

Mathematics education for the consumption: A citizenship question

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In this article we reflect about some aspects of a research that explored the potential and difficulties of conveying to the mathematics teaching process the responsibility of preparing students to be critical and reflective, and to face the challenges of living in a consumption oriented society, in a critical and reflective way. The investigation took the form of a pedagogical intervention process, in which the main researcher directly interacted, collaborated and influenced the pedagogical work of two high school mathematics teachers. Here we focus on the aspects related to mathematics education for the consumption and connections with citizenship.

Introduction

The research study addressed here stems from three sources of motivation. Firstly, the desire to engage mathematics teachers in on-site in-service work and to explore what researcher and teachers could learn in such process in terms of professional knowledge and teacher autonomy. Secondly, the possibility to work and discuss with other mathematics teachers about the theme “Education to be a critical consumer”. And by critical consumer, we understand a consumer who buys goods (or any object or any service or any information) in a conscious and critical way, by using his/her mathematical knowledge appropriately when deciding if it is convenient or not to buy or acquire something, therefore, trying to make a real use of his/her legal rights as a citizen. This thematic topic opens to teachers the possibility to discuss, clarify and reflect about political and ideological issues that underlie the mathematics content that a consumer might use or think about when deciding to buy, acquire and get some goods, objects, service or information. The third motivation was the political moment in Brazil in 1998. It was time for presidential elections in our country and we had several appeals coming from the media to discuss the stability of Brazilian economy since 1994. It was a rich opportunity to discuss in schools the changes in Brazilian life style due to the stability of our currency (Real) and the control of inflation rates (see, Carvalho, 1999; Santos-Wagner & Carvalho, 2000).

Rationale for the study

The role that has been given to mathematics education in the issue of citizenship assumes that we should provide forms to insert students, in autonomous and critical way, in a consumption-oriented society. In this sense, it is necessary that the process of mathematics teaching collaborates in the preparation of individuals, who are knowledgeable to act in differentiated job markets in a society that imposes new consumption standards, and thus furnishes new demands on the exercise of citizenship. In other words, the schools cannot avoid

the responsibility of promoting education for consumption, opening access of information and providing elements to the community to develop the process of decision-making and to exercise the citizenship. According to M. Santos (2000, p. 50), “in our country we never had the figure of a citizen. The well-known superior classes, including middle classes, never wanted to be citizens, and the poor could never be citizens. The middle classes were conditioned only to get privileges and not rights.”

Due to this aspect, when we propose, inspired by Freire (1997), to illuminate reality in the context of our lives and promote an emancipated learning style, we consider that this could be one of the paths to address topics related to education for consumption, as well as for the planning of differentiated ways to captivate teachers, and consequently their students. Within this perspective, we can use resources such as: i) oral and written announcements and reports, present in the media via television, newspapers, periodicals and magazines; ii) books, articles; iii) calculators; iv) educational videos; v) Brazilian Constitutional Code for Consumer Protection (Consumer Protection Code [Código de Defesa do Consumidor], 1998) (Art. 30, 31, 37, 52 and amendment 14); and afterwards vi) computer software as Excel, amongst other instruments. Naturally, with regards to the development of the content material, we should not be prescriptive given the inevitable complexity that involves any pedagogical practices, which attempt to contribute to student’s learning, comprehension and autonomy.

We must also alert to the need of combining and designing various activities, approaches to teaching, written texts and life experiences when teachers are willing to engage in the development of a critical mathematics education. It is clear that the use of differentiated activities, as the ones mentioned above, demands confidence from the educators standpoint, to provide to themselves as well as to their students the awareness of the benefits of these activities. These educators might realize that these varied activities lead them and students to experience more enjoyable and consistent learning circumstances. In addition to that, generally all the members involved in such educational experience feel more active and co-responsible for the learning process.

Our investigative work was originated in Carvalho (1999) and, from this starting point, the authors have reflected and taken into account the experiences of the main researcher and teachers involved, as well as the individual characteristics of the students that participated in the teachers' work.

Within this context we could construct a variety of activities, in accordance with the Consumer Protection Code (1988) , using information from a survey of the market prices and our related mathematical knowledge. Those tasks guided students when they needed to choose between long-term purchases and paying cash, as well as knowing their rights, such as when they pay for a bill before the due date with embedded in-price-interests. Naturally, the establishment of the Consumer Protection Code is the result of a historical process of claims from the developed countries (the well known first world), and later from Brazil, that acknowledged the vulnerability of the consumer within the market.

It is evident, due to great political interests, economic and ideological pressures that involve the consumer and the market, that the awaited Federal Law must not just be a legal status, but exercised as a right in fact, without the delay that is so typical of the Brazilian justice. These facts brought us to reflect upon issues such as: to whom does favor the delay and/or the lack of more effective actions from governmental agencies, in all the different legal domiciles? What collaboration, can we, teachers and mathematics educators, provide to help the development and widespread of this awareness process?

Yet, we should delineate our concrete investigative problem and provide the reader with an overall picture of the situation with respect to mathematics education for the consumption. We should think about several aspects when considering the general background of mathematics teachers in Brazil, together with the working conditions imposed to them, low income and heavy work load in at least two different schools. Initially, we should acknowledge some inherent problems when teachers need to address with a reasonable degree of trust and involvement topics such as probability and statistics, or commercial and financial mathematics. For instance, there is a lack of information concerning these topics accessible to schoolteachers concerning mathematical as well as pedagogical and methodological knowledge. Consequently, these topics are almost always timidly treated in the school environment.

Therefore, we planned our research study in the direction of overcoming some “difficulties” in the daily mathematics, such as: (1) the value of money in time; (2) money variations due to financial operations; (3) social macro-economic aspects; and (4) consumer rights. In our opinion, the main reflections are “what”, “why”, “how”, and “for whom” should contribute to a contextual teaching and learning process. Thus, it is necessary to articulate contents and concepts that can provide an effective citizenship that will enhance educational technological knowledge.

Didactical tools: significance and value

In our research we perceived some possibilities and limitations for mathematics teachers to acquire knowledge and incorporate the use of other resources, beyond their voices, their gestures, books and blackboards. Often, other tools like calculators, videos or computers, may widen and mediate the construction of mathematical meaning for both teacher and students. We consider relevant and urgent an educational project using the potential of images, that will provoke thoughtful and participatory actions, and not only a receptive attitude of the learner – being he or she a teacher or a student, having the image as the main object.

With regards to the possibilities of using videos in education we preferred to choose videos that addressed questions directly related to the consumption. The basic necessities of man have been transformed throughout his history. Saviani (1995, p. 15) argues that “in order to survive, man need to extract from nature actively and intentionally the basic means for his survival. In doing so, he initiates a process that changes nature, creating a human world (the world of culture).”

Historical Context

We can be sure that, as far as antiquity, the need for survival and the pleasure are factors that motivated the development of consumption relations. The form of capitalist production and distribution, in which naturally we include publicity, interferes directly in our culture. Consequently, consumption has become one of the greatest rituals of our society, as a direct result of propaganda. In this sense, when exploring consumption aspects related to television, we perceive that the propaganda serves as a means to send subliminal advertising and socialize implicit information to the population. Ferrés (1998) argues that in order to people to be free it is not enough to be physically free, but it is imperative that

(...) they know how to choose, that they are internally capable of choosing. Liberty will be measured by the capacity of having autonomous beliefs and behaviors, which are independent, based rather on convictions than on limitations, on reflections more than doctrines or emotion, in attitudes that are conscious and auto-critical than in unconscious ones. (...) The limitations of liberty continuously come from the inducement of more or less inadvertent desires and fears. One thing is to stop someone from acting according to his will, and another one is to condition his will to act according to what is expected (p. 18).

In analyzing nowadays globalization and culture, Ortiz (1994) says that in the global society there exists different life styles, which is nothing more than considering the members of current society as consumers. It is interesting to observe how this author recognizes the consumers. He begins considering the existence of a production system and a distribution system of goods that have great social reach. As he contends:

Consumer, this is a metaphor removed from the stomach, which little by little has grown, and has been awarded with sociological categories. Strange conception, that assimilates the individual to a “channel by which products navigate and then disappear”; individual as means, in which things circulate like information (Ortiz, 1994, p. 147).

Mathematics education for the consumption

By assuming that we have performed the role of a consumer several times in our lives, we ask ourselves: for what world we, teachers, are "preparing" our students, if we do not offer them sufficient mathematical literacy so that they can decide, and judge, with consistency and critical intelligence, in order to improve their purchasing power? Skovsmose (1995, p. 142), in his article “Democratic Competence and thoughtful knowledge in mathematics”, leaves us with some questions, with respect to mathematical literacy, such as:

What types of competence are considered necessary and important to live and participate in a democracy (if such exist) that will be tolerated by the development of mathematical literacy? What is the nature of such competencies in a highly technological society? Can mathematics education be useful, when furnishing the pillars for the future participation of young children and youth in a democratic life style as critical citizens? Does it make sense to equate the discussion about the content of mathematics education with the discussion about the nature of democracy?

We add to these issues, our thoughts on the works of D'Ambrosio, specially those present in his book *Ethnomathematics*, from 1990, and we find ourselves challenged to include other questions, such as: i) What is the nature of such competencies in a capitalist society, with such large social and cultural inequalities? ii) What is the role that teachers, civil and governmental institutions, and we play in such society? iii) What type of democracy does the majority of Brazilians experience? iv) What purpose does the actual mathematical curriculum serve, that has no tradition to explore either topics of financial mathematics or to discuss and reflect about the educational, political and ideological issues associated to this theme? v) What meanings could be constructed with respect to responsibility, right and duties, which are present in the whole exercise of citizenship, when financial mathematics would be incorporated in the curriculum?

Naturally, we do not have ready-made answers for all these questions, but we do have innumerable thoughts and stands, sometimes contradictory, that construct our understanding and meanings, almost always incomplete. In this search, we free ourselves from part of this anxiety with the words of Freire (1997) "I like to be a human being, because, not finished, I know I am a person conditioned but, aware of this incompleteness, I know I can go beyond" (p. 59). His words let us to "dare" new paths. Even in his perspective of "us being someone", he contends:

I like to be someone, even though knowing that material conditions, economic, social, political, cultural and ideological in which we find ourselves almost always generate barriers that are difficult to surpass in order to accomplish our historical task of changing the world, and I do know that such obstacles will not be eternal (Freire, 1997, p. 60).

This thought brings us certain tranquility, but also questions our responsibility, not only individual but also collective responsibility to help build this democratic path. We should discuss in a thoughtful and critical way our teaching methods with colleagues, students, friends, relatives and educators. With this perspective, it is worth mentioning the great discrepancy between what is taught, and what is learned in schools. In fact, students are influenced and constrained by the so-called "hidden curriculum". Skovsmose (1995, p. 163) addresses this issue as:

Mathematics education also has its "hidden curriculum". (...) Students learn that some people are good to manipulate technological problems and others are not. Consequently those that are "unable" will learn to become submissive to those that are better able to be leaders, and that will hold leadership positions.

In reality, we are reassuring that does not exist a pedagogical neutrality. According to Apple (1989), "education is from the beginning to its end, a political enterprise (...) In general, faith in the inherent neutrality of our institutions, in the knowledge taught, and in our methods and actions had served ideally to legitimate the structural bases of inequality (p. 29)". At the same time, we are critically thinking and trying to become aware that the act of student's acquiring and constructing knowledge does not come by the simple act of transferring information from the teacher to the class, but rather it occurs

through a process followed by collective successes and failures, in the every day classroom routine where one tries to make sense of what is explored and discussed in schools. Therefore, to acquire new ideas meaningfully, it is not enough to inform our students about consumption in order that they become aware as consumers. In this sense, Apple (1989) cautions us that:

This does not mean to say that many times some children, individually, have not being helped through our practices and our speeches: nor does this mean that all our daily actions are on the wrong direction. This really means that at a macro-economical level our work serves functions, which little have to do with the best of our intention (p. 29).

In fact, this is a historical process, that we, teachers, can facilitate, if on one hand, we could construct with our peers the knowledge of the basic mathematical relations that are present in the consumption relationships. If possible, this knowledge construction should be based on the awareness of the existent inequalities at the historical, social, political, educational and economical levels. We understand that the consumption relationships are permeated by such inequalities. On the other hand, we must stimulate and motivate ourselves as well as our students in order to be continually engaged in this cyclical and continuous process of knowledge construction, by means of effective practices, making worth our rights and duties as citizens.

Within this perspective we can see how urgent it is to close the gap between mathematics reality and the mathematics education for the consumption, that are present in the daily routine, and what mathematics is in fact taught in school. In this sense, we must be aware, from the beginning, to some aspects pointed out by textbook authors and curriculum developers, which have revealed difficulties and obstacles from the student point of view when exploring similar problems that rest upon concepts of commercial and financial mathematics.

Context of the investigation

The action-research took place from August 1998 until August 1999 in a private secondary school for working students, in Campinas (SP, Brazil). One of the investigators, who was also a mathematics teacher from this school (a teacher-investigator), planned with the others the action-research, and held constant discussions and reflections with them throughout the investigation. The subjects of the study were two mathematics teachers from this private school. These two mathematics teachers were responsible for teaching mathematics to students enrolled in grades 9 to 11. During the time of the action-research, the teacher-investigator maintained direct contact with these two mathematics teachers. This happened through constant interaction and collaboration between the teacher-investigator and the two mathematics teachers. For more details about the complete study see Carvalho (1999), Santos-Wagner & Carvalho (2000).

Methodology

This was an action-research, which followed a qualitative interpretive approach. For the investigators this was the best way to understand what takes place in the

process of on-site in-service work involving the close collaboration between one teacher-investigator and the teachers as well as to explore how this form of on-site in-service could benefit the professional development of teachers.

The first author wanted to participate in an action-research project where the process of collecting data could help the subjects of the study to become more autonomous and critical mathematics teachers. Therefore, for this investigation, the following data were collected: (i) semi-structured interviews; (ii) concept map construction and explanatory written texts (Santos, 1993, 1997; Santos & Kroll, 1992); (iii) joint meeting with the teachers for both course and lesson planning; (iv) informal conversation; (v) exhibition of videos followed by joint discussion with the teachers; (vi) problem-solving activities; (vii) reflections about all the tasks including also a final self-assessment of their participation in the work (see, also Connolly & Vilaridi, 1989, Novak & Gowin, 1984; Ponte, 1996; Santos & Nasser, 1995; Santos-Wagner, 1999; Schön, 1983, 1991).

The teacher-investigator transcribed all the data, which came from audio taped and field notes recording the moments of joint discussions and meetings for course and lesson planning. For the present work we focused our analysis on the data coming from the interviews, concept maps, written texts explaining the maps, and reflections made by the teachers.

Data analysis and discussion of the action-research

Information from all the aforementioned sources was organized and categorized while searching for patterns which characterized the evolution and/or changes in the professional knowledge acquisition of the teachers leading towards their professional enhancement as autonomous, conscious and critical mathematics teachers. We were interested mainly in examining the potential of such on-site in-service intervention as a way to let teachers more aware and critical of the subtleties involved in teaching mathematics education for the consumption.

We noticed that teachers enhance their teaching practice and engage in a significant process of professional development improving and/or deepening their content knowledge, pedagogical content knowledge, professional knowledge, curricular knowledge when they are conscious of all that is involved in the educational process. An evidence in this sense can be appreciated in the speech of one the subjects, as follows:

David: before, I used financial mathematics as I did with calculus, just computing and applying formulas as a fool. Nowadays, I understand the problem, the situation behind the calculations. It is possible to take a practical case and to apply what was taught and learned (...) I am not afraid to ask what I don't know. I am not afraid any longer (...) If I did not learn during my education, I can learn now (...) I am more confident (...) I will be able to accomplish my tasks, I know I'm able to do it. (Carvalho, 1999, p. 117- 118)

This level of awareness let teachers learn to reflect in action, on action and after action as advocated by Schön (1983). Therefore, teachers improve their condition to notice what is taking place in their classrooms, what causes problems of understanding to the students, what topics they need to explore in

several ways to help students to acquire meaningful mathematical knowledge for the consumption, what changes and/or adaptations in the curriculum can be beneficial to both their teaching actions and to students' mathematics learning. This more complete view and awareness of the complexities involved in the instructional process of mathematics empower teachers. Teachers become more autonomous and critical of their teaching practice and individual attitudes, as well as have better conditions to make decisions, to implement innovations and to change both their teaching approach and assessment methods. We must also highlight, that in our research, it was evident that the technological tools cannot substitute the critical judgment of teachers, especially, in the development of their own awareness, or to stimulate and provoke students to construct and articulate meanings. The following speech of the subject gives an indication that exemplifies these ideas:

David: (...) Mathematics helps the students to see if they are being deceived or not (...) it is funny to listen to them: "(...) computations are hard but it is worth doing and interesting". (...) Another student said: "(...) politicians also make false propagandas?" I answered: I believe they do, because they usually promise many things and actually don't do anything(...) I asked: "How could we punish these people?" One answer was: "Not voting in them any longer". (Carvalho, 1999, p. 125-126)

Final remarks

We believe that technology as well as critics mathematics education may reorganize the way by which we think, feel, act and react. In the master's dissertation that provided the material for us to reflect in this text, concepts and applications of mathematics were addressed in a context. As one of the results, we acknowledge the changes in views and attitudes exhibited by teachers and students as real consumers. The dissemination of the financial and consumption concepts learned in classroom was displayed through the development of posters, games, videos, among others, by the students that were afterwards presented to the school community. Beyond this, some students expressed the desire and willingness to develop other volunteer projects about mathematics education for the consumption that could inform and enlighten other communities.

In our life history, in the past as students, as well as now, as mathematics teachers, several questions and passions have marked us. We have searched ways to become educators who could work towards a contextual and critical mathematics teaching. On one hand, such search was made possible by the use of various didactical tools such as video, software, computers, journals, television, Internet, laws, among others. But on the other hand, we had to remember that it is our responsibility to produce knowledge that will serve as reference to a contextual mathematical education. It is necessary to articulate information that will generate a more effective citizenship and that incorporate technological educational knowledge.

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