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Identifying high school students' prior knowledge: An analysis in light of meaningful learning

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ABSTRACT

Background: The teaching of financial mathematics and statistics in high school is still frequently carried out in a decontextualised manner, prioritising mechanical procedures and hindering conceptual understanding, which makes the identification of students' prior knowledge, in light of the theory of meaningful learning, essential for the planning of initial pedagogical practices. **Objectives:** To analyse the first two steps of a potentially meaningful teaching unit (PMTU), the definition of the theme and the assessment of prior knowledge, and to investigate how these steps contribute to the understanding of concepts in financial mathematics and statistics based on students' contexts. **Methodology:** The study adopts a qualitative approach grounded in design-based research (DBR), guiding the construction and initial analysis of a PMTU. **Setting and Participants:** The research was conducted in a public school in the central region of Rio Grande do Sul, Brazil, with 20 first-grade students participating. **Data collection and analysis:** Data were collected through the construction of a word cloud based on collective mental maps and a diagnostic test, and analysed in light of the theory of meaningful learning. **Results:** The students demonstrated prior knowledge of everyday financial and statistical situations; however, they showed difficulties with conceptual articulation and interpreting situations that require higher levels of abstraction, indicating the presence of fragile or poorly differentiated subsumers. **Conclusions:** The findings indicate that the first two steps of the PMTU are fundamental for guiding the planning of contextualised pedagogical interventions and for the design of potentially meaningful instructional materials.

Keywords: Financial Mathematics; Statistics; High School; Potentially Meaningful Teaching Units.

Identificação dos conhecimentos prévios de estudantes do Ensino Médio: Uma análise à luz da aprendizagem significativa

RESUMO

Contexto: O ensino de matemática financeira e estatística no ensino médio, ainda é frequentemente desenvolvido de forma descontextualizada, priorizando procedimentos mecânicos e dificultando a compreensão conceitual, tornando a

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identificação dos conhecimentos prévios à luz da teoria da aprendizagem significativa, essencial ao planejamento das práticas pedagógicas iniciais. **Objetivos:** Analisar os dois primeiros passos de uma unidade de ensino potencialmente significativa (UEPS), a definição do tema e a verificação dos conhecimentos prévios, e investigar de que modo esses passos contribuem para a compreensão de conceitos de matemática financeira e estatística a partir do contexto dos estudantes. **Metodologia:** A pesquisa insere-se na abordagem qualitativa, fundamentada na pesquisa baseada em design (PBD), orientando a construção e análise inicial de uma UEPS. **Contexto e Participantes:** O estudo foi realizado em uma escola pública da região central do Rio Grande do Sul, com a participação de 20 estudantes da 1ª série do ensino médio. **Coleta e análise de dados:** Foram coletados por meio da construção de uma nuvem de palavras, a partir de mapas mentais coletivos, e da aplicação de um teste diagnóstico, sendo analisados à luz da teoria da aprendizagem significativa. **Resultados:** Os estudantes demostraram conhecimentos prévios relacionados ao cotidiano financeiro e estatístico, porém apresentam dificuldades na articulação conceitual e na interpretação de situações que exigem maior nível de abstração, evidenciando subsunçores frágeis ou pouco diferenciados. **Conclusões:** Os resultados evidenciam que os dois primeiros passos da UEPS são fundamentais para orientar o planejamento de intervenções pedagógicas contextualizadas e para a elaboração de materiais potencialmente.

Palavras-chave: Matemática Financeira; Estatística; Ensino Médio; Unidade de Ensino Potencialmente Significativa

INTRODUCTION

Financial mathematics and statistics play a prominent role in high school students' education, especially because of their direct relevance to everyday situations involving consumption, financial planning, data analysis, and the interpretation of economic information. The National Common Curriculum Base (Base Nacional Comum Curricular — BNCC) reinforces that these contents must be worked in a contextualised way, overcoming mere calculation and favouring the critical understanding of real situations (Brasil, 2018).

According to Campos, Teixeira, and Coutinho (2015), statistical data indicate a lack of financial planning among Brazilian families, reinforcing the need for financial education strategies to prevent over-indebtedness resulting from excessive consumption through adequate personal financial management. Thus, we advocate integrating financial education from basic education onwards, highlighting the role of mathematics, especially financial mathematics, which should be taught in a contextualised way and aligned with students' realities.

However, traditional pedagogical practices still predominate, often centred on the memorisation of mechanical procedures, thereby hindering the

construction of meaning and the application of knowledge in other contexts. Thus, David Ausubel's theory of meaningful learning (TML) offers relevant theoretical support by emphasising that learning is more effective when new knowledge is anchored in ideas already present in the student's cognitive structure.

Moreira's potentially significant teaching units (PMTU) constitute a methodological proposal aligned with the TML, organising teaching in steps that value prior knowledge, contextualisation, and the construction of meaning. Among these steps, the first two, choosing the theme and verifying previous knowledge, assume a structuring role, as they guide all the planning of the other stages that constitute a PMTU.

Given this context, this article aims to analyse the first two steps of a potentially significant teaching unit, based on identifying and analysing high school students' prior knowledge through collective mental maps and a diagnostic test. Thus, we seek to highlight the relevance of these first steps for teaching by emphasising their structuring role in planning and in the construction, organisation, and understanding of concepts in financial mathematics and statistics.

THEORETICAL FRAMEWORK

Financial mathematics and statistics occupy a central place in high school students' education, especially in developing the ability to interpret and make decisions in economic and social contexts. The teaching of these contents contributes to students' understanding of situations related to resource management, spending planning, interest analysis, investments, and the critical reading of financial information, which are fundamental aspects for the exercise of citizenship in a society increasingly guided by data and economic decisions.

The BNCC reinforces the importance of this knowledge by indicating that students must understand concepts such as percentages, interest, rebates, and additions, as well as discuss topics related to economics and finance in a contextualised way and in articulation with other areas of knowledge (Brasil, 2018). In this sense, statistics plays a complementary and inseparable role alongside financial mathematics, providing tools for the organisation, analysis, and interpretation of financial data, enabling the critical reading of information presented in tables, graphs, and economic indicators. The articulation between these two areas avoids the fragmentation of mathematical knowledge and expands its functionality in students' daily lives.

According to the Consumer Indebtedness and Default Survey (Pesquisa de Endividamento e Inadimplência do Consumidor—Peic) conducted in 2018, 61.2% of the Brazilian population was in debt (CNC, 2018). In this sense, financial education plays a significant role in enabling people to acquire the knowledge, skills, and attitudes necessary to manage their finances sustainably, thereby helping prevent excessive indebtedness and improve quality of life.

According to Campos, Teixeira, and Coutinho (2015), financial education in the school context aims to develop an understanding of how the financial market operates, the responsible use of credit and financing, the planning and monitoring of the personal and family budget, and the appreciation of savings. In addition, it seeks to encourage the organisation of financial management, future and retirement planning, and the dissemination of responsible financial practices in the family and social spheres.

Although foreseen in the official documents, these contents are still often addressed in a procedural, decontextualised way, prioritising the execution of calculations to the detriment of conceptual understanding. This approach tends to favour machine learning based on algorithmic memorisation, making it difficult to apply knowledge in real situations and compromising the construction of lasting meanings.

In this context, the theory of meaningful learning provides a robust theoretical foundation for rethinking the teaching of financial mathematics and statistics. According to Ausubel (1976), learning occurs significantly when new information is related in a substantive and non-arbitrary way to relevant prior knowledge, called subsumers. Moreira (2011a) points out that this process involves modifying both new knowledge and existing ideas in the learner's cognitive structure, thereby promoting greater stability and conceptual differentiation.

For meaningful learning to occur, two conditions are essential: the learning material must be potentially significant, and the learner must be predisposed to learn (Moreira, 2011a). Therefore, identifying students' prior knowledge plays a central role in teaching planning, as it allows the teacher to understand which concepts are already present in students' cognitive structures and how they can serve as anchors for the construction of new meanings. From this identification, it is possible to develop previous organisers and problem situations that facilitate the assimilation of new content, promoting the progressive differentiation and integrative reconciliation of concepts.

The potentially significant teaching units (PMTU), proposed by Moreira (2011b), constitute a methodological strategy aligned with the assumptions of the TMLs, by organising teaching in planned sequences that value prior knowledge, contextualisation, and the negotiation of meanings. PMTUs are based on the premise that teaching occurs only when there is meaningful learning, the central objective of the educational process.

For the creation of a PMTU, Moreira (2011b) proposes eight steps: 1st step, definition of the theme**;** 2nd step, verification of prior knowledge; 3rd step, preparation of previous organisers; 4th step, presentation of the content; 5th step, resuming the content at a higher level of complexity; 6th step, conclusion of the content; 7th step, assessment; 8th step, evidence of meaningful learning. The first and second steps stand out in this study, as they are decisive for the success of the proposal, guiding the choice of content, the contextualisation of activities, and the construction of potentially significant materials aligned with students' socioeconomic realities. By identifying prior knowledge through instruments such as collective mental maps and diagnostic tests, the teacher obtains essential information to plan pedagogical interventions aligned with students' cognitive structures.

Thus, the articulation among financial mathematics, statistics, the theory of meaningful learning, and PMTU shows that learning these contents depends not only on the presentation of techniques and procedures but also on understanding the context in which they are embedded and the relationships students establish with their prior knowledge. In this sense, the initial steps of PMTU assume a strategic role in the organisation of teaching, contributing to the construction and understanding of mathematical concepts in a contextualised, critical, and meaningful way.

METHODOLOGY

The research presents a qualitative approach and is based on design-based research (DBR), a methodology characterised by iterative cycles of planning, application, analysis, and redesign of pedagogical interventions in real teaching and learning contexts. The choice of DBR is justified by its suitability for studies that seek to investigate and improve educational practices, articulating theoretical foundations and concrete classroom demands.

The study was conducted in a public school, part of the 8th Regional Coordination of Education, in the central region of Rio Grande do Sul, involving 20 students in the 1st grade of high school. The socioeconomic context of the community is predominantly characterised by agriculture,

agribusiness, livestock, and family businesses, which directly influenced the choice of mathematical content and problem situations proposed in PMTU. This context enabled the use of real data that reflected students' experience, thereby favouring the contextualisation of the concepts of statistics and financial mathematics.

The diagnostic test was developed based on cognitive and didactic criteria, taking into account different levels of complexity and prioritising the identification of conceptual understanding and the mobilisation of students' prior knowledge. The instrument was submitted to peer analysis by teachers in mathematics education, which enabled adjustments to the writing and conceptual alignment of the questions.

This article focuses on the first two steps of PMTU: defining the theme and verifying students' prior knowledge. For data collection, three main instruments were used: the construction of a word cloud, elaborated from mental maps in small groups, in order to identify the concepts spontaneously associated by students with financial mathematics and statistics; the application of a diagnostic test containing questions from these two fields of knowledge, aiming to analyse students' level of conceptual and procedural understanding; and the observation records made during the activities, which made it possible to capture students' interactions, doubts, and strategies.

Data analysis was carried out in the light of the theory of meaningful learning, seeking to identify existing subsumers, conceptual weaknesses and evidence of mechanical or potentially significant learning. These elements supported reflections on the importance of the initial steps of the PMTU in planning contextualised pedagogical interventions to construct meaning.

RESULTS AND DISCUSSIONS

The analysis of the first two steps of the PMTU highlights their centrality to planning pedagogical practices aligned with the theory of meaningful learning. The first step, regarding the choice and definition of the theme, was based on both the guidelines of the official documents, especially the National Common Curriculum Base (BNCC), and participating students' socioeconomic realities.

In this scenario, the choice of content in financial mathematics and statistics emerged from real-world problems in school and community life, taking into account the centrality of the educational problem, as recommended by design-based research. Concepts such as the organisation and interpretation of data, percentages, increases and decreases, and interest are essential for

making conscious financial decisions in both the family and social spheres. Thus, the definition of the theme did not occur arbitrarily but was anchored in concrete situations experienced by the students, thereby endowing the mathematical content with meaning and functionality.

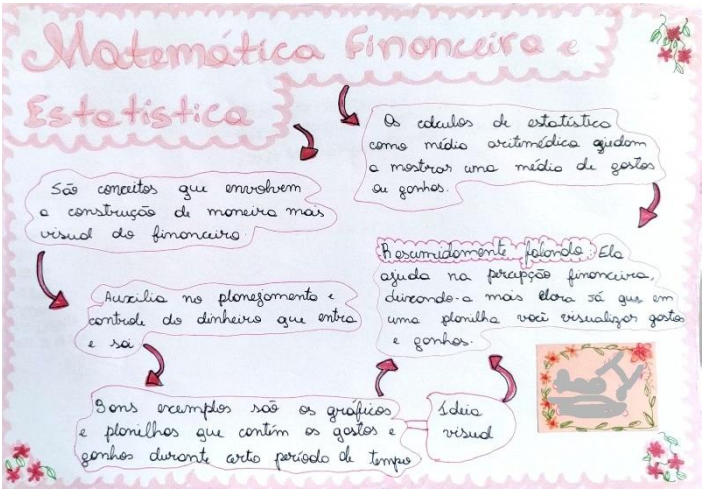
From the perspective of the theory of meaningful learning, this first step plays a fundamental role, since the relevance and proximity of the theme to students' reality favour their predisposition to learn, one of the necessary conditions for meaningful learning. By recognising content as part of their daily lives, students tend to mobilise previous knowledge, which begins to serve as a basis for the construction of new meanings.

The second step of PMTU, which involves verifying prior knowledge, facilitated a deeper understanding of students' cognitive structures regarding financial mathematics and statistics. For this survey, two complementary strategies were used: creating a word cloud from students' mental maps and administering a diagnostic test.

Initially, organised in small groups, the students were asked to represent words and concepts that they associated with the proposed themes (Activity 1). The productions showed different ways of understanding: one group elaborated short sentences (Figure 1), while the others opted for keywords, highlighting the concepts considered most relevant.

Figure 1

Representation of short sentences



One group chose a central concept, based on which the other words were interrelated. For example, the term “money”, as used in financial mathematics, was related to the concept of “numbers” in the context of statistics, indicating the initial construction of connections between the areas. This organisation (Figure 2) reveals attempts at conceptual articulation, albeit at an introductory level.

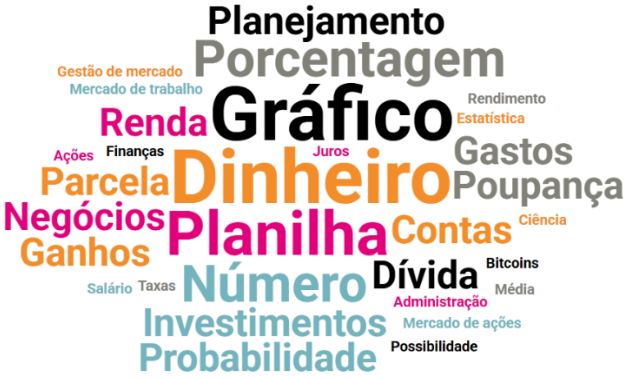
Figure 2

Representation of keywords

The systematisation of these terms yielded a word cloud that highlighted the most recurring concepts (Figure 3).

Figure 3

Word cloud with concepts associated with financial mathematics and statistics



The analysis of the word cloud revealed a significant presence of terms related to statistics, such as graph, percentage, average, probability, data, and spreadsheet, as well as concepts associated with financial mathematics, such as money, income, expenses, investments, savings, interest, and debt. This recurrence indicates that students perceive these contents as tools for interpreting and making decisions in real-world situations, demonstrating an initial understanding of their practical applicability. These concepts can be understood as relevant subsumers, since they already have meaning for students and are linked to concrete experiences in their social and economic contexts.

In addition, the spontaneous articulation between financial mathematics and statistics observed in the word cloud suggests a potential for integrative reconciliation, as students do not conceive of these fields of knowledge in a totally fragmented way. However, although the word cloud shows conceptual familiarity, it does not, in isolation, allow assessment of the level of mathematical understanding of these concepts. For this reason, it was necessary to administer the diagnostic test to deepen the analysis of prior knowledge and identify potential conceptual weaknesses.

The diagnostic test (Activity 2) is an initial assessment instrument designed to identify and highlight high school students' prior knowledge of fundamental concepts in financial mathematics and statistics. Its application took place before the development of didactic activities to support pedagogical planning and the organisation of interventions throughout the teaching unit.

The instrument consisted of ten questions, covering both basic operative procedures and contextualised problem situations that require data interpretation, critical analysis of information, and the mobilisation of mathematical concepts applied to everyday contexts.

The first questions investigate skills related to operations with decimal numbers and calculations involving increases, discounts, and percentages, allowing students to verify their understanding of essential concepts in financial mathematics, such as percentage change, value comparison, and the meanings associated with the percentage symbol.

Subsequent questions address central concepts of descriptive statistics, such as data organisation, identification of the median, mode, and average, and the reading and interpretation of tables and graphs. For this, up-to-date data from official sources, such as Olympic Games results and rice production

statistics in Brazil, were used, favouring the contextualisation and the approximation of mathematical content to socially relevant situations.

It is noteworthy that some questions request, in addition to the calculation, the justification of the procedures adopted, allowing the analysis not only of correct or incorrect answers but also of students' ways of thinking, their resolution strategies, and possible alternative conceptions. Thus, the diagnostic test goes beyond the merely classificatory character, assuming a diagnostic and formative function.

The results obtained from this test serve as a basis for organising the PMTU, enabling the teacher to adjust activities, select more appropriate examples, and propose teaching situations that favour the construction of meaning by relating new concepts to existing knowledge.

1) *Calculate:*
a) $171{,}27 + 2{,}1 =$ *b)* $171{,}2 - 5{,}72 =$ *c)* $9{,}27 \times 3{,}4 =$ *d)* $45{,}6 \div 0{,}12 =$

Question 1, as shown in Figures 4 and 5, showed different performance results. In item a), referring to the sum, the results were more satisfactory (14 correct answers and six errors). In item b), on the other hand, only seven students got the subtraction right, while 13 got it wrong, mainly by failing to regroup, indicating weaknesses in understanding of positional value.

Figure 4

Examples of recurring errors in operations with decimal numbers.

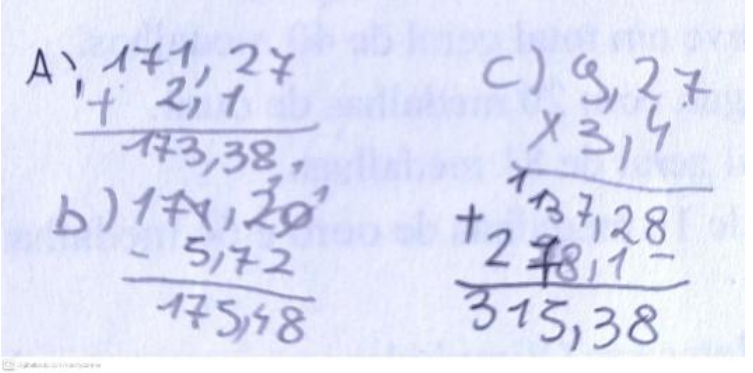
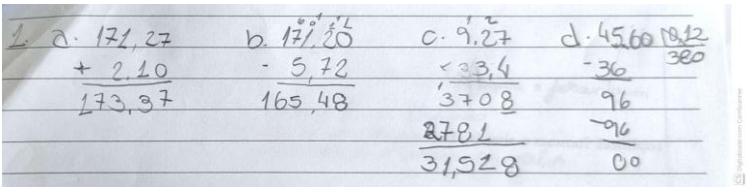


Figure 5

Examples of correct resolutions in operations with decimal numbers.



In multiplication, item c), despite eight correct answers, the high number of errors (9) and blank answers (3) indicate difficulties in positioning the comma and predominance of mechanical learning. These difficulties were even more pronounced in the division, which presented nine blank, six incorrect, and only five correct answers. In multiplication and, above all, division operations, mechanical procedures predominate, evidenced by the high number of errors and blank answers. These results indicate cognitive insecurity and suggest insufficient understanding of the concepts involved.

2) *A product costs R*$250,00 *and undergoes an increase of R*$37,50*. What is the new value of the product?*

In Question 2, which addressed the concept of addition, the results were widely satisfactory, with 17 correct answers, one (1) error and two blank answers. This performance indicates that the problem situation mobilised already-consolidated subsumers, since it required only the direct addition of the initial value and the increase. According to Ausubel (1976), when new content is clearly and directly related to stable prior knowledge, learning tends to be more effective, as the question confirms.

3) *A product costs R*$120,00 *and had a discount of* 15%*.*
a) Do you know the meaning of the symbol %? Justify your answer.
b) How much was the rebate?
c) How much will the product be after the discount?
d) If the discount were applied in two adjustments of 10% and 5%, would the final value be the same? Justify with calculations.

In Question 3, dealing with percentages and discounts, we noted more pronounced conceptual difficulties. In item a), whose objective was to identify

the meaning of the % symbol, we found that some students confused percentage with increase or decrease, revealing the absence of progressive differentiation between the concepts. Such confusion indicates that the mathematical symbol is not adequately anchored to a clear conceptual meaning.

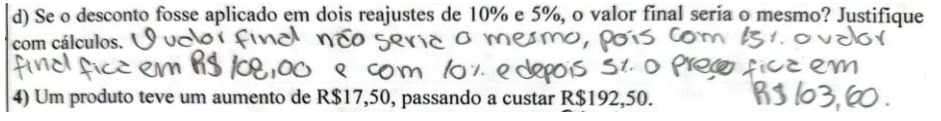
In item b), only three students got it right, while ten got it wrong and seven left it blank. Many students interpreted the 15% as an absolute value in reais or did not know how to operationalise the calculation, showing a weakness in understanding the percentage as a ratio rather than an isolated number.

In item c), the results remained consistent with the previous item (three correct answers, six errors and 11 blanks), since the resolution depended on the answer of item b), reinforcing the idea that the lack of adequate subsumers compromised subsequent learning.

In item d), which required understanding the successive application of percentages (10% and 5%) and comparing it to a single 15% adjustment, there were three partially correct, four incorrect and 13 blank answers. Some students demonstrated a conceptual understanding that the percentages affect different values, although they made calculation errors (Figure 6). This result is particularly relevant from the perspective of meaningful learning, as it indicates that, even without operational mastery, there is evidence of conceptual understanding, which constitutes a favourable basis for future pedagogical interventions.

Figure 6

Conceptual error in the application of successive percentages.



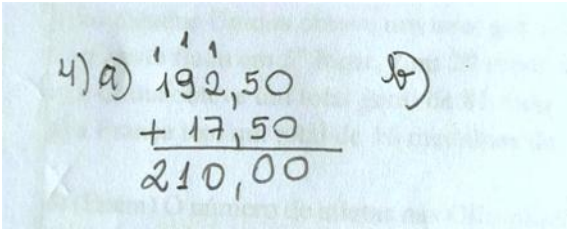
4) *One product increased by R$17.50, reaching R$192.50.*
a) How much did the product cost before the increase?
b) What was the percentage increase in relation to the original price?

In Question 4, item a) presented 13 correct answers, four errors and three blank ones, suggesting that most understood the need to perform a subtraction to find the original value of the product. The observed errors, especially the use of ‘sum’ rather than ‘subtraction’, indicate flaws in the

interpretation of the statement, not necessarily a lack of procedural knowledge (Figure 7).

Figure 7

Error in the resolution associated with the difficulty of interpreting the statement.



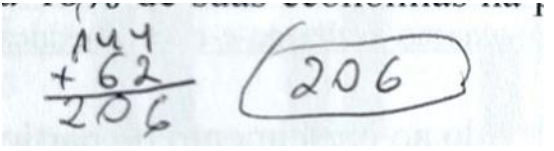
In item b), only two students got it right, while six got it wrong and 12 left it blank, indicating difficulty understanding the percentage as a relationship between the increase and the initial value. Many students interpreted the value of R$17.50 as the percentage itself, reinforcing the conceptual fragility.

5) *A tourist spent 40% of his savings on the beach; there was R*$144,00 *left. How much did the tourist have?*

In Question 5, which required a high capacity for interpretation and articulation between percentage and absolute value, no correct answers were recorded. Some of the students limited themselves to adding percentages and monetary values, which characterises a mechanical approach, dissociated from the mathematical meaning of the problem (Figure 8). According to Ausubel (1976), the absence of substantive relationships between concepts prevents meaningful learning, as evidenced by the question.

Figure 8

Example of incorrect resolution presented by students.



6) *The mathematics teacher showed her students their scores as described below.*

7; 5,8; 0,7; 6; 7; 5,9; 0,8; 9,1; 8,5; 7,4; 7,1; 8,2; 4,3; 6,5; 6,8

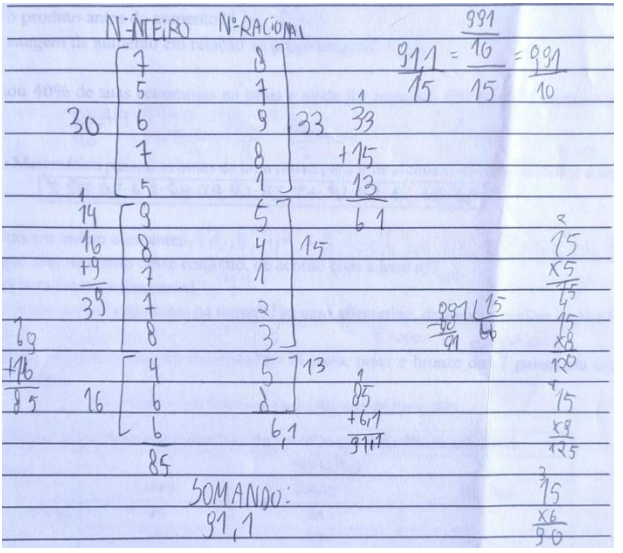
Answer:
a) Arrange the scores in ascending order.
b) What is the score that is in the centre of this set, according to letter a)?
c) Identify which score was more frequent?
d) Would you know how to calculate the average of the scores of the class? If so, describe and calculate.

In Question 6, related to descriptive statistics, the results were heterogeneous. In item a), only eight students correctly organised the numbers in ascending order, while 11 made mistakes and two left them blank, revealing difficulties in recognising the positional value of decimal numbers. In item b), which asked for the intuitive identification of the median, only four students got it right, indicating that this concept is not well anchored.

On the other hand, in item c), related to the mode, there were 12 correct answers, suggesting that this concept, due to its more concrete and intuitive nature, has greater potential for meaning-making for students. In item d), although only one (1) student got it right, four presented partially correct answers, demonstrating conceptual clarity about calculating the average but with operational errors, which reinforces the distinction between conceptual understanding and performing calculations. In Figure 9, we note that the student correctly performed the summation procedure; however, during the division step, he transcribed the previously obtained result incorrectly, using the sum instead of the value corresponding to the sum.

Figure 9

Partially correct resolution of the arithmetic mean calculation.



7) *The following table shows the number of gold, silver, and bronze medals of the seven countries in descending order in this ranking.*

Figure 1: First placed at the Olympic Games in Paris, 2024.

The top seven at the Olympic Games in Paris in 2024.			
Country	***Medals***		
	Gold	***Silver***	***Bronze***
United States	*40*	*44*	*42*
China	*40*	*27*	*24*
Japan	*20*	*12*	*13*
Australia	*18*	*19*	*16*
France	*16*	*26*	*22*
The Netherlands	*15*	*7*	*12*
United Kingdom	*14*	*22*	*29*

Source: Available at: https://www.olympics.com/pt/olympic-games/paris-2024/medals. Accessed on July 10, 2025.

Looking at the data in the table, it is correct to say that:

a) The United States obtained an overall total of 40 medals.
b) Japan was in 5th place, with 20 gold medals.
c) China obtained an overall total of 81 medals.
d) France has a total of 16 gold medals and 64 medals in total.

9) *The table shows rice production in Brazil between the agricultural years 2018 and 2023, separated by two cultivation systems: in upland areas and irrigated areas with controlled irrigation.*

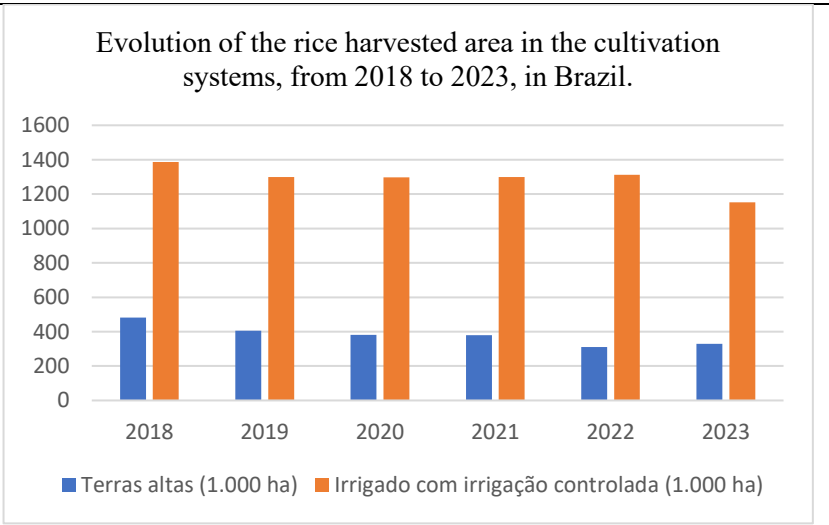
Figure 2: Evolution of rice production in the upland areas and irrigated cultivation systems, from 2018 to 2023, in Brazil.

Ano agrícola	Terras altas (1.000 t)	Irrigado com irrigação controlada (1.000 t)	Total (1.000 t)
2018	1.134	10.605	11.739
2019	990	9.322	10.312
2020	918	10.156	11.074
2021	893	10.727	11.620
2022	740	9.918	10.658
2023	856	9.427	10.283

Source: Available at: https://www.embrapa.br/agencia-de-informacao-tecnologica/cultivos/arroz/pre-producao/socioeconomia/estatistica-de-producao. Accessed on July 10. 2025.

Based on the data, analyse the following statements:
I. Rice production in upland areas showed a general downward trend between 2018 and 2022, with a slight recovery in 2023.
II. Total rice production in 2023 was higher than that recorded in 2019.
III. The highest production of irrigated rice with controlled irrigation occurred in 2021.
Check the correct answer(s):
a) Only I
b) Only II
c) Only I and III
d) Only II and III
e) I, II and III

10) *Note the following graph, which shows the area harvested from rice in Brazil between 2018 and 2023, distinguishing two cultivation modalities: upland rice and irrigated rice with controlled irrigation.*
Figure 3: Evolution of the rice harvested area in the cultivation systems, from 2018 to 2023, in Brazil.



Source: Available at: https://www.embrapa.br/agencia-de-informacao-tecnologica/cultivos/arroz/pre-producao/socioeconomia/estatistica-de-producao. Accessed on July 10. 2025.

In recent years, upland rice crops have been declining in area in Brazil. The total area harvested fell from 482,000 hectares in 2018 to 330,000 hectares in 2023, a 31.5% decline. This reduction was mainly due to replacing rice with more profitable crops, such as soybeans, corn, and sugarcane. On the other hand, the irrigated area remained stable, averaging 1.3 million hectares.

Based on the graphic and the text, check the correct alternative:

a) The area harvested from irrigated rice showed a sharp drop from 2020, following the trend of upland rice.

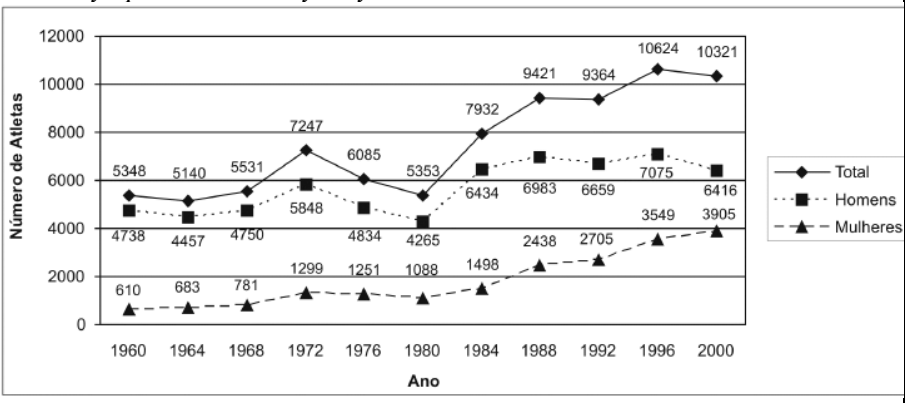
b) Between 2018 and 2023, upland rice area decreased, while irrigated area remained relatively stable.

c) The two cultivation modalities showed an increase in the area harvested in recent years, driven by the growth in demand for rice.

d) The replacement of rice by more profitable crops equally affected both upland and irrigated rice.

Questions 7, 9, and 10, which involved the exclusive interpretation of tables or graphs, showed satisfactory performance, with 80%, 50%, and 70% of correct answers, respectively. These results indicate that students have subsumers related to data reading, although occasional interpretive difficulties persist.

8) *(ENEM) The number of athletes in the Olympics has been increasing in recent years, as shown in the graph. Over 10,000 athletes competed in the 2000 Olympic Games in Sydney.*



Source: Available at: https://www.gov.br/inep/pt-br/areas-de-atuacao/avaliacao-e-exames-educacionais/enem/provas-e-gabaritos. Accessed on July 10 2025.

In the last five Olympics, this increase was due to the growth in the participation of

a) men and women, in the same proportion.

b) men, because the number of women has been decreasing with each Olympics.

c) men, because the number of women has practically not changed.

d) women, because the number of men has been decreasing with each Olympics.

e) women, because the number of men has practically not changed.

In Question 8, which required interpreting a line graph, only 30% of answers were correct, suggesting difficulties with integrating graphical information and analysing trends over time. However, in Question 8, the low performance (only 30% correct answers) in interpreting line graphs indicates difficulties with integrating information and analysing variations over time. Such difficulties seem to be related to reading and attention to the statement, especially because it is a question of the ENEM that, although essentially interpretative and without requiring calculations, requires careful understanding of the information presented. This scenario highlights the need to intensify activities that favour the articulation of graphical representation and mathematical meaning.

In general, the results indicate that students performed better on questions that required direct calculations or immediate interpretation, suggesting relatively stable knowledge. On the other hand, as situations demanded a higher level of abstraction, critical interpretation, or articulation between concepts, there was a significant increase in errors and blank answers, evidencing the presence of fragile or poorly differentiated subsumers.

According to Ausubel (1976), when subsumers are insufficient or poorly structured, learners tend to resort to mechanical learning, based on memorising procedures, without proper conceptual understanding. The high number of blank answers also suggests a state of cognitive insecurity, reinforcing the need to use previous organisers and teacher mediation.

The integrated analysis of the first and second steps of the PMTU therefore highlights the importance of this methodology in the development and understanding of the concepts of financial mathematics and statistics. The choice of theme, based on real data from the students' context, favoured a predisposition to learn, while verifying prior knowledge allowed us to identify both existing subsumers and conceptual gaps to be addressed throughout the teaching activities.

FINAL CONSIDERATIONS

This article aimed to analyse the first two steps of a PMTU, the definition of the theme and the verification of prior knowledge, drawing from the identification and analysis of the initial conceptions of high school students on statistics and financial mathematics. For this, a word cloud and a diagnostic test were used as instruments, based on real data from students' socioeconomic context.

The results show that students have prior knowledge of everyday situations involving money, expenses, percentages, and basic data reading, which are potential subsumers for learning new concepts. However, such knowledge is, in large part, poorly differentiated and weakly articulated, especially when problem situations require a higher level of abstraction, interpretation, and conceptual integration. This scenario indicates the predominance of mechanical learning, the result of pedagogical practices centred on memorising procedures.

The analysis of the word cloud revealed that students perceive financial mathematics and statistics as complementary areas, associated with the organisation, interpretation, and financial decision-making. This initial perception reinforces the relevance of choosing the PMTU theme, as it directly

reflects students' lived experiences, aligning with the first step proposed by Moreira (2011b) and the principles of the theory of meaningful learning.

The diagnostic test, in turn, played a fundamental role in the second step of PMTU by making visible the limits and potential of students' prior knowledge. The identification of recurring difficulties in percentage calculations, averages, and interpretation of graphs and tables shows the need for previous organisers and didactic planning that consider the progressive differentiation and integrative reconciliation of concepts.

Thus, the results reinforce the importance of the initial steps of the PMTU as structuring elements of the teaching process, since they enable the teacher to identify students' cognitive starting point and plan pedagogical interventions aligned with their realities. We conclude that the PMTU, by valuing students' prior knowledge and context, constitutes an essential methodological strategy for the construction and meaningful understanding of financial mathematics and statistics concepts in high school.

As a limitation of this study, we note its exclusive focus on the initial steps of the PMTU, without in-depth analysis of subsequent steps. However, this excerpt highlights the relevance of these steps, which are often not systematically considered in teacher planning. For future research, we suggest expanding the analysis to include the other steps of the PMTU and conducting comparative investigations of different diagnostic instruments for identifying subsumers.

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AUTHORSHIP CONTRIBUTION STATEMENT

TV and EB formulated the idea presented. TV prepared the interviews, carried out the activities, collected and analysed the data, developed the discussion, and prepared the original draft. EB oversaw the research and performed the final review of the work.

DATA AVAILABILITY STATEMENT

The data obtained from the interviews are in the possession of the first author due to the confidentiality inherent in the investigative process within the ethics scope.

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