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The recomposition of post-pandemic learning through a mathematical modeling activity: System of equations of the first degree

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ABSTRACT
This article reports an activity of recomposition of learning carried out in the ninth years of the State High School Castelo Branco, in the Municipality of Três de Maio-RS. The need for the activity was due to not having been worked in the previous school year the content of linear system of two equations of the first degree, so it was developed an activity of recovery of the contents of Cartesian plan and equation of the first degree that had their results compromised due to the COVID-19 pandemic, together with the activity of recomposition of learning for the subsequent continuation of the contents of the matrix of the current school year. The activity also had the assumptions of Mathematical Modeling in education, in which students were introduced to this practice, comprising its three main stages: perception and apprehension, understanding and explicitness and signification and expression (BIEMBENGUT, 2016). The Activity also remains supported by the theory of dialogicity (FREIRE, 2019), through which it is understood that the student, as an individual in development, becomes (co)author of knowledge through dialogue with the teacher and with other students in the classroom. It was verified the importance of performing this type of activity through the difficulty that the student, especially from elementary school, has in externalizing his thinking and his conclusions about any activity, concluding that the textual production and presentation by the student reporting what was developed in the activity helps the process of exteriorization. The realization of the activity in the classroom counted on expository activities and mathematical modeling through problem-situations proposed for group work and subsequent preparation of report and presentation to the class.

Keywords: Recomposition of Learning, Systems of Two Equations of the First Degree, Problem Situation Solving, Dialogue.

1 INTRODUCTION

The development of knowledge is a sequential process that each individual goes through in the school day. The curricular matrices, being organized so that the contents complement each other as the years pass, guide the basis of teacher planning during the school year allowing the insertion of parallel contents along with the various tools that assist in the teaching and learning process.

However, it is already known that, due to eventualities, the matrix may not be completed during a school year, leaving part or even complete contents without being worked, which implies in the (re)organization of the subsequent school year.

It is observed that a major obstacle recently had was remote teaching, due to the COVID-19 pandemic, where many teachers were not sufficiently prepared to conduct online classes and the lack of didactic resources also became an aggravating factor for this practice.

Although there was no lack of efforts on the part of schools and teachers to fulfill the school routine successfully, it is perceived that remote teaching required from students a posture that was not fully consistent with reality until then. It can be mentioned, in addition to the difficulty of access to information, the lack of objectivity, autonomy and self-teaching by the students' search for knowledge, which implied the non-completion of some matrices during the period of remote teaching.

Because they are sequential, the contents of the mathematics discipline, which will be approached exclusively from this point, need strategies to be resumed and inserted in a school year not proper to the matrix, making use of strategies of recovery or recomposition of learning. Although they have similar objectives, in the recovery of learning pedagogical practices look back with the objective of recovering a certain content that has already been taught, but with failure or lack, while in the recomposition of learning should be planned means that allow the construction of previous knowledge that help to develop the skills related to the school year, boosting learning and allowing you to continue with the content of the school year. (BRITTO, 2022).

The activity reported in this article was developed in the ninth years of the Castelo Branco State High School, in the municipality of Três de Maio-RS, requiring the recovery of the learning of the Cartesian plan and equation of the first degree and the recomposition of the learning of systems of two equations of the first degree, content that, among others, is a prerequisite for the school year mentioned. It was identified, during a dialogue with other mathematics teachers, that the content of systems of two equations of the first grade had not been worked on in the previous school year.

The methodology used to carry out the activity counted on the combination of expository classes on the content and later of practical and dialogical activity, being necessary the proactivity of the students for the understanding and resolution of the problem-situations and presentation of the results obtained for the class.

2 LEARNING RECOMPOSITION ACTIVITY

With the change in the format of teaching in Brazil imposed as a result of the COVID-19 pandemic, some aggravating factors have emerged hindering student learning, such as the difficulty of access to information and the internet for the monitoring of classes and delivery of activities, the lack of resources and training for the realization of online classes by teachers. Yet another factor that contributed to the current situation after the pandemic was the measure of approval of all students, regardless of school performance, adopted by some states. This set of impacts entails a fragility of teaching that will reverberate for several years until it is remedied. (SENA et al, 2021).

According to the data obtained through the diagnostic evaluation, Evaluate is IRT, referring to the ninth years, carried out in 2022 by the State Department of Education of Rio Grande do Sul, a low percentage of performance in the skills and competencies related to the Cartesian plan and the equation of the first degree was identified. It was observed among the results only 15% of correct answers for the ability "to associate the algebraic representation of a linear equation of 1st degree, with two unknowns, to its graphic representation", 36% of correct answers in the ability "to correspond a system of equations of the 1st degree with two equations and two unknowns to a textually described problem-situation", 30% of correct answers in the ability "to identify, in the Cartesian plane, the solution of a system of equations of the 1st degree with two equations and two unknowns" and 35% of correct answers in the ability "Use system of polynomial equations of 1st degree in solving problems".

Based on these data, a teaching project was elaborated that, together with the content, addressed the ability of Mathematical Modeling for the resolution of problem-situations, textual production and presentation of group work based on problem-situations that can be easily found in everyday life.

The objective of the project was to enable the continuation of the ninth year matrix through an activity that involved the contents that had a shortage in the previous year and work those that were pending in a maximum period of one month.

After the revision of the contents on the Cartesian plane and the equation of the first degree, the explanation on the system of two equations of the first degree was carried out together with fixation activities. Then the class was organized into four groups, to which a problem-situation was distributed for analysis and resolution through algebraic modeling, according to chart 1, at the same time that the students understood the main stages of Mathematical Modeling.

Frame 1- Problem Situations Created by the Teacher and Proposals to Students

Situation-Problem 1	In an amusement park there are two prices for admission: children up to 12 years pay R $ 18.00 and adults pay R $ 25.00. Joana and her husband took their children and some friends to this park. In total, they bought 5 tickets and spent R$ 111.00. How many adults and how many children went to the park?
Situation-Problem 2	A company A charges a fixed amount of freight for delivery of goods of R $ 400.00 plus the value of R $ 5.00 per kilometer traveled. Another company B charges a fee of R $ 250.00 freight plus R $ 6.50 per kilometer traveled. Make a feasibility study for hiring the service of each company.
Situation-Problem 3	John needs a loan of $ 30000.00 to buy a car. Bank A offers the following proposal: entry of R $ 5000.00 and monthly installment of 350.00. Bank B offers the following proposal: R $ 6500.00 entry and monthly installment of R $ 250.00. Make a feasibility study of each financing.
Situation-Problem 4	Joana decides to apply R $ 500.00 in a savings account in bank A, which offers a rate of return of 3% per month on the amount initially applied while Jésyka decides to apply R $ 850.00 in bank B, which offers a rate of 1.7% per month. Do a feasibility study of each application.

Source: Classroom Record (2022).

The resolution of the proposed problem-situations was carried out in three distinct moments, consistent with the main stages of Mathematical Modeling in education. According to Renz Junior (2015 p. 20), one can define mathematical modeling:

> [...] as a set of actions that allows us to represent the reality around us through a mathematical model that, in turn, describes such reality. This model allows to interpret the relationship between events and the world through data analysis, reflections, deductions of results and predictions.

Based on this understanding, the students were instructed to observe in which of the three main stages of mathematical modeling they were solving the proposed problem-situation and what are the limits of these stages. It is observed that, when used in education, mathematical modeling must be consistent and adapted to the stage in which the student is, in this way, mathematical modeling is also approached as modeling that, according to Biembengut (2016 p. 171), "is a teaching method with research in the limits and school spaces, in any discipline and phase of schooling (...)".

In the first stage of modeling (modeling for education), perception and apprehension, the student is encouraged to read and understand the problem, what are the values and variables involved, at this moment the information of the proposed problem and what it is asking are extracted so that it is solved. In the second stage, comprehension and explanation, students are challenged to elaborate hypotheses and formulate the possible solution of the problem, while in the last stage, meaning and expression, is the moment when the results found are validated, it is also in this stage that the sharing of the results obtained occurs. (BIEMBENGUT, 2016).

2.1 DIFFICULTIES AND DIALOGUES

The main difficulty that is observed when the student receives a problem-situation is to establish a starting point that leads him to the solution. In this way, the structured dialogue between the teacher and the student becomes essential. This dialogue should be thought of so that the student does not receive the answers, but questions that guide him to identify the means and related problem-situations that allow the elaboration of a script to solve the problem-situation in focus.

During an activity it is natural to arise questions from students, the activity planning should foresee the main questions that may arise, previously allowing the teacher how to approach the practice. Chart 2 shows excerpts from two dialogues that the students had with the teacher.

Table 2- Excerpts from Questions Asked by Students to the Teacher

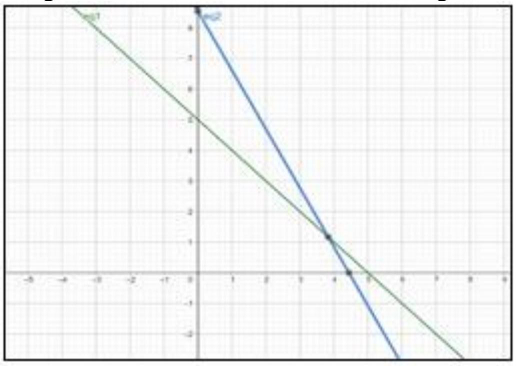
Dialogue 1	Student 1: Teacher, what is to do? Teacher: Have you read the problem? Student 1: No. Teacher: Then do the reading aloud to the group and to me.
Dialogue 2	Student 2: Teacher, how do we put together the equation of the first degree? Teacher: First we need to identify in the problem what is the fixed value and what is the rate of change, the value that changes over time. Student 2: How so rate of variation? Professor: The rate of change is what makes the numerical value of the expression change, for example, if you have a debt of R $ 20,000.00 and pay a monthly installment of R $ 350.00, which of these values influences over the months in the total debt? (students are debating among the group)

Source: Classroom Record (2022).

It is observed in the excerpt of the first dialogue a situation commonly found in the classroom, in this case the best solution is to ask the student to read the text at the same time that questions are asked about it, such as, for example, "what are the values present in the problem?" or "what is the problem asking for?".

Thus, after performing the reading, each group needed to debate about what they understood in relation to the concept of rate of variation. As a consequence of this debate, the concept of growth and degrowth was formulated within a sequence of data, and then the modeling of the equations of the first degree was initiated, being visually perceptible the growth or degrowth after plotting the graphs of the equations in the Cartesian plane with the aid of the *Geogebra* software.

Figure 1- Student-Plotted Chart in Geogebra



Source: Student Record (2022).

From the moment the graph of the equations of the first degree was plotted, an alignment between the objective of the problem-situation and the mathematical practice was perceived, since it was visually clear that the objective was to find in an algebraic way the point of intersection between the two graphs, characterizing the solution of the problem-situation.

3 THE STUDENT AS (CO)AUTHOR OF KNOWLEDGE

The student as an individual in development increasingly seeks to understand the why of the content he is studying in the classroom and where it is present in everyday life. Although many contents are theoretical, there is a need to understand that it is a basis for future content, which has practical application. Another point that stands out is the need to develop the mathematical language and the correct nomenclature of its elements, improving the technical language.

It is verified, in this way, that education in Brazil is increasingly starting for interdisciplinary practices and transdisciplinary projects, in this environment dialogue is essential, because it is not possible to distribute the content vertically. As Freire (2019, p. 109) quotes:

> Dialogue is an existential requirement. And, if it is the encounter in which the reflection and action of its subjects addressed to the world to be transformed and humanized are solidarized, it cannot be reduced to an act of depositing ideas of one subject in the other, nor can it become a simple exchange of ideas to be summarized by the permutants.

The dialogical practice of teaching contributes to the student to develop the ability of expression and opinion, because many students, when they are challenged to give a subjective answer, end up hesitating and saying that they do not know, because they understand that the answer to be given to those who question must be the answer they want to hear.

Activities such as the one reported in this article provide the development of the practice of writing with the "own words" about the understanding of the problem-situation and how it was solved and, mainly, when the question "what can we conclude based on the problem-situation solved?". Through this type of activity the student, especially in elementary school (and post pandemic), learn how to expose and defend their ideas.

The teacher, as a mediator position, becomes responsible for proposing good problem-situations for students, accompanying and guiding the search for solutions, considering for this the previous knowledge that students have, dialoguing about the means to find a solution and clarifying that certain methods may not work correctly, questioning and stimulating students to think critically in search of a satisfactory solution (ROMANATTO, 2012).

It can be observed in table 3 excerpts from the conclusion of two studies, before the orientation by the teacher. It is evident through the analysis the presence of the difficulty of writing the Portuguese language and the difficulty of expressing opinion, due to the lack of cohesion in the conclusion.

Table 3- Excerpt from the Conclusion Made by Two Groups (original spelling of the students preserved)

Group	Group text (students)	Expected text
Group 1 (Problem-Situation 1)	"When looking at the Cartesian plan, we soon realized that no other value could form a point with the 111 reais spent on tickets in the Cartesian plan. We soon concluded that adding to the total the 5 tickets that were purchased, there were a total of 3 adults and 2 children to the park."	[...] Based on the result found, 3 adults and 2 children, it can be seen that when the number of adults and children is changed the point of intersection of the graphs also changes, resulting in another amount to be paid for the tickets. For each paid amount of tickets there is only one point of intersection in the charts.
Group 2 (Problem-Situation 4)	"In the calculations we did we found the value of Y which is the months and X is the amount that should be deposited per month in bank A the value is 15x per month and bank B is 13.6x per month, we chose bank B because over time more months it yields more."	[...] We have that x represents the amount of months and y the total amount in the account. The income of bank A is R $ 15.00 per month and bank B is R $ 13.60 per month [...]

Source: Student Record (2022).

Learning mathematics is not limited only to learning formulas and calculations, but to the interpretation of the environment in which one lives through language and numbers through the resolution of problem-situations. The student needs dialogically the guidance of the teacher to develop the practice of training and externalization of the concrete opinion.

4 CONCLUSIONS

The teaching work with the objective of forming individuals to think organized and critical is a challenge that is increasingly accentuated, being necessary to awaken the interest in learning and eliminate its obligation.

It is understood that the best way to awaken and concretize the interest in the content of a discipline is its dynamic work, based on methodologies where the student feels generator and discoverer of knowledge. Although some limiting factors, such as time, lack of resources and even the existing barrier between interest and the student, become obstacles to the dynamics of the classroom, the curricular matrix of the school year must be followed so that your work is not isolated within the discipline, because the work by projects is increasingly present in schools, requiring transdisciplinary work.

It is verified that both the resolution of problem-situations, through any method, and the mathematical modeling in education should not be used only as a way of exemplification of the content worked. They should be used as a means where the student can create equations, tables and graphs in a semi-autonomous way guided by the teacher, through the practice of error until developing his logical algorithm to solve problem-situations.

The learning recomposition activity developed contributed largely to the continuation of the contents of the ninth grade curricular matrix. The introduction of the concept of mathematical modeling (consistent with the teaching stage) and its three main stages developed in the students a systemic view of the procedure to solve a problem-situation, understanding the importance of reading and self-questioning. It was still possible to perceive an advance in terms of the capacity for argumentation and externalization of knowledge and conclusions.

Finally, an important point to highlight is the understanding that each problem-situation that it proposes to solve needs a different strategy, maintaining a standard algorithm as to the resolution related to the understanding and extraction of existing data and information and the final goal to be achieved, being necessary to always relate to some related problem-situation or make use of the available technologies.

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