



REVISTA DO PROGRAMA DE PÓS-GRADUAÇÃO EM
EDUCAÇÃO MATEMÁTICA DA UNIVERSIDADE FEDERAL
DE MATO GROSSO DO SUL (UFMS)

Volume 12, número 28 – 2019

ISSN 2359-2842

Financial education and financial mathematics, a possibility through mathematics education

Educação Financeira e Matemática Financeira - Uma Possibilidade Pela Educação Matemática

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ABSTRACT

In this article, we present some results of a qualitative research already published partly in the VII International Seminar of research in Mathematics Education (VII SIPEM). There have been some questions about a critical education in financial mathematics studies on how to promote financial education in a meaningful way to solving problems in high school. At research in the textbooks, no activities were found with this approach in a meaningful way. The objective of the research was to develop pedagogical intervention activities that could promote financial reflection on the part of students and teachers, problematizing issues of financial mathematics to achieve financial education with problem solving. The topics studied are economic and financial aspects of the content of financial mathematics and according to guidelines of the Reference Matrix of the New ENEM. Thus, we elaborate an educational product that is composed of texts and problems exploring situations of the current socio-economic reality. Activities were applied to students in the third grade of high school. The analysis of these activities was qualitative, and the results obtained were treated according to the parameters of solving problems, and the objective of the research carried out to resignify the financial mathematics by parameters of financial education.

KEYWORDS: Financial Mathematics, The Secondary School, Financial Education, Solving Problems, Analysis of Mistakes.

RESUMO

Neste artigo apresentamos alguns resultados de uma pesquisa qualitativa já divulgados, parcialmente, no VII Seminário Internacional de Pesquisa em Educação Matemática (VII SIPEM). Em levantamentos nos livros didáticos, não foram encontradas atividades que promovessem a Educação Financeira no Ensino Médio de forma significativa. A investigação teve como objetivo elaborar atividades de intervenção pedagógica passíveis de promover reflexão de ordem financeira por parte dos estudantes e professores, problematizando questões da Matemática Financeira para atingir a Educação Financeira pela Resolução de Problemas. Os temas trabalhados tinham cunho econômico-financeiro no contexto da Matemática Financeira e, segundo orientações da Matriz de Referência do Novo ENEM. Atividades foram aplicadas a estudantes do terceiro ano do Ensino Médio. A análise dessas atividades se deu de forma qualitativa e os resultados foram tratados segundo os parâmetros da Resolução de Problemas, sendo cumprido o objetivo da pesquisa, o de ressignificar a Matemática Financeira por parâmetros da Educação Financeira.

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PALAVRAS-CHAVE: Matemática Financeira, Ensino Médio, Educação Financeira, Resolução de problemas, Análise de Erro.

Introduction

The topic of article is financial mathematics in the perspective of citizenship formation in a financial education context. In this study we seek to answer the question: *"How to promote financial education significantly based on problem-solving in high school?"*.

The answer to this question comes through economic and financial activities, listing parameters to contribute to citizenship formation, in a reality that increasingly demands economic issues in the social life of individuals in a capitalist society.

The experimentation occurred with the creation of activities applied in two classes of 3rd-graders of a private high school in the city of Belo Horizonte. Those classes were composed of 30 students from a high social layer and purchasing power, and the activities promoted discussions in some situations that were closer to their reality. The students' age range was from 16 to 18 years old.

In this article we present the movement of financial mathematics towards financial education, driven by the students' learning process, according to their own demand to know some applicability of the mathematical contents, which we understand to be possible through problem solving. The mechanisms for this analysis helped to classify the responses into groups, providing data that marked future interventions, making them more assertive and pertinent to any current educational context.

The financial mathematics in the process of learning with financial education

Based on a survey on some research works produced in the last decade, especially in the master's degree in mathematics education at the Federal University of Juiz de Fora (UFJF) and in the State-of-the-Art Research Group (Grupo de Pesquisa de Ponta)³, we have been able to illustrate how financial mathematics moves towards financial education.

³ The State-of-the-Art Research Group (Grupo de Pesquisa de Ponta), led by Professor Dr. Marco Aurélio Kistemann Júnior, from the department of Mathematics at the Institute of Exact Sciences, is composed of pioneering researchers in the areas of financial education and economic education and has been working since 2011.

Here, we can cite Resende's works (2013). In his dissertation *A educação financeira na educação de jovens e adultos: uma leitura da produção de significados financeiro-econômicos de dois indivíduos-consumidores* (Financial education in youth and adult education: a reading of the production of financial-economic meanings of two individuals-consumers), Resende analysed, through the semantic fields model, the relationship between financial education and the preparation of the individual for situations involving consumption, presenting parameters that correlate consumption and the gender of the consumer.

We also have the work of Campos (2013) who, in his dissertation *Investigando como a educação financeira crítica pode contribuir para tomada de decisões de consumo de jovens-indivíduos-consumidores (JIC'S)* (Investigating how critical financial education can contribute to consumer-consumer-decision-making), advocates for the education of citizens through financial education and critical mathematics education, because, according to the author, "by having access to information, understanding the financial-economic language, as well as in its postulates and *modus operandi*", this

subject would not be seen as a mere consumer, endowed with a servile condition, at the mercy of a market that has been structured under a growing number of increasingly complex financial-economic information, but as a citizen who critically positions himself in relation to the scenario that has been established in the present time (CAMPOS, 2013, p. 13).

The author combined, in his analysis of activities, both classroom paradigms, the paradigm of the exercise and the scenario for research, with the three types of references of Skovsmose (2000): reference to mathematics, reference to semi-reality and reference to reality, still based on the semantic field model.

These research works proposed situations that developed the students' critical view of daily financial relations. Also studied was the treatment of textbooks in the last decade, giving the theme some forms of questions and their proximity to students' daily lives.

We also mention Britto (2012), who, in his research *Educação financeira: Uma Pesquisa documental crítica* (Financial education: A Critical documentary research), alerts to the conditioning of individuals receiving financial education influenced by interests of financial institutions, and suggests the "financial education legitimacy process" in an exercise of concatenation between financial education and critical mathematics education, by which we would form better informed citizens, ready to consume better.

Regarding the bibliographical research, on the academic studies and titles related to the teaching of Commercial and Financial Mathematics, Rosetti Jr. and Schimiguel (2009) emphasise financial education for the development of knowledge, for citizenship and inclusion, stating that, regarding mathematics finance, "most textbooks approach the subject in an impractical and non-inclusive way, with the direct application of formulas" (ROSETTI JR. e SCHIMIGUEL, 2009, p. 5). Through studies and experiments, we have found that many of those formulas will never be used by students in everyday situations, because they deal only with simple reasoning, aimed at the treatment of percentages and rules of three.

A natural movement is taking place, causing changes in the way we treat the teaching of financial mathematics, which, according to Assaf Neto (2002, p. 13), means the "study of money over time".

Due to the need to understand some socioeconomic situations, mathematics education stands out with emphasis on the re-reading of financial mathematics teaching and the promotion of critical education in mathematics education spaces.

Financial education, based on financial mathematics, has a formative objective, aimed at an educational commitment at the service of society, which, according to Lima and Sá (2010), makes young people "reject corruption, make fair negotiations, meet deadlines and combined values" and "ultimately to be socially responsible" (LIMA & SÁ, 2010, p. 5).

Educating this future worker, citizen and consumer for a conscious acquisition of processes and products inherent to their need for life is the role of the school for financial education.

However, both curricula and mathematical contents give rise to a re-reading, a reformulation aimed at a critically aware consumer. According to Rosetti Jr. and Schimiguel (2009), preparing the individual to exercise citizenship "demands from the school and its curricula the implementation of competences and skills that provide an autonomous posture in the face of the problems to be faced" (ROSETTI JR. & SCHIMIGUEL, 2009, p. 2).

To avoid controversial comparisons, Oliveira (2007) explains that: "Financial education should not be confused with the teaching of techniques and hints on how to manage money well, and should not be confused with a manual of easy moral rules" (OLIVEIRA, 2007, p. 9).

We complement, from what can be read in the texts of the National Strategy of Financial Education - ENEF⁴ - (2010), the conceptualization about the financial products, reporting that the financial education

is the process by which individuals and societies improve their understanding of financial concepts and products so that, with information, training and guidance they can develop the values and competences needed to become more aware of opportunities and the risks involved and then be able to make better informed choices, know where to look for help, and take other actions that improve their well-being (BRASIL, 2010, p. 57-58).

To structure the educational practice in accordance with the interdisciplinarity of mathematical contents and social reality, new competences for mathematics trainers are required, based on coordinates that favour active learning with parameters coming from an economically capitalist society, which inserts innumerable economics, sociology, politics themes, besides other social issues.

So, to promote financial education in a significant way, we selected and elaborated some activities that actually approach economic-financial issues demanded by the students themselves and involved concepts of financial mathematics. For these activities to take place and generate some change in student learning, we chose to work based on problem solving.

Activities that seek to promote financial education and its treatment through problem solving

The reality in which students mature envisions a globalised world with Zygmunt Bauman's perception (2007) that everything becomes "*liquid*", where an extremely fast and simple decision making is required, both in its conception and in its execution. This optimisation of resolutions increasingly demands formation of competent professionals capable of generating good and applicable models to solve occasional situations. This guides us to the following question: How can didactic practice support students so that they enter this globalising society through the development of their mental structures?

⁴ ENEF was developed in partnership with the government, the private initiative and civil society, seeking to promote and foster a culture of financial education in the country, broaden the understanding of citizens, to have them make conscious choices regarding the administration of their resources, and contribute to the efficiency and soundness of the financial, capital, insurance, pension and capitalisation markets (BRASIL, 2010, p. 2).

Echeverría and Pozo (1988) stress that problem solving "offers students open and suggestive situations that require an active attitude or an effort to seek their own answers, their own knowledge" (ECHEVERRÍA e POZO, 1988, p. 9).

Listing some working techniques with problem solving and with facing a problem situation, we have observed Diniz's methodological perspective⁵ (2001), which states that "problem solving addresses situations that do not have an obvious solution and which require the respondent – the person who resolves the situation -to combine their knowledge and decide on how to use them in search of a solution" (DINIZ, 2001, p. 89).

We also want the student to seek problems to be discussed in the classroom, bringing data, texts and questionings to be problematized and whose results can be tested by other colleagues and by the teacher. It is a movement that withdraws the teacher from the centre of the class and transforms the students into the constructing agents of their own knowledge (ONUCHIC; ALLEVATO, 2014). The students begin to realise that they can learn when they must seek answers and mechanisms to respond to their own concerns.

Five activities suggested by the students were selected to be worked in the classroom, each requiring 4 classes of 50 minutes each to be performed. Among the activities we have:

Activity 1 - Study on some ways to save money. Here students deal with savings, inflation, and bank deposit certificate (CBD) using prior knowledge on percentages, successive increases and discounts, and exponential function. This practice, like all others, was guided only by the teacher in class.

Activity 2 - Study on some cases of labour cost calculations arose from the students' doubts about the labor costs arising from the operation of a business society, since many of the parents were engaged in some business practice. In this activity they discussed the relationship between the end of contract and settling the employee's payments, income tax withheld at source (IRRF), interpretation of paycheck, FGTS (a monthly payment by the employer by force of law to a specific account that the employee can request on regulated situations) and unemployment insurance. The mathematical contents involved were: percentage and function per sentence.

⁵ Methodological perspective was the term used by Maria Ignez Diniz in the book *Ler, escrever e resolver problemas: habilidades básicas para aprender matemática* (Reading, writing and solving problems: Basic skills to learn mathematics) (DINIZ, 2001b, p. 99), so that it could conform its concept of problem solving.

Activity 3 - Calculation of constant installments, which will be discussed in this article, raises considerations about the use of formulas with which the students had never worked and that are common in sales on installments. The request to discuss this item came from the doubts about home appliance financing and the built-in costs, which involved the use of percentages and mathematical formulas.

In **Activity 4 - Attention to real estate financing - SAC table and some fees**, students wanted to know how a person who earned little, about a minimum wage and a half, could own a property. In this practical activity, we constructed some SAC tables using a scientific calculator and using only percentages. We dealt with some real estate taxes pertaining to deed, registration and operational costs.

Finally, **Activity 5 - Some means of vehicle acquisition: leasing, direct consumer credit (CDC) and consortium**. Thinking about a scenario in which the students of the research were young people in the 3rd grade of high school, last stage before higher education, from a high social layer and purchasing power, it is only natural that they wanted to know how to acquire their own vehicle. Hence, we presented some purchase options and we could argue that, although among the options one is more economical than the other, we must take into account that the choices must meet the individual needs and conditions, showing that other variables are relevant in the treatment of each one's financial sanity.

We chose to have them work on the activities in pairs, so that the students interacted and discussed with each other to defend their points of view and conclusions, as agreed by Ponte, Boavida and Abrantes (1997). For these authors the oral, written or gestural speech exist in every teaching-learning relationship. They affirm that oral communication plays an important role in mathematics teaching, since "it is essential for students to express their ideas and confront them with their colleagues'" (PONTE; BOAVIDA; ABRANTES, 1997, p. 14).

According to Polya (2016), during problematization, the guidelines "should be generic, applicable not only to the present problem, but also to problems of all kinds, because only then can they develop the student's *skills* and not just a specific technique" (POLYA, 2006, p. 17).

We chose to use scientific calculators in the resolution of activities to speed up operations and focus on the interpretation of data and conclusions for the problems proposed (NASSER, 2009). The work we reported was performed by two students, represented here by the initial two letters of each student's name to keep confidentiality, according to the educational institution in which we applied the activities.

Analysing the answers

To improve tabulating the data, we selected and treated five types of errors that were based on the cognitive axes from the Reference Matrix for the New ENEM (BRASIL, 2009) and from the specific demands of the promotion of mathematical critical thinking by financial education, conforming to Polya's four stages of work to solve problems (2006, p. 4): *understanding the problem, planning resolution, planning the execution and making the retrospective of the complete resolution*, which we present below:

1. Error of incomprehension of the introductory text: Error that refers to the skill of language domain (DL) interfering in *understanding of the problem situation*, proposed by an initial informative, encouraging text.

2. Error of incomprehension of the problem situation: Error regarding the confrontation of problem situations (SP) through an incorrect *resolution plan*.

3. Error in using formulas/concepts: Error originating from the construction of argumentation (CA), *execution of the resolution plan*.

4. Operational error in the use of formulas/concepts: It refers to some lack of basic contents or distraction regarding the technical steps to solve the problem.

5. Error in the critical interpretation of the conclusion: Error referring to consistent proposal elaboration (EP) for the situation presented. In *retrospect*, the students examine their calculations, including rereading the texts of the question to adapt their final analysis to the procedures used.

The error analysis made explicit the specificities of each one of the questions, including those of subjective interpretation. The students were given the possibility to continue with the resolution of the questions even if at some stage they made some mistake due to the most varied factors, according to the five typified errors. Following this article, we exemplify our error analysis through one of five activities selected.

Analysis of Activity 5 - Some means of acquisition of vehicles: leasing, direct consumer credit (CDC) and consortium

When discussing in the classroom examples that make possible the work with some concepts of financial mathematics, we present five themes with activities that guided our study:

Activity 1: "*Study on some ways to save money*"; Activity 2: "*Study of some cases of labour cost calculations*"; Activity 3: "*Calculation of constant installments*"; Activity 4: "*Attention to financing real estate - table of the constant amortization system (SAC) and some fees*" and Activity 5: "*Some means of vehicle acquisition: leasing, direct consumer credit (CDC) and consortium*".

These activities followed two principles for their choice: (1) students' questions about topics possibly covered by financial mathematics and (2) the conditioning of these subjects to the contents of high school mathematics.

In this article, we presented the analysis of activity 5: *Some means of vehicle acquisition leasing, direct consumer credit (CDC) and consortium*.

Common questions arise about the ways of financing vehicles, so some encouraging texts were inserted in this activity, in a way that could reveal some doubts that usually arise in problematizations on financial mathematics. The activity has 3 (three) questions. Question 1: "*Financing or participating in a consortium to acquire a car?*", Question 2: "*Calculating inflation*" and Question 3: "*Financing a vehicle or waiting a little longer in a consortium?*"

We present below the encouraging text, which intended to show students some nuances of the two most usual forms of vehicle financing.

Leasing was well-publicised in Brazil in the late 1990s, until the devaluation of the currency in 1999, and is currently used by companies that have tax advantages, such as discounts on corporate (juridical person) income tax (IRPJ), not counting initially in the balance sheet of the company, participating only the amount paid for the installments, which many consider as a "rent".

We say "rent," because when we take the vehicle from the concessionaire, it is not registered in your name, but rather as possession of the guarantor bank, which charges you with respect to the procedures to convey to the owner's name, unlike our direct credit to the consumer (CDC).

One disadvantage of leasing in relation to other financing type is that before the first two years, if you anticipate some instalments, they do not suffer any interest reduction. In a way, we are bond to it until the end of the period contracted, mainly because the leasing is a rent contract with the right to purchase the merchandise at the end of the contract, it is not credit. If the buyer does not want to wait until the end of the term (24 months) to discharge the debt, he/she pays an early settlement fee, i.e., a fine for breaking the leasing contract.

With regard to the CDC, we can say that it is the consumer's preference among the financing types, since it allows the advanced payment of some installments including the interest discounts, but it operates with a higher interest rate than the leasing, which is justified by the format of economic activity. At the CDC, the client is granted a credit, so all documentation is in the buyer's name, thus, if the buyer does not honour his/her debt with the financial company, it may take legal action against the buyer.

Regarding the consortium, an invention dating back to 1967 that sought to meet the demand for sale of the Brazilian automobile industry due to the low supply of direct consumer credit, consisted of a group of people who would get together and pay a monthly amount with the purpose of acquiring a commodity.

There are two ways for a consortium partner to win monthly, either through a bid or a drawing of lots. In the bid, the interested parties present a secret offer, and the highest bid takes the desired letter of credit.

Among the disadvantages, we must settle the amount of the bid given in that period, and we can still demand a guarantor to guarantee the other installments, making the process very bureaucratic.

The advantages are the interest, which is minimal in comparison with the other financing types, only collecting some fees, such as the administrative and the reserve fund fees.

The options for buying a car are very varied precisely to meet the possibilities and profiles of each buyer, but in all of them one can lose money and incur debt if there is not a correct financial planning, as they are debts assumed in the medium term.

The first question entitled "*Financing or participating in a consortium to acquire a car?*" asked: *João is in doubt about financing a vehicle in the amount of R\$ 23.000,00 or make a consortium thereof, and next to his year-end salary plus 13th and vacation, he should accumulate approximately R\$ 13.000,00. The proposals submitted to him are:*

1. *Financing in 36 installments of R\$ 900,00 without downpayment, in the leasing format.*
2. *Financing in 36 installments of R\$ 385,00, with downpayment of R\$ 13,000.00, also in leasing.*
3. *Consortium in 36 installments of R\$ 750,00. What would be the best option for John?*

The students, by defining their preferences in their responses, indicate the profile characterisation of the Brazilian consumers who, according to the Brazilian Service of Support

to Micro and Small Enterprises (SEBRAE), tend to consume renowned and fashionable brands, attending to the vanity in search of status and the immediate satisfaction provided by consumerism.

The vast majority (62%) preferred the second option because of smaller instalments, and they did not think about investing the money (R\$ 13.000,00) and contract a consortium, which would be much cheaper than the other options, however the comparison would demand more reasoning.

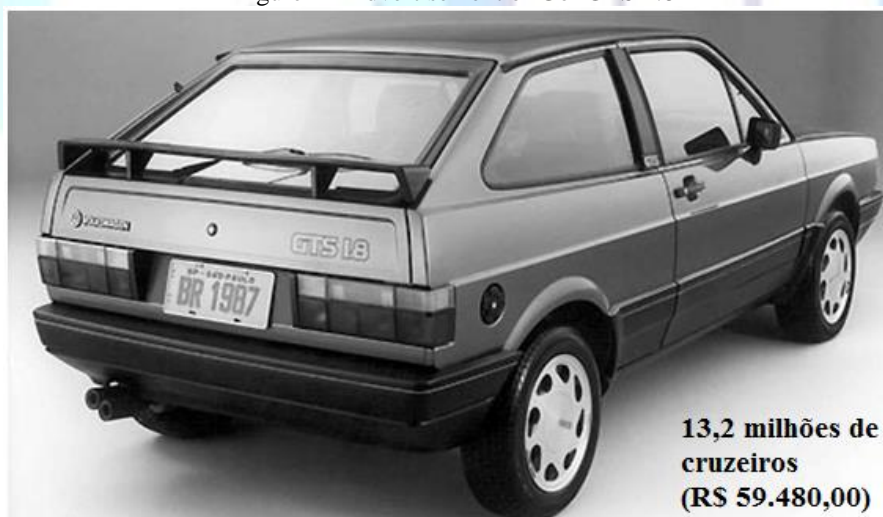
This first activity was not evaluated based on errors, because all the answers were correct and serve only as an illustration of some of our students' social aspirations.

Question 2, "Calculating Inflation," asked: *How many reais would be the minimum valuation of the car in the image in a year of use?* Below, there is the introductory text titled: "When is a consortium a good investment?".

"Investment is the decision to postpone consumption and invest the money that would be spent on a financial product - or even something like a real estate - to try to get a bigger value in the future. In Brazil there is still such confusion, especially among owners who are over 40 and have grown in times of high inflation. At that time there was a reasonable chance that the price of the used car would rise more than inflation - even because there was not as much supply of vehicles as today".

Revista Quatro Rodas. November 2007.

Figure 1 - Advertisement of Gol GTS 1.8



Source: Revista Quatro Rodas, November, 2007

After the Cruzado plan, inflation again reduced the finances of Brazilians, resulting in a fall in the average actual salary and the rise in interest rates. In 1987, a new shock was needed.

Basically, the Cruzado plan II (June) and the Bresser plan (November) resumed the practices of the Cruzado. Inflation, about to reach 365% a year, did not subside.

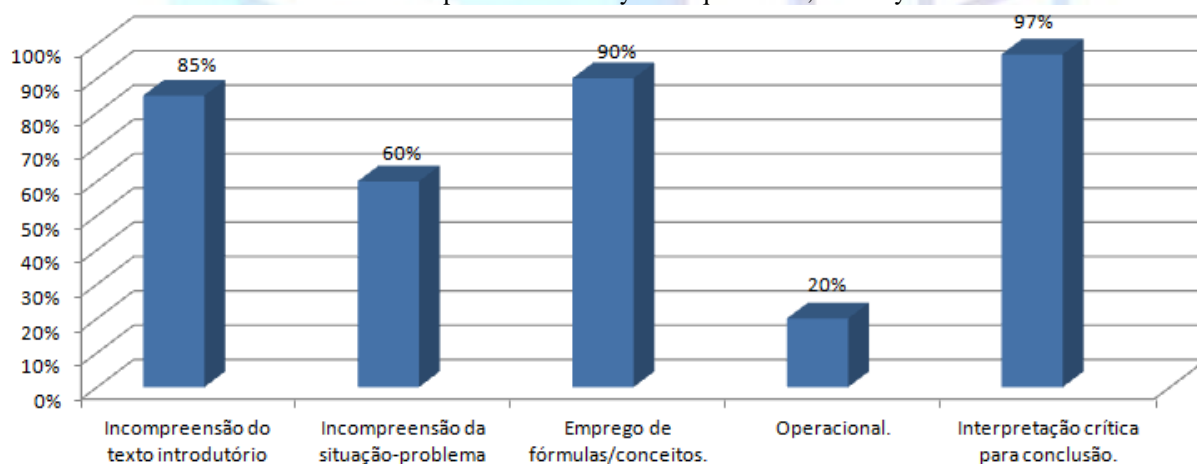
As of January 15, 1989, the Summer plan generated a sharp fall in inflation. Although ephemeral, monthly rates dropped from around 30% in the previous months to around 7%. However, at the end of the Collor government, inflation reached 2,708% per year, when the currency was still the *cruzeiro*, which would precede the *cruzeiro real*.

Financing a vehicle in the 80's (close to the occurrence of the Summer plan) was a good investment, because monthly it would have an appreciation of around 35%, which today makes no sense, since the vehicles devalue up to 10% from the moment they leave the dealer, let alone over the years.

The statement asks for a reading of related data: between the figure, which discreetly presents the year of the car (1987) and reported price at the time (2007) in *reais* (R\$ 59.480,00); and the historical data presented in the motivating text about inflation in the period the car was advertised, which was 365% a year. Brazil was experiencing an shocking economic situation with high inflation.

The error chart points to this incorrect reading, followed by an interpretation of the students who did not make the relationships between textual and graphic elements, culminating in a consequent error of critical interpretation. "The reading and interpretation of these resources develops the ability to question, raise and verify hypotheses, as well as to seek relationships between data, inherent skills in the process of reading any type of texts (SMOLE & DINIZ, 2001, p. 83).

Graph 1 - Error analysis of question 2, Activity 5



Source: Research data

We worked with this kind of problem, with many unimportant data for resolution, to demystify the case that

a problem cannot allow doubts and that all text data is necessary for its resolution. Besides, it shows the student the importance of reading, helping him to learn to select relevant data for solving a problem (DINIZ, 2001, p.110).

The third and last question: *"Financing a vehicle or waiting a little longer in a consortium?"* was very long and required much thought to be interpreted. It presented in its encouraging text a table that related the depreciation of a car to its value to be financed and to what would be received with its sale, all in function of the time and, also, a figure that showed a simulation of financing by the Federal Savings Bank (CEF), as presented below:

*"However, this economic mechanics (financing as investment *) stopped working after Brazil tame inflation. Today, the Brazilian situation is similar to that of any stable economy. Cars lose value over time. However, even without being an investment, the automobile is usually the first asset to be sold when you need to make quick money".*

*Revista Quatro Rodas, November 2007. * Our comment.*

Marcos needs to pay off a debt and found a solution to change his popular vehicle to a simpler or more used one to make a difference in money and for this he heard the opinion of a financial adviser, who told him that:

This practice of selling a car is old, but there are some problems:

- *Brand-new cars devalue about 5% to 10% once they leave the dealers;*
- *Simpler and cheaper models lose something like 8% of their value every year;*
and
- *In average cars, this devaluation is more pronounced, reaching 10% or even 15% a year.*

Moreover, there is a problem of financing, you lose much money if the car is sold in the initial years of its financing, but, the older the car, the worse its acceptability in the consumer market. This occurs for two reasons: first; after three years, on average, maintenance expenses arise and secondly; the launching of new models.

See the demonstration table:

Table 1 - Long-term financing with amounts in reais

Carro Popular	2007	2008	2009	2010	2011	2012	2013
Valor do carro no ano da venda	24.700	22.984	22.294	19.747	18.452	17.373	16.294
Valor do financiamento a pagar	40.965	34.138	27.310	20.483	13.655	6828	0
Quanto recebe ao vendê-lo	-16.265	-11.153	-5.016	-736	+4.797	+10.546	+16.294
Compensa vender nesse ano?							

Source: Authors - 2013

a) Analyse and complete the table above with "yes" or "no", taking into account the data of the text.

b) Marcos owed R\$ 15.000,00 for the payment of taxes and fees for the acquisition of a property. To pay off the debt, he decided to sell his vehicle year 2007 (consider that we are in 2013) and buy another, 0 km, fully financed in 36 instalments, under the same conditions presented to his friend João (ACTIVITY 1), instead of taking a bank loan in his agency according to the simulation below:

Figure 2 - Personal credit simulator of the Federal Savings Bank (CEF)

CAIXA Simulador COMERCIAL

Produto: Crédito Pessoal Automático (CDC Automático)

Cálculo por: Valor de Dívida Valor de Prestação

Valor da dívida: 15.000,00

Taxa de Juros: 3,88

Prestações: 36

Calcular Limpar

Valor da prestação:
R\$ 780,17

* Essas simulações são apenas demonstrativas e não valem como proposta – Os valores a serem contratados dependem da capacidade de pagamento e das garantias da operação, e as taxas podem ser ainda menores, em função da sua categoria profissional e do seu relacionamento com a CAIXA.

Valor do IOF: *(cobrado uma única vez no ato da contratação)
R\$ 262,94

Custo Efetivo Total (CET):
4,01% mensal
60,24% anual

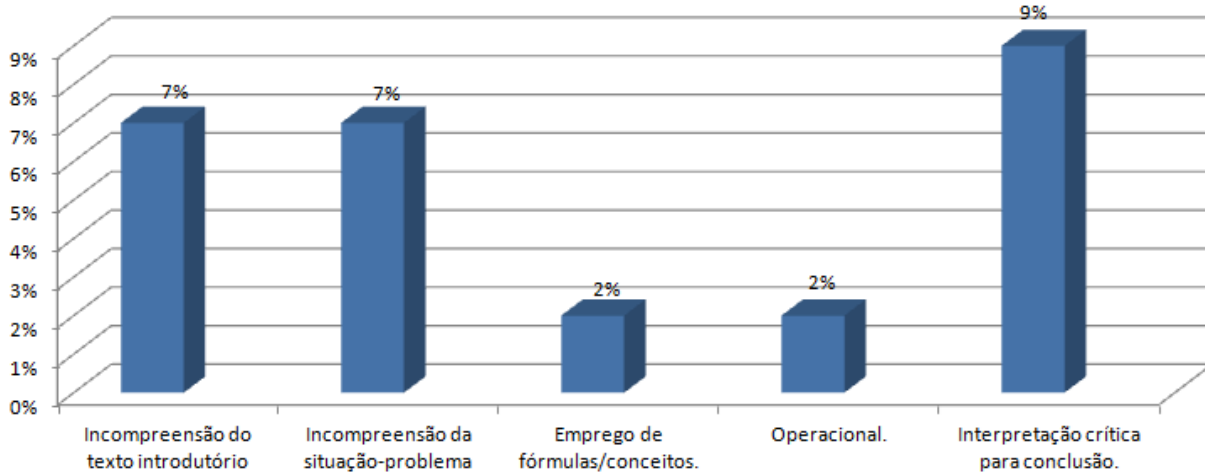
Source: <http://www1.caixa.gov.br/simuladorcredito/simulador.asp?operacao=calcular>

Item (a) assisted in the interpretation of the table and we should not even consider its mistakes, as it was very easy.

Item (b) considered a simulation made by the CEF, which included 36 instalments of R\$ 780,17 at a monthly interest rate of 3.88% and reported that the value of the IOF (tax on

financial operations) would be charged only at the time of the contract and at value of R\$ 262,94. The answers given to item (b) provided the following data:

Graph 2 - Error analysis of question 3 (b), Activity 5



Source: Research data

The answers showed a maturity of students regarding financial education, which they experienced during problem solving, and the following answers present this "evolution":

"It is better for him to buy a new car by paying higher instalments, because if he continued with the old car, it would start to present maintenance losses and it would devalue increasingly; $36 \times 780,17 = 28.086,12$ reais and $36 \times 900 = 32.400$ reais". Responses of the IT pair, which concluded as follows:

"If the person goes to the mechanic and asks him how much the old car will spend would cost for maintenance, and if that value exceeds 120, it is worth getting a new car, because the difference between the car and the debt is 120; $900 - 780 = 120$. But one must take into account whether the person really wants a new car".

The students extrapolated the presented question, reaching a critical level that was not observed in previous classes, when they made affirmations about the needs and conditions of each individual, leaving aside prejudices about the indebted ones. The understanding that many variables, not just mathematics, should be raised in decision-making when dealing with money, have led students to a more critical thinking, which turns to the real duty of financial education, to educate in a way conscious.

Final considerations

With the participation and involvement of the students, we achieved a way to educate financially, making them aware of the need to save money to improve their lives. During the activities, we asked whether what had been learned would be useful to them in some future situation and whether some knowledge was added. Many responses were positive in the sense of what was intended: *"Promoting financial education significantly from the resolution of problems in high school"*.

The objective of *"Identifying activities that promote an understanding of real situations in financial mathematics"* has been fulfilled. As a result of the research of the professional master's degree in Science and Mathematics Teaching⁶, an *Activity Book* was prepared as a product of the mentioned master's degree, in which the questions analysed and restructured were presented to *"Promote a formative and critical mathematics teaching"*.

When using the problem solving methodology in context, there is a series of difficulties, both in the order of adequacy on the part of the students, who suffer from the decentralization of the teacher and the management of the class, in a more mediating role, allowing the student a freer and less directed attitude. These difficulties were evidenced in the investigation. The teacher in his/her didactics, when proposing situations in spaces that are not limited to the content of mathematics, needs complementing his/her formation to dialogue with other areas of study in interdisciplinarity.

Mathematics, by solving problems of – not specifically mathematical - themes, but of social economic foundation, made the students reflect, facilitating the development of a social and critical consciousness in a society of essentially economic values.

Treating financial mathematics with parameters of mathematics education - problem solving, contextualisation, accomplishment of activities in situations of interdisciplinarity, especially of an economic and social context, may lead to the insertion of a new discipline or the content of financial education within the scope of basic education, justified by the results obtained in investigations and studies like the one presented here.

⁶ Professional Master's Degree in Science and Mathematics Teaching from Pontifical Catholic University of Minas Gerais - PUC Minas.

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Submetido em Abril de 2019

Aprovado em Maio de 2019