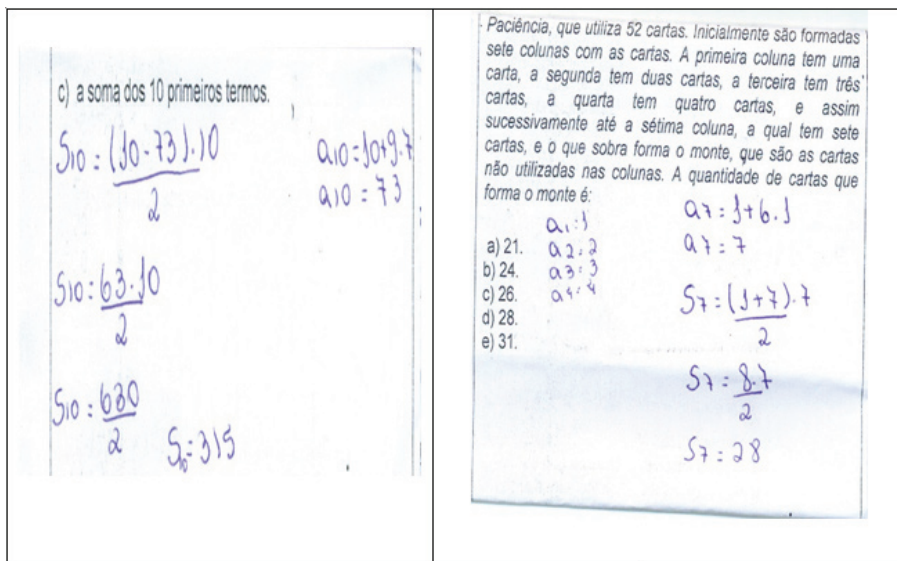


Figure 3. Inattention to Problem Solving¹

In Question 1 - c) the student interprets correctly and understands what is to be done, but misses the signal when using the summation formula of the terms of an A.P. In the production related to Question 2, the other student calculates correctly the sum of seven terms of an A.P., however, he does not provide the answer, perhaps because he did not interpret the statement correctly, the rest of the cards. They are errors of different natures. Although they both recognized the formula as a problem-solving tool, one misused it and the other did not interpret what was asked.

Despite the errors pointed out, we emphasize that questions that require the direct use of formulas do not need to be abolished from the classroom context. We just highlight that those questions (of direct application of a procedure/formula) should not be used to begin a discussion of a content, because the emergence of mathematical ideas and concepts from the mathematical organization of situations encourage the students to be (co) responsible for their learning process (MENDES, 2014).

On the other hand, saying that the student does not know mathematics because he “chose” item d from Question 2, as presented in Figure 3, can be a very limited way of looking at the skills the student has developed. Thus, the analysis of the written production

¹ In item c), the student not only misses the sign of the formula of the sum of the terms of an A.P., he also makes a mathematical error by subtracting 73 from 10 to get 63 instead of -63.

may be a way of broadening this view. In this regard, Viola dos Santos, Buriasco and Ferreira (2010, p. 145) emphasize that written production

[...] is presented as a strategy that can make it possible [for teachers] to know characteristics and particularities of students' mathematical activity through their records. [...] it is possible [...] to read in search of evidence and clues that they give about the relationship they establish with the statement, and which contexts they constitute in the processes of resolution and mobilization of mathematical concepts. Thus, instead of merely identifying that a problem, when "unresolved" by the student, is different from the one considered correct, the following question arises: which problem did he solve?

In Figure 4 we present the production of a student who answered Question 1 correctly, missing Questions 2, 3, and 4.

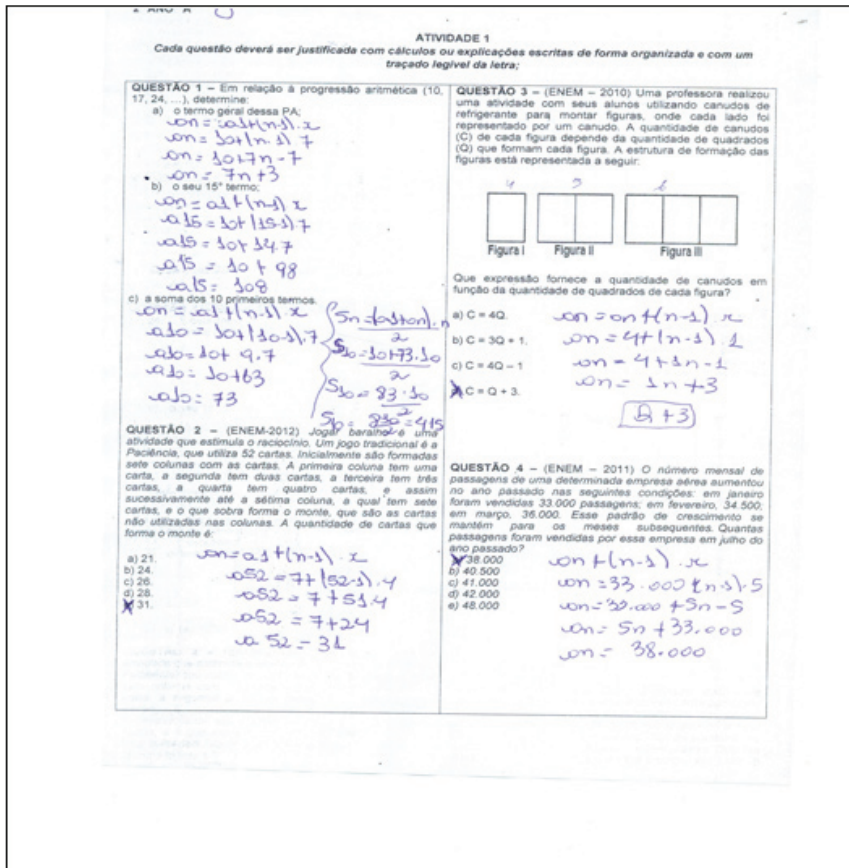


Figure 4. Difficulty in interpreting the wordings of the problem

By answering Question 1 correctly and missing Questions 2, 3 and 4, the student shows that his difficulty does not affect the understanding of the proposed mathematical contents, in this case, the study of sequences (A.P.). In this situation, we verify that he lacked attention and skill in reading and interpreting the statement. This may be because formal education is based on the mere transmission of explanations and theories, and on the student's thoughtless assimilation, leading him to a training, since practical teaching took place through repetitive and mechanical drills. This can be confirmed by the narratives of some students who participated in this activity, for example, "I find it easier to do the exercises of the book, because we can only insert the numbers in the formula. Interpretation exercises, I find more difficulty. I think because I don't like reading and because we are not used to interpreting problem situations, most teachers don't request that".

From this point of view, Van Den Heuvel-Panhuizen (2005) points out that a good contextual problem is one that can be "imaginable", "achievable", "conceivable" in the mind of respondent and not just when presented under aspects of "real life".

Finally, we highlight the relevance of using the results of external evaluations to feed pedagogical actions that favor the reflection on which curriculum we seek to develop to allow students to produce their own knowledge.

Table 1 presents a quantitative reading of percentages of hits and misses between Questions 1 and Questions 2, 3, and 4.

Table 1
Comparison of hits and misses (textbook × ENEM)

	General Term (A.P.)			A.P. term			Sums of terms (A.P.)		
	Hit	Miss	Not done	Hit	Miss	Not done	Hit	Miss	Not done
Textbook	63%	37%	0%	84%	16%	0%	63%	37%	0%
ENEM (Brazilian Sat Exam)	47%	42%	11%	63%	26%	11%	63%	26%	11%

The conclusion is that the students presented better results in the questions taken from the textbook that involved only numerical calculations and did not require more critical interpretation and analysis of the wordings. 61% Of the students who answered the ENEM questions used the formulas as a resolution tool. The highest percentage of error was in the questions that requested the student to determine the general term of an A.P., which allowed us to infer that they find it easier to solve mathematical problems that involve numbers only.

FINAL CONSIDERATIONS

In looking at this investigative activity, we cannot stop at the right/wrong dichotomy resulting from judging the information presented. These data do not allow us to state what

students really know. Our aim here is to highlight the paths students took, to recognize the differences in the construction of solutions to the problems, and to show that students find it more difficult to interpret the language used in the statements than handling with the mathematical content involved. This reveals that evaluative practices in the classroom context need to investigate the paths each student chose.

It is a fact that the underperformance of students when solving mathematical activities may own to several reasons, because it depends not only on emotional factors, but on several other factors related to cognition.

However, in this research, it was possible to highlight the relevant aspects that configure the underperformance of those students in external math evaluations: the difficulty of understanding the wording of the questions, and the fact that they cannot relate the content with their daily practices. It is possible that mathematics teaching still happens mechanically, repetitively and abstractly, as could be observed in the dynamics of problem solving and the students' narratives during the application process, since they are not familiar with carrying out tasks involving reflection and a connection with reality. Therefore, it can be assumed that students present poor performance when taking external tests not because they are unaware of mathematical knowledge, but because the type of problem they are exposed to differs substantially from those of their daily classroom practices.

AUTHOR CONTRIBUTION STATEMENT

S.M.S.S. conceived the idea, developed the theory, adapted the methodology to this context, created the models, performed the activities, collected and analyzed the data. The authors S.M.S.S., M.T.M. and Z.F.D.C.R. discussed the results and produced the final text, sharing ideas and writings.

DATA AVAILABILITY STATEMENT

The data that supported the results of this study will be made available by the corresponding author, M.T.M., upon reasonable request.

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