

Mathematics, what is this tension? Student's social representations in a Federal Institute of Minas Gerais

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ABSTRACT

Starting with the question: “Mathematics, what is this tension?”, this article summarizes a study with the objective of unveiling the social representations of Mathematics and understand how a group of first year high school students at a Federal Institute in Minas Gerais relate to this discipline. We sought support in Serge Moscovici's Social Representations Theory, complemented by Denise Jodelet, and used a questionnaire and interviews to obtain information about their experiences, beliefs, intuitions and feelings with Mathematics throughout their school life. The results indicated that depending on the tensions experienced in this discipline, students represent it in different ways. We consider the importance of these representations as something that affects their way of thinking, feeling and acting. They can enjoy it or not, feel afraid or not in the face of this discipline, be more or less dedicated to studies, as a result of the social representations they have of Mathematics.

Keywords: Mathematics Education; Social Representation of Mathematics; High School.

Matemática, que tensão é essa? Representações sociais de estudantes de um Instituto Federal Mineiro

RESUMO

Partindo da pergunta: Matemática, que tensão é essa?, este artigo sintetiza um estudo cujo objetivo foi desvelar as representações sociais da Matemática e compreender como um grupo de estudantes da primeira série do Ensino Médio de um Instituto Federal Mineiro se relaciona com essa disciplina. Buscamos apoio na Teoria das Representações Sociais de Serge Moscovici, complementada por Denise Jodelet e utilizamos questionário e entrevistas para obter informações sobre suas experiências, crenças, intuições e sentimentos com a Matemática ao longo da vida escolar. Os resultados indicaram que dependendo das tensões vivenciadas por essa disciplina, os estudantes a representam de formas diversificadas. Percebemos a importância dessas representações como algo que os afeta na sua forma de pensar, sentir e agir. Eles podem gostar ou não, sentir medo ou não diante dessa disciplina, dispensar maior ou menor dedicação aos estudos, como consequência das representações sociais que têm da Matemática.

Palavras-chave: Educação Matemática; Representação Social da Matemática; Ensino Médio.

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Matemáticas, ¿qué tensión es esta? Representaciones sociales de estudiantes de un Instituto Federal de Minas Gerais

RESUMEN

A partir de la pregunta: Matemáticas, ¿qué tensión es esta?, este artículo sintetiza un estudio cuyo objetivo fue develar las representaciones sociales de las Matemáticas y comprender cómo un grupo de estudiantes del primer año de escuela secundaria de un Instituto Federal de Minas Gerais relacionarse con esta disciplina. Nos apoyamos en la Teoría de las Representaciones Sociales de Serge Moscovici, complementada por Denise Jodelet y utilizamos un cuestionario y entrevistas para obtener información sobre sus experiencias, creencias, intuiciones y sentimientos con las Matemáticas a lo largo de su vida escolar. Los resultados indicaron que dependiendo de las tensiones que experimenta esta disciplina, los estudiantes la representan de diferentes maneras. Percibimos la importancia de estas representaciones como algo que les afecta en su forma de pensar, sentir y actuar. Pueden gustar o no, sentir miedo o no ante este tema, dispensar más o menos dedicación a los estudios, como consecuencia de las representaciones sociales que tienen de las Matemáticas.

Palabras Clave: Educación Matemática; Representación Social de las Matemáticas; Escuela Secundaria.

INTRODUCTION

Expressions such as “Mathematics is only for intelligent people”, or others that describe the contents of this discipline as something "difficult", "unbearable" are part of the discourse of many people who like or dislike Mathematics. Interestingly, part of the people who do not like the discipline join the chorus of the group that defends that Mathematics is “useful” or that “Mathematics is in everything”. It seems paradoxical, but it isn't.

These and other ideas from the consensual universe in relation to Mathematics are created and shared by families, social groups and other media, becoming part of the student's language and imagination, often guiding their behavior and feelings in relation to this subject. The result, in practical terms, can be greater or lesser dedication to studies, the emergence of feelings of fear or confidence in Mathematics, in addition to its glorification as the most important of sciences, which is in everything and without which we cannot live.

In addition to the influence of the context in the creation and sharing of these ideas, the experiences lived by each individual, such as academic success or failure in Mathematics, can influence these judgments. It is not uncommon to hear reports of people who have experienced unpleasant situations related to Mathematics.

In our daily relationships, we are asked to take a stand on a wide range of topics. These positions, translated by social representations of an object, are engendered from what we share in a consensual universe with our group, establishing our insertion in it.

In the interactions that occur in this group, ways of perceiving Mathematics are created, generating true “common sense theories” (ALVES-MAZZOTTI, 1994) that guide, in some

way, the way we will position ourselves when asked to respond about this discipline. These are the social representations (SR) referred to by Moscovici (2012).

In the specific case of Mathematics, studies that bring up social representations of students in relation to this subject can serve to problematize and provoke reflections on situations that arise in the school context, such as failure, poor academic performance, etc.

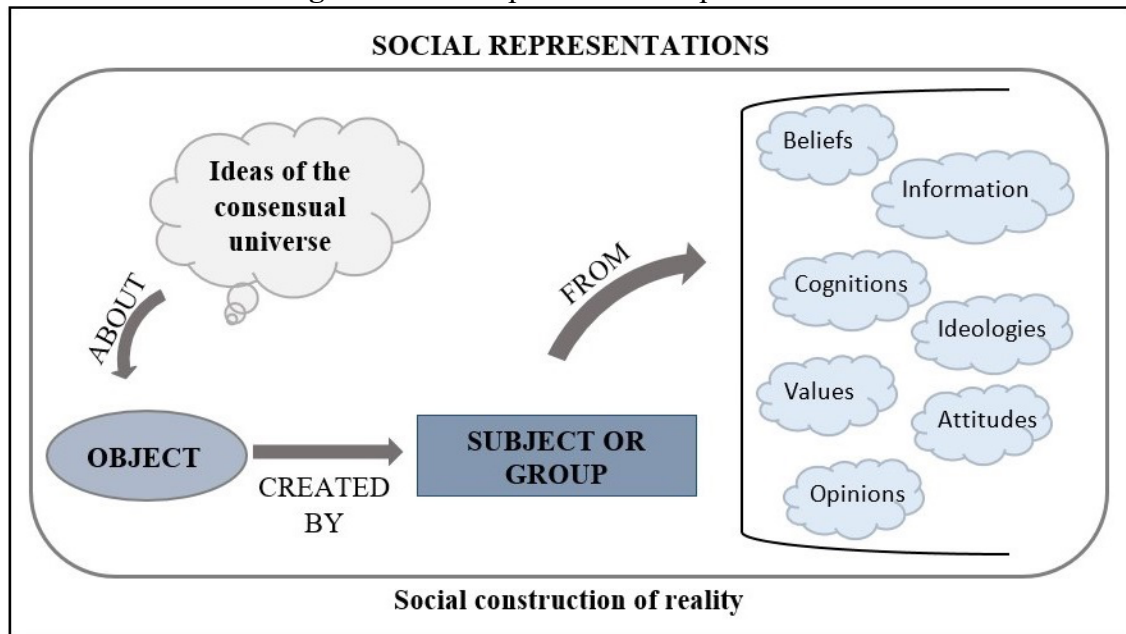
It is in the context of these discussions about social representations that this article is inserted, part of a master's thesis in Mathematics Education, developed by the first author, advised by the second author and whose objective was to unveil the social representations of Mathematics of first-year students from High School and analyze how this discipline strains them. The study was based on the Social Representations Theory (SRT), particularly on the ideas defended by Serge Moscovici and his disciple, Denise Jodelet.

SOCIAL REPRESENTATIONS THEORY

When pressured to quickly form opinions, take positions or seek consensus within a group, the individual goes through moments of tension. These moments are called pressure for inference by Moscovici (2000/2017), that occurs when the individual, having no escape from the situation, organizes himself and adopts opinions similar to those of others. The decisive effect of this is the formation of social representations. According to the author (p. 277), the individual uses the following reasoning: “There are fewer ideas than men, therefore all men with similar ideas are alike”. Depending on the tensions the subject experiences, he represents the same reality in a different way.

For Jodelet (2001), social representations are ideas shared by an individual or group based on their beliefs, information, cognition, ideology, values, attitudes and opinions, creating a consensual universe and providing for the social construction of reality. Schematically, this concept is shown in Figure 1.

Figure 1 – Concept of Social Representation



Source: The authors (2020).

According to Moscovici (2012), the representation allows for the abstraction of the real, associating to it a shared idea between the subjects. He continues stating that social representations are "a modality of particular knowledge having the function of elaborating behavior and communication between individuals" (p. 27) and considered as "almost tangible entities" that "circulate, intersect and crystallize continuously, through speech, gesture, encounter in the everyday universe" (p. 39). The author also considers that social representations are dynamic, mobilizing subjects to think, feel and act, producing behaviors or relationships with the environment to create and recreate concepts, images and symbols, transforming the unfamiliar into familiar.

In this way, the social representations of an object are created by the subject from and in the interaction with another subject. Therefore, for Moscovici (2000/2017), this relationship between the subject (the one who represents), the object (the one or what is represented) and the other (the one who is close and communicates with the subject) is a relationship in that each term is determined by the other two.

Diverging from Durkheim's epistemology regarding the static character of collective representations, their acceptance as absolute entities and his concept of primitive societies, Moscovici (2000/2017) became interested in the new phenomena observed by him in contemporary society; and recognizing the limitations of collective representations, formulated

the Theory of Social Representations, starting in 1961, with the publication of the work “*La psychanalyse son image at so public*” (Psychoanalysis, its image and its audience). This theory originates from Émile Durkheim's sociology with regard to the phenomenon of collective thought, influenced by Levi-Bruhl's anthropology (rational representations) and contributions from the study of the representation of the child's world by Jean Piaget and the theory of development of thought in children by Vygotsky (Moscovici, 2000/2017).

After founding, in 1965, the “*Laboratoire de Psychologie Sociale*”, in Paris, at the “*École de Hautes Études en Sciences Sociales*” (LPS-EHESS), Serge Moscovici went on to work, in the following decades, with Jean-Claude Abric, Willem Doise and Denise Jodelet, who assisted him in research and had him as advisor for their doctoral theses. These three advisees developed different currents of the Theory of Social Representations that complement it since they come from the same epistemological matrix (AGUILAR, 2011).

The current developed by Jean-Claude Abric emphasizes a structuralist approach, proposing an analysis of social representation from its central core and peripheral elements (AGUILAR, 2011), seeking to understand what representation is and what constitutes the central core, considering representation as being more static. Willem Doise addressed social representation from a societal perspective articulated by the insertion of the individual in society (ALMEIDA, 2009), seeking to understand which elements are present in this context that help build social representation. Denise Jodelet, who maintained the assumptions of Moscovici's original proposal, approaches social representations in a dimensional/structural analysis, seeking to understand “Who knows and where does one know from?; 'What and how does one know?; 'About what does one know and with what effects?’” (JODELET, 2001, p. 28).

Our research was based on the dimensional/procedural approach of social representation defined by Jodelet (2001), as it allows us to understand the processes of construction and elaboration of these representations about the object, in this case, Mathematics, from the perspective of the research subjects. For that, we look for “sociocultural organizers, attitudes, normative models or even cognitive schemes” (JODELET, 2001, p. 38). This approach, according to Ribeiro (2016, p. 70), “leaves dichotomies aside and proposes a dialectical historical analysis to understand how people think, feel and act”.

The fact of being enrolled in social groups decisively influences the way teachers and students think, feel and act. This participation contributes, therefore, for these actors to arrive at school with part of their knowledge built from their interactions with others, in their daily

lives, at work, with family, with friends. To a certain extent, Arruda (2002, p. 131) corroborates these ideas when he states that “reality is socially constructed and knowledge is a construction of the subject, but not disconnected from its social inscription”. In the same line of thought, Gilly (2002) states that social factors act in the educational field, favoring the construction, evolution and transformation of social representations in groups.

Specifically in relation to Mathematics, Torisu (2018) highlights that students, teachers, parents, media and society in general create and share consensus that it is a “difficult” discipline, “reserved for a few”. On the other hand, there is consensus that this discipline is important and indispensable for developing reasoning and knowledge in other areas.

Ramos (2003) revealed that students, mothers and teachers in his study had an image of Mathematics as something difficult and which the majority does not like; however, it is socially valued, which dialogues with the discussions in the previous paragraph. The author emphasizes that the way in which family, friends, school community and the media conceive Mathematics, together with individual experiences, influence the way we perceive this discipline, valuing it more or less, considering it easy or difficult, useful or not, contributing to the fabric of the representation of this object.

All of the above reinforces our understanding that the student's way of thinking, feeling and acting in relation to Mathematics can influence their relationship with this discipline. It also makes us believe that the results of a study involving the Theory of Social Representations, seeking to understand the relationship of a group of students with Mathematics, can raise discussions/reflections on the subject and, who knows, ease the rejection of this subject.

METHODOLOGICAL ASPECTS

The present study, of a qualitative nature and anchored in SRT, has as its main objective to investigate whether Mathematics tensions a group of students and, if this occurs, to investigate whether these tensions change their way of thinking, feeling and acting in relation to this discipline. Data were collected through a questionnaire and two semi-structured interviews containing questions that, in some way, were related to the student's life, inside and outside the school environment.

According to Ribeiro (2016, p. 86), “semi-structured interviews are adapted to the study of social representations as they are a viable alternative for accessing constituent contents, as well as the struggle and coping with reality undertaken by the subject”. Thus, information about

the students' family context and their relationship with Mathematics throughout their academic life was obtained, with the aim of getting to know their experiences, beliefs, intuitions, feelings. The result of this investigation was access to the students' ways of thinking, feeling and acting in relation to Mathematics.

The choice for this information was also influenced by ideas defended by Jodelet (2005). The author states that social representations are constructed by the subject from two perspectives: their social coexistence and their personal experiences with the object. In relation to the social coexistence aspect, we can highlight, in this research, the position of family members, friends, classmates and the school community regarding Mathematics in the student's perception. The affective relationship that the student establishes with this discipline and with his teacher, the importance and usefulness given to its contents are characteristic semblances of the personal experiences aspect. Both aspects could be explored by the aforementioned data collection instruments.

The research was carried out with a group of first year high school students at a Federal Institute in the State of Minas Gerais. This level of education was chosen because research investigating social representations of Mathematics with high school students is still scarce. We chose the first year because it is mostly made up of novice students at this level of education. In this way, we were able to consider the social representation that the student brought from their previous experiences, without leaving aside those that were created and shared in the context of the Federal Institute.

The fictitious names, chosen by the students themselves, were: Nicole, Kevin, Jheni, Nenem, Gustavo, Sabiá, Sofia, MN, Nath and PH. With ages ranging from 14 to 16 years old, four were girls and six were boys. Six lived in urban areas and four in rural areas. At the time of the research, one resided in the city where the Federal Institute is located, three resided in districts of that city, five in neighboring cities and one in a more distant city, which, in order to attend the institute, co-lived with other colleagues. None of them had failed Mathematics in previous grades.

It is noteworthy that the research followed all ethical standards and the project was approved by the Research Ethics Committee of the Federal University of Ouro Preto³

³CAAE: 9848.0918.0.0000.515 Opinion number 2,967,887

RESULTS

After analyzing the students' responses to the data collection instruments, we were able to answer our research question. However, what were these questions about? And what were the answers obtained? Given the large amount of data obtained throughout the research and the page limit in this article, we selected some that elicit moments of tension that probably caused students to create their social representation, modifying their behavior in relation to Mathematics, and some representations generated regarding this discipline. We understand that this cropping does not impact the understanding of the results.

What do the students say about Mathematics?

One of the questions was worded as follows: Do you think the Mathematics that is learned at school helps to solve situations (in general) in your daily life? How? Some excerpts from⁴ the subjects' answers:

Nicole: *"Math I learn at school? When you go, for example, to buy something, you want to see the price of something, understand? You want to see the advantages and disadvantages of price"* (05/08/2019 – First Interview).

Jheni: *"Everything has Mathematics, right? There is no way out of it. When you're going to give someone change, sell something or buy something, there's Mathematics"* (05/06/2019 – First Interview).

Nenem: *"Ah, learn times tables, all that. Then you even know how to do math by heart, you know, without needing a calculator, right, just like if the guy sells you something, then you can do it in your mind"* (05/06/2019 – First Interview).

Sofia: *"The basics in Mathematics are what we have to learn for life. [...] Operations with plus, minus, subtraction, multiplication [...], but there are many other things you also need. [...] If you go to a bakery and you go with more money than you need to pay, you have to know how much change the woman has to give you, because otherwise, either she gives you more or she gives you less"* (05/06/2019 - First Interview).

MN: *"You buy... go to the cafeteria, buy ten candies and have to share the candies"* (05/09/2019 – First Interview).

Nath: *"[...] in our daily lives are composed of Mathematics, so everything you do will have calculations or something like that"* (08/05/2019 - Second Interview).

PH: *"[...] you go to the market to buy feed, you have to know how many kilos that bag of feed has, how long it will last. And that's it"* (05/07/2019 - First Interview).

These answers showed that almost all students believed that learning Mathematics is useful, even though they had difficulties in learning its contents. Similar results were found in other studies. Ramos (2004, p. 89), for example, concluded that "even for those whose living

⁴It is noteworthy that both written and oral responses were presented without changes in meaning and/or spelling correction.

with the discipline has been difficult, the importance of Mathematics and its usefulness are indisputable”. In his study, Torisu (2014) concluded that the perception of the usefulness of Mathematics in everyday life was one of the reasons for students to participate in the tasks proposed in the classroom, even if they did not like the subject. These results contrast with the content of sentences commonly said by many people, for example: 'Mathematics is useless', 'I don't know why I should learn this; I won't use it anyway'.

Although for most students Mathematics is useful in their daily lives, this utility seems to be restricted to the use of basic operations in everyday situations of buying, selling, etc., not presenting any example that requires more elaborate mathematical knowledge. Associations like this were also evidenced in the research by Torisu (2014). Ramos (2003) explains that examples such as those presented by students make sense because in everyday situations it is not necessary to have a high level of mathematical knowledge.

This association of mathematical content to trivial day-to-day tasks may reflect the misunderstanding of “everyday life” in the school environment. Regarding this distortion, the National Curriculum Parameters – PCN (BRASIL, 1998) warn that many times the mathematical content worked on is supposedly part of the student's daily life, while important topics are discarded due to being regarded as not interesting or not immediately applicable in daily life. The National Common Curriculum Base – BNCC (BRASIL, 2017) adds that it is important to present issues to students that are related to the world of work and community regarding Mathematics.

One of our hypotheses was that students also perceive mathematical knowledge as something useful for future professional activities. To find out if our hypothesis would hold, we asked the students the following questions: What do you intend to do when you graduate from High School? (Studying or working? – If studying: What?) How important will mathematics be in your future profession? Some answers were:

Nicole: “*Studying. Maybe Civil Engineering. [...] it is useful for everything, regardless of the profession*” (04/30/2019 – Questionnaire).

Jheni: “*Study. I intend to study Medicine. [...] I want to be a surgeon and I need it for that*” (05/02/2019 – Questionnaire) and “*[...] a doctor has to know Mathematics, right?*” (05/06/2019 – First Interview).

Nath: “*Medicine. [...] I have to know the right calculations, where I'll have to cut, if I have to add more, stuff like that*” (05/06/2019 – First Interview).

Nenem: “*Studying more, right? [...] it's all courses for me, Mathematics is... you have to know Mathematics because practically almost everything you need to do today, you need to know*”

Mathematics” (05/06/2019 – First Interview) [He wants to pursue a profession in the STEM field].

Sofia: *“I prefer to study. I want to be a doctor. [...] when I go to Med school, I'll have calculus, then I'll have to know everything I learned in High School”* (05/06/2019 – First Interview).

For student Sofia, Mathematics is very useful for the ENEM test: *“Mathematics has a great weight in ENEM”* and *“If you want to go to university, everything you learn in the classroom, you have to know it so you can get a good grade in ENEM”*. This statement may be related to the fact that, in this exam, there is a test that assesses, exclusively, mathematical knowledge (Mathematics and its Technologies Area), unlike, for example, the Languages, Codes and their Technologies Area, in which subjects such as Portuguese Language, Literature, Foreign Language, Physical Education, Arts and Information and Communication Technology share the leading role. This exclusivity can suggest to the student that Mathematics is special, therefore, more important than other areas, having a *“[...] great weight in ENEM”*.

Kevin, who wants to be a Physical Education Teacher, considered, in response to the questionnaire, that Mathematics would not be useful for his future profession. He wrote: *“No, because after I graduate, I want to study Physical Education”*. However, in an interview carried out after the application of the questionnaire, Kevin had changed his mind. He said: *“I've studied, I've researched [...] about it”*, to affirm that he had carried out research on the internet about the importance of Mathematics for his course.

The association of mathematical knowledge to the needs of a future profession, whatever it may be, seems to be common among people and defended by some researchers. For Cunha (2017), Mathematics conditions us to create a critical sense and to think, exercising reasoning and, with technological advances, it has become essential for society and in all professions, all areas of education and therefore it is considered an important discipline. However, in our research, the importance of Mathematics as an auxiliary to the future profession was underlined, in most cases, by students who intended to pursue professions in STEM careers (Civil Engineering and Technical Course in Metallurgy) and Medicine.

In summary, for these students, in addition to the mathematical knowledge being useful for their future professions, they help to solve simple everyday situations.

As already discussed, the social representation of Mathematics is constructed from the discourses of the media, family members, friends and society in general. In addition, the experiences that each one lives through in the relationship established with this discipline are

important for the formation of this social representation that, shared by many, ends up constituting a set of ideas about this discipline.

Therefore, we seek to know the experiences and changes in the relationship between students and Mathematics throughout their school career. For Jodelet (2017), social representations are modified through cultural and historical changes, in social relationships or in the subjects who create them from experiences and social inclusion. We were able to observe these movements from the students' answers, when asked about their motivation to learn Mathematics throughout their school life. Let's look at some answers:

Jheni: *"It was good then because everything was easy, right? It changed because it got more complicated"* (05/06/2019 – First Interview).

Nenem: *"Oh, it was easy. Used to be, only got good grades. Ah, this year, it's changing. The content isn't entering my head, no"* (05/06/2019 – First Interview).

MN: *"I felt good because it was easier then. Now things are much more complicated, it's not that easy."* (05/09/2019 – First Interview).

For these students, the motivation to learn Mathematics in the first years of school was associated with the easiness each one felt in assimilating the contents. Over time, motivation decreased in an inverse proportion to the increase in learning difficulties. The consequences of this process can be felt in the student's performance, as reported by Nenem.

However, unlike the above-mentioned students, for Sofia and Nicole, the motivation to learn Mathematics went the opposite way. From shy, in early school years, it increased for different reasons stated by the students, such as a better understanding of the contents and the understanding that Mathematics has useful applications in life. The reports below reflect the ideas discussed.

Sofia: *"I didn't have much motivation. I started to motivate myself from starting in sixth grade, alone. I improved a little bit more in Mathematics because I started to study Mathematics more. For every test I have, I study, did all the homework, then I improved a lot"* (05/06/2019 – First Interview).

Nicole: *"I had no motivation. It changed because... I signaled to the teachers and they taught me that Mathematics isn't... you can apply it everywhere in life, understand? Then, like... it's not just operations, everything has a reason why"* (05/08/2019 – First Interview).

These reports are in line with the ideas of Oliveira (2015, p. 113), when the author considers that "students build their representations based on the context in which they are inserted, which involves experiences and interactions with the environment. These are the

representations that guide their practices and justify their actions”. This is also in line with ideas defended by Moscovici (2012). For the author, representation shapes what is fed from the outside to individuals and groups through interactions, remodeling the object's elements within a context of notions, values and rules, producing communications and determining behavior between individuals. Thus, social representations can have implications for our behavior and actions.

What tensions does Mathematics generate?

Mathematics can generate moments of tension that make subjects create representations of an object, which are produced and reproduced reflecting their social environment. Depending on the tensions experienced by the student, he represents Mathematics differently, changing his attitude towards it. This change in representation is generated by moments of tension, called pressure for inference by Moscovici (2000/2017).

For Jodelet (2001), the pressure for inference refers to the need to take a position in a situation that demands an attitude. Carvalho (2017, p. 254) adds that “this position is built from information about reality in line with the social context of the group to which one belongs”. The result of this may be membership in the social group, but it is not the core. In this way, Mathematics can generate moments of tension that demand an attitude from students.

Throughout the students' reports, we observe the social representations influenced by the pressure for inference and its re-elaborations based on the tension of Mathematics. Understandings about this will be presented in the next paragraphs.

When she was in fifth grade, Sofia felt unmotivated to study Mathematics, as it was customary for the class teacher reproach those who made a mistake in solving a problem in a harsh way. This teacher's behavior generated fear in Sofia, discouraging her and making her learning more difficult. From the sixth year onwards, the student began to study on her own because, in her opinion, the mathematical content would be necessary for her entry into Medicine school: *“I improved a little more in Mathematics because I started to study Mathematics more. For every test I have, I study, did all the homework, then I improved a lot. [...] If you want to go to university, everything you learn in the classroom, you have to know it so you can get a good grade in ENEM. [...] the Mathematics score has a great weight in ENEM, so you have to do a lot of Mathematics to pass”* (05/06/2019 – First Interview).

The tension generated by Mathematics made her represent it as something useful, causing an imbalance in the way Sofia acted, prompting her to dedicate herself more to her studies.

Nicole also felt unmotivated to learn math in her early school years, although her relationship with teachers throughout her school career was not troubled. However, she had difficulties in learning its contents. This scenario changed when, in response to the student's signals for her difficulties, the teachers taught her that we can use mathematical knowledge in everything: *"I signaled to the teachers and they were teaching me that Mathematics isn't... you can apply it everywhere in life, understand? Then, like... it's not just operations, everything has a reason why"* (05/08/2019 – First Interview).

Although she admits her difficulty with Mathematics, Nicole is very dedicated to her studies.

Unlike Sofia and Nicole, students MN, Jheni, Nath and Nenem felt motivated to learn math in their early school years, even if for different reasons. Over time, this motivation diminished. The tensions caused by Mathematics manifested themselves in different ways for each one. However, the utilitarian representation of Mathematics changed their attitude towards this discipline, as we can see below.

In the first years of his school life, MN felt motivated because he found it easy to learn mathematical content. The ease has diminished over the years to the point where MN considers it *"normal"* to get bad grades on math tests. This situation affected his motivation in a negative way. This picture changed when he started to consider Mathematics as something necessary *"in everything"*. This became the reason for his greater dedication to studies: *"Now I'm going to start studying"* (04/30/2019 - Questionnaire) and *"one day you'll need Mathematics for everything [...] almost everything needs Mathematics"* (05/09/2019 - First Interview).

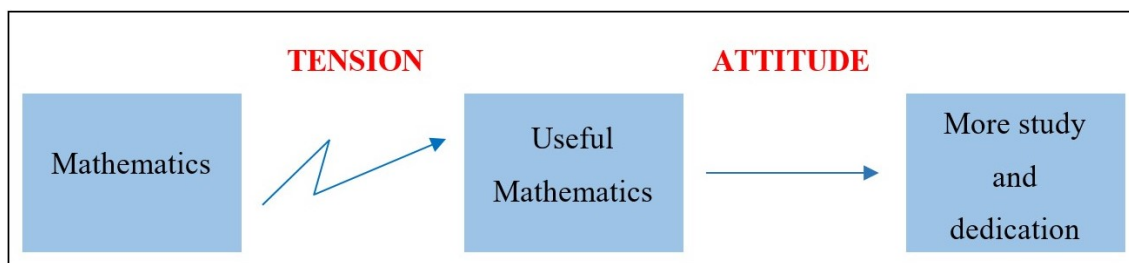
The easiness to learn the contents of Mathematics at the beginning of school life also motivated Jheni to study. This diminished over time and, along with it, her motivation. This scenario changed when choosing her future profession, she considered that learning mathematical content could be useful: *"[...] I want to be a surgeon and I need it for that"* (05/02/2019 - Questionnaire) and *"[...] because a doctor has to know Mathematics, right? [...] there are medications, you have to talk about what the person will need, right? It has to involve Mathematics, right?"* (05/06/2019 - First Interview).

Nath felt motivated to learn Mathematics in the first years of her school life, but she did not dedicate herself to studies because she had great difficulty learning its contents. Like Jheni, she wanted to pursue a career as a doctor. This fact was important for Nath to consider Mathematics important for her future profession: " [...] because I have to know the correct calculations, where I'll have to cut, if I have to add more, stuff like that" (05/06/2019 - First Interview).

Good results in Mathematics assessments in the early school years motivated Nenem to learn. Over time, this performance got worse because I couldn't understand a teacher's explanations. His motivation for studies diminished. However, under the influence of his mother, he began to perceive Mathematics as something necessary for future studies. In his words, "Mathematics is all careers for me⁵, Mathematics is... you have to know Mathematics because practically everything you do today, you need to know Mathematics" (05/06/2019 – First Interview).

In Figure 2 we present a diagram of pressure for inference in the cases of Sofia, Nicole, MN, Jheni, Nath and Nenem.

Figure 2 – Pressure for inference exercised by Mathematics and attitude towards SR “Mathematics is useful”



Source: The authors (2020).

Mathematics oriented students PH and Sabiá in different ways, as we can see in their answers when asked about their motivation to learn Mathematics throughout their school life.

PH: “Lost from the early years. It started changing. The first things got easier, but at the beginning I felt lost until I got better” (05/07/2019 – First Interview).

Sabiá: “There were times when I learned things, but when I would write it down, I wrote something wrong, I lost confidence, but now I have confidence, you know? [...] at the beginning I didn't like studying Mathematics very much, no, whenever I talked about Mathematics I

⁵From this excerpt, we understand that Mathematics is important for all courses.

already thought: Darn! It's too difficult, I'm afraid of getting a lot wrong. Mother of God! It's too hard! But then I started liking it, I don't have much difficulty, no" (05/07/2019 – First Interview).

Sabiá's report shows us the influence of the social representation of Mathematics in the relationship he established with this discipline. And when asked if that was what he heard from other people, he replied:

"Yeah, it was, and, like, I carried it with me. Wow! It's going to be too hard. A lot of people said it was difficult, then I said: so, it must be very difficult to study Mathematics, but I ended up learning more, I found it a little easier. Then, I ended up mastering learning Mathematics" (05/07/2019 – First Interview).

The fear of making mistakes and the lack of understanding of the mathematical content contributed to reduce the motivation of PH and Sabiá to learn Mathematics in the first years of school. Their motivations increased for different reasons, which we report below.

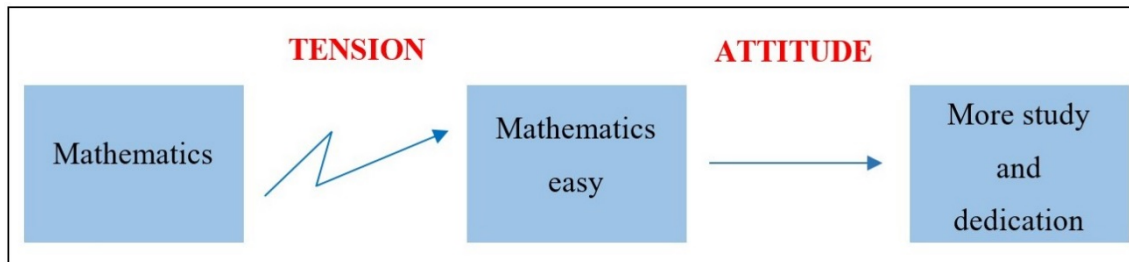
Feeling lost and unmotivated to learn Mathematics in the first years of school and having a somewhat troubled relationship with his teachers, PH failed to pay attention to the teachers' explanations when they were unable to resolve his queries. This situation changed a little when he felt more prepared watching videos on the *Internet* to try to learn the topics at hand: *"When I don't understand the topic, I talk about my questions, it doesn't help me at all, I just end up not paying attention in class and leave it to study at home. He doesn't answer my questions so I manage to resolve it by myself. [...] video lessons [...] The first things got easier, but at the beginning I felt lost until I perfected it"* (05/07/2019 – First Interview).

Before starting his studies, Sabiá always heard that Mathematics was a very difficult subject and this frightened him. Consequently, when I started school, I didn't like to study this discipline: *"[...] because when I talked about Mathematics I already thought: Darn! It's too difficult, I'm afraid of getting a lot wrong. Mother of God! It's too hard [...] and, like, I carried it with me. Wow! It's going to be too hard. Many people said it was difficult, then I said: so, it must be very difficult to study Mathematics [...]"*. With school life, he learned more and more, finding it easier, which, in our opinion, alleviated his fear of this discipline: *"[...] but I ended up learning more, I found it a little easier. Then, I ended up mastering learning Mathematics"* (05/07/2019 – First Interview). Although he admits to having a little difficulty in learning certain contents of Mathematics, Sabiá is very dedicated to studies, studying at all idle hours.

Sabiá and PH started to represent Mathematics in a different way, showing ease to learn its contents. The representation of Mathematics as something easy was generated by the tension exerted by this discipline, which encouraged them to dedicate more time to their studies.

We can outline, in Figure 3, the pressure for inference in the cases of PH and Sabiá.

Figure 3 – Pressure for inference exercised by Mathematics and attitude towards SR “Mathematics is easy”



Source: The authors (2020).

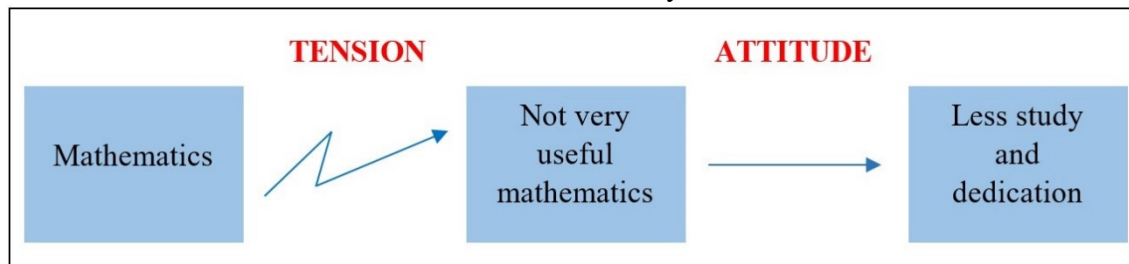
Another report to be considered is in relation to Gustavo's motivation to learn Mathematics throughout his school life: *“A great motivation in Mathematics was when I started to learn. It changed, now I have more difficulty with Mathematics. Because every year it became more difficult, then I became less excited and disinterested in learning the subject”* (05/06/2019 – First Interview).

We can, as well, consider his answer regarding the usefulness of Mathematics to solve everyday situations. Initially, the student was emphatic in his response, denying its usefulness. However, he then reconsidered his answer: *“No. It depends, because there's a lot of Mathematics that we only learn here at school, it doesn't carry over to life. Lots of stuff we won't need”* (05/06/2019 – First Interview).

Discouraged by the difficulty in learning mathematical contents and due to seeing little use, Gustavo does not dedicate himself much to his studies. However, he didn't always feel that way. In his early school years, when he considered mathematical content easier, this student felt motivated to study. Each year, this ease was decreasing and so did his motivation. He studied only for homework: *“Only the weekend, if I have anything due”* (05/06/2019 – First Interview). In this way, he started to represent Mathematics as something of little use.

In Figure 4, we outline the pressure for inference in Gustavo's case.

Figure 4 – Pressure for inference exercised by Mathematics and attitude towards SR
“Mathematics is not very useful”



Source: The authors (2020).

Based on the information provided by the students, the pressure for inference suffered to form an opinion about Mathematics can lead to positive or negative thoughts, feelings and actions. Encouraging greater dedication to studies, the utilitarian vision of this discipline and the ease to learn its contents, for example, had a positive impact. On the other hand, the non-utilitarian view negatively affected the motivation to learn Mathematics.

We could notice, through the research, that a negative image of Mathematics circulates in society and is shared by many and that the difficulty felt by students in the learning process of this subject contributes to the creation and circulation of this representation. Taking other's discourse as our own seems to be more appropriate, giving us the impression of belonging to the group, as explained by Jodelet (2009).

SOME FINAL CONSIDERATIONS

Mainly because it is considered a discipline that contributes to the high rate of failures and as difficult to comprehend, we perceive, in the academic world, a concern in relation to learning Mathematics. Despite the comprehension difficulty and the fear developed in this subject throughout their school trajectories, for some students, overcoming fear, dedication to studies and teacher support, contributed to raising their motivation to learn Mathematics.

The negative representation of Mathematics by most participants does not mean that it is less valued. By their answers, even those who felt unmotivated or frightened, recognized it as an important discipline, especially to develop daily tasks.

Depending on the tensions exerted by Mathematics, the students who participated in the research represented this discipline in different ways, resulting in different attitudes such as more (or less) study and dedication.

We realize how social representations of Mathematics can directly affect the way students think, feel and act. They can like it or not, they can feel fear or absence of it, they can spend more or less time dedicated to study depending on the social representations they have about this discipline. Therefore, it is important that negative representations of Mathematics are attenuated through strategies proposed by the Mathematics teacher in partnership with the school community and that public policies can provide conditions so the school and teachers can carry out their work activities with dignity, in addition to providing guarantees and conditions for student access, inclusion, permanence and success in academia.

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