Motives in Mathematics Investigative Tasks as Appropriations of Social Discourse in the Light of Activity Theory

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ABSTRACT

Investigate the motives of students to participate in tasks proposed in mathematics classes can bring contributions to the understanding of what effectively leads them to get involved in classes and can also contribute to the area of Mathematics Education. The purpose of this article is to present a discussion about the motives of a group of four students from the ninth year of a public school in Belo Horizonte, Minas Gerais, Brazil, when involved in investigations in the Mathematics classroom, using, for this, the lenses of Activity Theory. Data were collected through interviews. The qualitative analysis of the data showed that the reasons that lead them to participate in investigative tasks are related to these tasks, but not only. The social environment in which students are inserted may be as, or even more important for the emergence of motives.

Keywords: Activity Theory. Motives. Mathematics Education.

Motivos em Tarefas Investigativas Matemáticas como Apropriações do Discurso Social à Luz da Teoria da Atividade

RESUMO

Investigar os motivos de estudantes para participação em tarefas propostas nas aulas de Matemática pode trazer contribuições para a compreensão do que os leva, efetivamente, a se envolverem nas aulas e pode contribuir, também, para a área da Educação Matemática. O objetivo deste artigo é apresentar uma discussão em torno dos motivos de um grupo de quatro estudantes

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do nono de uma escola pública de Belo Horizonte, Minas Gerais, Brasil, quando envolvidos em investigações na sala de aula de Matemática, utilizando, para isso, as lentes da Teoria da Atividade. Os dados foram coletados por meio de entrevistas. A análise qualitativa dos dados mostrou que os motivos que os levam a participar de tarefas investigativas estão relacionados a estas tarefas, mas não somente. O entorno social no qual os estudantes estão inseridos pode ser tão, ou até mais importante para o surgimento de motivos.

Palavras-chave: Teoria da Atividade. Motivos. Educação Matemática.

INTRODUCTION

It is with increasing frequency that mathematics teachers are heard to report the lack of interests of students for classes in this subject (Powell, 1986; Shernoff & Schidt, 2008). Intending to reverse this situation, some teachers seek alternative methods that may be more attractive to students or, in other words, motivates them to participate in mathematics classes (Middleton & Spanias, 1999; Singh, Granville, & Dika, 2002). In this search, one of the paths envisioned by teachers to motivate students is to engage them in mathematical investigations (Skovsmose, 2000; Ponte, Brocardo, & Oliveira, 2003).

The idea behind teachers` alternative methodologies such as mathematical investigations is that such teaching approaches supply extra fuel to classes, leaving students more motivated (Wardekker et al, 2012). This has been promising and studied by several scholars (Maehr & Meyer, 1997; Stipek, 1993). However, unlike this conception of motivation, the present text will relate it to the concept of motive according to a cultural-historical perspective in a context in which students are involved in mathematical investigations in a classroom. The focus is on the motives by which students become engaged in investigative tasks in mathematics.

Therefore, two key expressions that will guide this discussion are emphasized here: investigative tasks and motives.

Mathematics classes based on investigative tasks consist of the proposal of open tasks for which several solutions are possible and in which students are directly involved in experimentation leading to explorations, questions, conjectures, arguments, and so on. (Ponte, Brocardo, & Oliveira, 2003). A more detailed discussion of this trend in Mathematics Education (ME) will be presented, below.

The basic theoretical framework for our discussion is Cultural-Historical Activity Theory (CHAT), the roots of which are found in the Russian school of psychology founded by Vygotsky in the 1920s and in which the concept of motive takes on great importance. According to Foot (2002, p.25), in this theory "motive always entails and individual subjects personal relationship with the object of a collective activity, whereby meaning is derived from the encounter between motive and object". However, given the importance of motives in this study, a more accurate discussion of this context will be discussed below.

Taking into account the diversity of activities in which students of basic education are involved, the objective of this article is to present an analysis of the motives to

engage in investigative tasks in mathematics classes of four students from a Brazilian secondary school and, based on this analysis, to reexamine a theoretical understanding of motives.

To achieve this objective, we have organized this article as follows. First, we address the fundamentals of CHAT with to how motives is understood in the CHAT framework, and present studies having different theoretical perspectives. Second, we discuss mathematical investigations and present methodological aspects of our study. Finally, through our analysis of empirical data, we approach an understanding of the motives.

CULTURAL-HISTORICAL ACTIVITY THEORY

One of the fundamental ideas of CHAT is that human development occurs as the individual participates in cultural activities and appropriates historically constructed knowledge. However, this development is not unidirectional. At the same time that the individual changes, that person changes the surrounding environment, as a two-way street, in a dialectical relationship.

The notion of activity appeared with the studies of Vygotsky who, influenced by the idea of praxis as concrete and conscious historical activity, proposed a theory opposed to the naturalism and passive receptivity of the empiricist tradition (Kozulin, 2002). Vygotsky argued that, between the person and the environment, there is a dialectical relationship mediated by artifacts, materials or ideational. For him, mental development is the result of the interactions of the person with nature and the sociocultural environment.

Human activity, understood in this way, may be represented by Figure 1, thus:

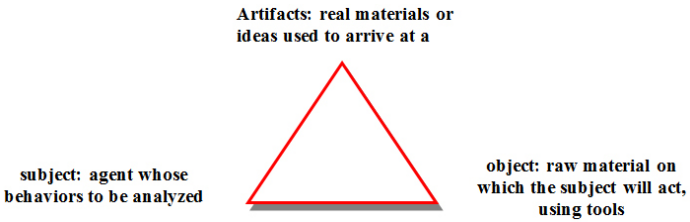

Figure 1. Structure of activity, according to Vygotsky.

The subject directs actions toward the object of the activity, using artifacts as mediators. The representation in Figure 1 seeks to emphasize a way that the subject, acting on the object, transforms it and is also transformed by it. There are, however that the relationship between subject and object is always dialectically mediated by the artifacts in such, other elements that contribute to the constitution of human activity, primarily that such activity is performed by a collective of subjects.

Leontiev, a disciple of Vygotsky, was responsible for placing the collective character of human activity in relief, in such a way "the individual could no longer be understood

without his or her cultural means and the society could no longer be understood without the agency of indiviudals who use and produce artifacts" (Engeström, 2001, p.134). For Leontiev (1978), an activity arises from a need that becomes a motive that guides the individual toward an object that satisfies the need. However, it was Engeström (2001), influenced by the ideas of Vygotsky and Leontiev, who created a representation of collective human activity using a triangle, as in Figure 2:

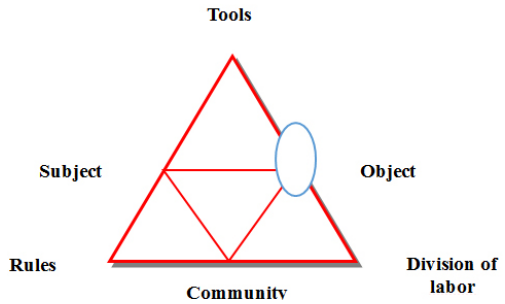

Figure 2. Model of the activity system (Engeström, 2001).

This structure, which represents an activity system, describes and considers human activity as collective. According to Engeström (1987), p.78).

> In the model, the subject refers to the individual or sub-group whose agency is chosen as the point of view in the analysis. The object refers to the 'raw material' or 'problem space' at which the activity is directed and which is molded and transformed into outcomes with the help of physical and symbolic, external and internal mediating instruments, including both tools and signs. The community comprises multiple individuals and/or sub-groups who share the same general object and who construct themselves as distinct from other communities. The division of labor refers to both the horizontal division of tasks between the members of the community and to the vertical division of power and status. Finally the rules refer to the explicit and implicit regulations, norms and conventions that constrain actions and interactions within the activity system (Engeström, 1987, 78)

In Engeström's model, individuals' agency expressed through their activity is the point of view of analysis. Their activity is guided by motives, and they are the focus of this article. Motive is one of the important theoretical constructs of CHAT, from which human activity can be understood.

MOTIVE IN CHAT

The different approaches in the study of motives have resulted in fruitful discussions about this construct. Particularly, in the cultural-historical approach, scholars present varied

analytical perspectives (Hedegaard, 2012; Fleer, 2012; Torisu, 2014) often connecting the motive to other psychological constructs.

In his book, Activity, Consciousness and Personality, Leontiev (1978) argues that an activity appears from a need, it becomes a motive, that guides the individual toward the object of satisfaction of that need and that the motive coincides with the object of the activity. He writes:

> The fact is that in the subject´s needy condition itself the object that is capable of satisfying the need is not sharply delineated. Up to the time of its first satisfaction the need does not know its object; it must still be disclosed. Only as a result of such disclosure does need acquire its objectivity and the perceived (represented, imagined) object, is arousing and directing activity of function; that is, it becomes a motive (Leontiev, 1978, p.161)

However, there are those who disagree with the idea that motive is the object of the activity (Bozhovich, 1968; Kaptelinin, 2005) or that the activity possesses a unique motive (Kaptelinin, 2005; Araújo, Santos, & Silva, 2010; Torisu, 2013). Kaptelinin (2005) argues for the possibility of activities being guided by more than one motive polymotivational activities and that they do not necessarily coincide with their objects.

This and other forms of understanding motives in the cultural-historical approach reveal a wealth of research possibilities. Researchers throughout the world have dedicated efforts to understanding motives in social practices in which individuals develop, such as family, school, etc.

Hedegaard (2012), for example, showed that in daily activities that are part of a family routine (homework, dinner, etc.), children's motive for learning is related to institutional and family values. Medina and Martinez (2012) showed how interaction among peers during play contributes to the emergence of motives in children and how the form of organization of this space of play varies from place to place, reflecting the values and norms of the world of the adults in each place. Fleer (2012) sought to learn how children from Hong Kong who live in Australia develop motives for learning within family practices. She found that "encouragement plays an important role in bridging the gap between parental demands and the child´s wishes, which assists the child to appropriate family values, thus facilitating the development of a learning motive and learning itself" (Fleer, 2012, p.107). Winther-Lindqvist, (2012), performed a related study in which the author associated the Cultural-Historical Theory with the theory of social representations, discussed by Moscovici and the development of social identities, discussed by Duveen, to better understand the development of social identities of children and their motives during the transition from early childhood education to elementary school education. In all these studies, motive was understood as something that emerges from the social relations, that is, even though the existence of individual motives is acknowledged, they emerge as the result of experiences of the subject in social groups.

The present study´s concerns motives in social practices within schools, particularly in teaching-learning practices identified as mathematical investigation.

MATHEMATICAL INVESTIGATIONS

The word "investigate" may assume various meanings, including to research, inquire, to discover something, to check and to examine a set of facts. In mathematics, many researchers and teachers support the use of mathematical investigations in classroom, and their arguments are varied. However, what really is a mathematical investigation?

We can use as example two simple tasks and contrasted them gain an understanding of investigation in the mathematics classroom. Task 1: What is the sum of 8 and 7? Task 2 is: How many different sums can be constructed whose result is 15? The first task is traditional and has a unique result, while the second has numerous solutions such as 8 +7, -6 + 21, 21/3 + 40/5 and so on. The point is that leads to a mathematical investigation.

In general, mathematics investigation permits tasks for which there is not one, unique solution. Thus, different paths may lead to different solutions and all possibly correct. During the investigations students experiment, explore and question which allows them greater freedom to participate actively in their learning.

Yet, when the students choose to participate in an investigation in mathematics classroom, what are their motives?

Using the ideas discussed so far, our intention is to present a study about the motives of four students when they were involved in investigative tasks in their mathematics class. The results may elicit discussions about what makes the student participate in school tasks and, as a consequence, provoke mathematics teacher to reflect about on the practice thus contributing to the area of mathematics education.

METHODOLOGY

Chaiklin (2012) discusses appropriate methods for investigating motives. According to this author, everything depends on how the researcher understands what motive is. For the present authors, motives have a cultural-historical character and, in this sense, include the entire web of relationships that compose the life of the individual. Thus, motives of the students, the participants of this study, were not seen only at the moment they were involved in the activity, but also as something influenced by other moments of their lives. To access these moments, interviews were fundamental.

However, these are not simple interviews in which the participants listed motives for their participation in the proposed mathematical investigative tasks. In interviews, the students were encouraged to talk about their families, about their relationships with school and with mathematics, about their relationships with friends, in short, about their social world. The analyses of the responses to the questions about the themes cited permitted the authors

to establish connections between the students' motives for participation in the mathematical tasks and their social world. The responses brought with them marks about the lives of the participants which greatly influenced them in school and which, at times, became motives for participation in school. This corroborates Freitas' (2002, p.29) ideas that, dealing with interviews in research into the cultural historical perspective affirms that "the interview is the self-expressed subject, but the voice carries the sound of other voices, reflecting the reality of the group, gender, ethnicity, class, historical and social moment". It also corroborates Chaiklin's (2012) ideas that, in studies that understand motives as something inserted into a system of relationships, it is necessary to interpret the interviews statements of the in relation to social demands so that we may have access to the motives.

The participants and the context of this study are presented, below.

CONTEXT AND PARTICIPANTS

The participants were four students[1] from the ninth year of a public school in the city of Belo Horizonte, Brazil. Their fictitious names are Paulo, Lauro, Leandro and Gabriel. They all have studied in this school since their first year and, for this reason, had already created strong friendships.

The school is located on the campus of a large public university. Admission is by lottery. The school is seen by the community as a good school. One reason for this is that it affords graduates of its elementary school admission to a highly regarded technical school, without the student having to be compete in a selection process. This attracts students to the school and a main reasons that parents participate in lottery selection.

Paulo, Lauro, Leandro and Gabriel have participated in this context and, as participants of this study, are presented in detail in the chart, below:

Student	Relationship with mathematics	Relationship with the school	About the family	Free time
Paulo (15 years old)	Liked mathematics a lot and was considered an excellent student both by the teachers and his colleagues.	Had a good relationship with everyone, teachers and colleagues.	Lived with his parents and one brother. The family supported him well in his studies and spared no efforts for him to have a good education.	Plays football and video games.
Lauro (14 years old)	Preferred Physics to mathematics, but also liked mathematics.	Understood that school was a place to learn useful things for day-to-day life and the future.	Lived with his mother in an area in the same region as the school. Spent weekends with his father. He said that the family's financial situation was comfortable	Tennis and football lessons.

[1] Number of the substantiated opinion issued by the Research Ethics Committee of UFMG, which approved the research: 20309162.

Student	Relationship with mathematics	Relationship with the school	About the family	Free time
Leandro (14 years old)	Had problems with mathematics. His performance was terrible.	Liked school, but felt hounded by the teachers.	Lived with his mother, stepfather and four siblings in a peripheral area of Belo Horizonte. The financial situation was delicate and, for this reason, it was his decision to help his mother who struggled hard for him to have a good education.	Plays ball, sleeps and flies kites.
Gabriel (17 years old)	Did not have a good relationship with mathematics and his grades were low.	Stated that he did not like school because he had been retained twice. Did not like participating in classes.	The family seemed to support him in school, but not strongly. He lived in a peripheral area with his parents, siblings and grandparents.	Watches TV series, talks with friends from the neighborhood and goes to the movies.

Figure 3. Presentation of research subjects.

We obtained this and other information from two set of interviews, conducted at different times. And, why did we feel the need to have more detailed information about the lives of the students in the group? We begin with the assumption that motives emerge within social practices and because, according to Lave and Wenger (2002), the social world is seamless, meaning. That different moments are intertwined in the lives of people. These moments do not exist in a vacuum. Lompscher (1999) also contributes to this discussion when he recalls that motives are set during the process of human, social activity. People participate in various activities throughout their lives and this generates a variety of motivations that influence other activities.

Next, we present one of the tasks proposed to the groups.

DATA AND ANALYSES

Investigative Tasks as Activity

One of the tasks that we proposed was about cellular phone plans that were offered by a hypothetical company. Although this company did not really exist, the artificial situation was very close to what individuals' experiences, when they need to decide among cellular phone plans. In this task, a telecommunications company offered three telephone plans, each included a landline, a cell phone and text messaging. The variations among the plans were, basically, in the fixed monthly rates, the per-minute price for each type of call and the allowed number of minutes of talktime, access-time to the Internet and number the amount of text messages. The students had to use calculations to show, among the three options offered by the company, the best cost-benefit for a hypothetical user.

The profile of this user was the point of departure for the investigation of the best plan. To make the situation closer to something real, the students could not ignore the fact that there are several other expenses that make up part of a person's monthly budget. We suggested, then, that the students consider that an ideal budget would take 14% of the net salary to pay the telephone fees and services. They were then asked to consider a consumer who receives R$2.500, 00 of net salary and spends, on average, R$170.00 on fees. Although this information had been provided that which dealt with the expenses for telephone service was simulated by the students. They chose how the user was to use the cell phone.

From the profile created for the user, the students had to use tables of values provided on a page that showed the task and, performing calculations data in the table, find the plan that best suited the needs of the user and was the most economical. We consider the students work on the task as an activity, represented in Figure 3.

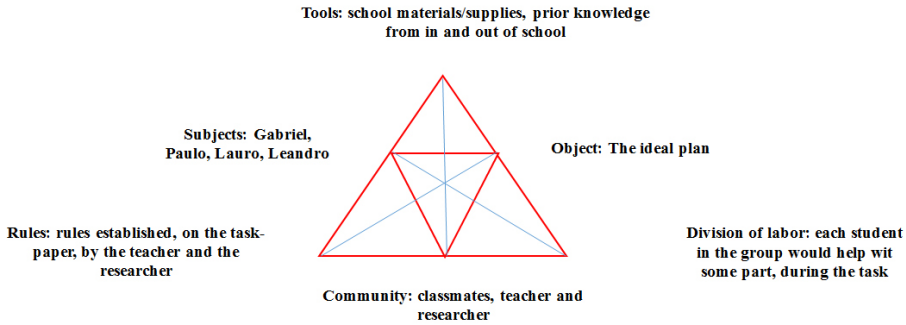

Figure 4. Activity: Cellular phone plan.

Looking for Motives for Participation in the Activity

Following their work on the task, the students were interviewed in the same session. The idea was to learn why they had accepted the invitation to participate in the proposed study. What had motivated each one?

Researcher: When you got involved in this type of task in the class, was there one main reason? If yes, what was it?

Paulo: I think there was one main reason.

Researcher: What is it? What do you think it is?

Paulo: I think that we are thinking about the future, right? (pause) if we need to do ... like that, there are calculations there, we ... we're going to need it in the future, right?

Lauro: No, I think there is a reason why. Because, somehow, there were some activities related to math, but also to every day life [...]".

Paulo: Cell phones.

Lauro: yeah, cell phones (agreeing with Paulo), some things that you can relate to every day that help you, like with the help of math and more stuff, I think that you can develop, get that practice and bring it into the every day part of your life. The stuff with the cell phones and all.

Researcher: Then you think that math, not all of it, at some point can help you later on, in your everyday life?

Lauro: Exactly, in the future when we're working.

Researcher: And you, Gabriel?

Gabriel: More because of the day-to-day... we might need it... then, we know how to do what's best.

Researcher: Leandro...

Leandro: I was also one of those students that thought, like … what am I using this for? And then there was the cell phone and I understood more or less why we were doing this… because, sometimes you have a plan of something you wanted but you could get it cheaper, depending on how much… then I saw that you can use it every day, like everybody said.

These responses would suggest that, in all cases, there was a predominating motive that was related to the utilitarian vision of mathematics for use in daily life and in the future. But, would the possibility of everyday use of the mathematical knowledge involved in the task be the only motive for these students to become involved?

To attempt to answer this question, it was necessary to know more about the lives of these students, both inside and outside of school. This is consistent with the underlying theory to this study, for which the motives have a cultural-historical character and are materials in the web of relationships that compose our lives. Therefore, a second interview was held in which the participants were heard individually to respond to different aspects of their lives.

Lompscher (1999) claims that a learning activity may have some categories of motives, among them social and cognitive motives. Social motives are associated with the relationships that the students establish in their environment such as, for example, relationships with colleagues and teachers, relationships with parents, etc. Cognitive motives are associated with the history of the student in relation to particular content. Repeated good performances may generate self-confidence in the students that motivate them to be dedicated. The opposite may also occur.

Understanding the investigative activity of this study as a learning activity, and based on Lompscher's (1999) motive categories, categories were created for the responses given to the interviews to which the motives were linked. The categories were as follows: utilitarian vision of mathematics; family; school; relationship with mathematics.

In the category 'utilitarian vision of mathematics', the students explained a little more, sometimes with examples, of why they responded that their participation in the

investigative activity was linked to the utilitarian vision of mathematics. Below, some of their responses to this category:

Leandro: Oh yeah, the telephone. For me to learn. This can happen even in my every day life, I'm looking at it, my bills there, and I noticed that an account in the plan that I could ... that I talk less but actually spent more on the Internet – I could spend a lot less than I am spending on another plan.

Gabriel: Yeah ... Just like that stuff, PLIM, the operator. I spend more because of it. There, [...] like, if one day in my life I need to look at a plan, something like that, which is better for me, then I can use that.

Lauro: In society you have to know, at least, a minimum of Mathematics and that for you to interact with people and everything, you have to know a minimum of mathematics. What time to get a bus, you could say ....

Learning mathematics for use in every day situations seemed to mobilize the students for the tasks. It was one motive, but we were interested in finding out if there were others, especially because the importance that the mathematical content has, as something that can help us in every day life, is something widely discussed in social discourse. However, this reflected the influence of only one of the branches of the social web in which the students found themselves.

In the second category of responses, the attempt is to learn what the students' relationships with their families were like. From the analyses of the responses, it could be understood how this relationship contributed to the emergence of motives for the investigative activity. For the entire group, the family was highly important. How did they perceive that?

Paulo came from a well-structured family, very concerned with his academic preparation. This was evident when Paulo mentioned things like:

Paulo: They give me the best conditions for studying, […] my family gives me a lot of support with my studies, and many times she (mother) doesn't go out to have fun, in order to stay home with me because I need to study.

Such comments seemed to generate a feeling of commitment in Paulo, with his parents and with himself. There is evidence of this in such responses as:

Paulo: The fact that they give me everything that I ask for motivates me to study harder and harder to show them that I am making it worthwhile and I only have fun when my conscience is totally clear, that is, when I don't have to study or do any work.

In Lauro's case, the family was also important and seemed to have a discourse that seemed similar to Paulo's family. Although separated, his parents maintained a very friendly relationship that allowed Lauro to live in a healthy environment and to share his experiences with both, father and mother. The school was chosen by the father who considered it a good place for his son's studies. By being selected for the school, Lauro made his father very happy. He said:

Lauro: The greatest happiness was his, because I didn't know much….

Lauro's family demanded that he speak correctly, without slang. This characteristic of Lauro was easily noticed in the conversations. At one point in the interview, the interviewer praised his good Portuguese, to which he responded:

Lauro: I think it's the influence of my father and mother" and "my father also doesn't like slang… They always insist that I speak correct….

In Leandro's family, school was also important. However, this importance seemed to take on a different nuance compared to the cases of Paulo and Lauro. In the families of these latter two, the interest in the studies seemed to be associated, as in Leandro's family, with the possibility of technical preparation, envisioning a good future profession. However, the comments of Leandro's mother seemed to place the entire hope for a successful future on him, which generated a considerably large feeling of responsibility and, maybe, not very clear to an adolescent. It is as if he were the future solution to the financial problems that they were experiencing. A remark of Leandro's maybe translates what was written previously:

Leandro: She (the mother) says that the only thing that she is leaving to me is education. My mother says this practically every day. At home, my mother bet everything on me… Now it's on you.

Gabriel came from a close family, that valued school, but in a way that did not seem very strong. His mother enrolled him in the lottery, envisioning entrance into a technical program, like the other mothers. Regarding this, he said:

Gabriel: "She is also thinking of the technical school and these things".

However, at home, it was expected that the student would get good grades:

Gabriel: "Like, at home, she doesn't demand this stuff because now […] I'm doing it. Now, tests she demands good results, like, she says: study, I don't know what. And then if I'm bad she pulls my ear to improve and stuff".

About the ENEM[2], which is used for entrance into many institutions of higher learning, in Gabriel's words, his father thought as follows:

Gabriel: "My father told me that I'm going to do the ENEM just to see what it's like […]".

Maybe, for this student's father, doing the ENEM was not so important because the university was not something immediately necessary. Who knows if a technical program could provide him a good job with a good salary? Who knows if this would be sufficient?

[2] Exam that evaluates the quality of basic education in Brazil and whose result may allow entry into several Brazilian universities.

As may be noted, from the point of view of the students, all four families valued school as a space that can provide their children an intellectual gain and a promising future. Therefore, respecting the rules of the institution was a fundamental condition so that the benefits could be enjoyed. In other words, the motive 'to fulfill the role of the student performing the task' seemed to be, in the family activity, part of the discourse of the parents which we interpret as rules.

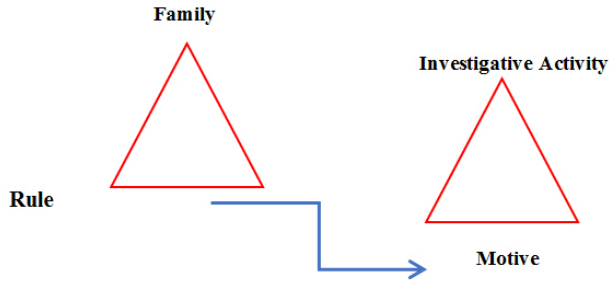

Figure 5. Rule of the family becoming motive.

Within the family structure, the parents' comments were socially constructed. The students, in turn, appropriated these comments. The children should follow the social rules, among which was respect for people, including teachers. And here, respect could assume several synonyms, including obeying. Each student, in appropriating the family comments, did so in their own way which gave a different meaning to each one.

Thus, thinking of the dynamics of the activities in which the students participate, a family rule became a motive for the student to participate in school tasks. In the literature, studies such as Medina and Martinez (2012) and Corsaro and Rizzo (1998) also showed that values and rules may become motives to guide people's activities.

The possibility of a structural element of the activity becoming motive for the students in learning activities has been discussed by Lompscher (1999, p.7). According to this author:

> Each component of the general activity structure – object or content, actions and course of activity, conditions and means, partners and social relations, the activity subject him or herself – may become motive to learn.

However, Lompscher discussed these ideas thinking of structural change within the same activity. The conclusion of the present study, that the rules of a particular activity become motive for another, bring Lompscher's discussion a bit further, as it admits that structural elements of one activity may become motive for another.

In the third category, the responses showed the perceptions of the students in relation to school. Paulo was always a good student. He also has always maintained a good relationship with his teachers and colleagues. He said:

Paulo: I always tried to have a good relationship with my teachers, because I don't think it is necessary to create conflicts with them. In relation to my colleagues, I had a great relationship with everyone or, at least, I tried to.

Lauro considered school very important to his daily life and to his future. Especially, his professional future. He was the student that referred most to the role of the knowledge acquired in school as something that could help in promoting a better future. In this sense, he explained that:

Lauro: School, passing this knowledge to us, will then […] also help us in the future. I think that, when we are participating in the classroom activities and the proposed activities, we are gaining knowledge so that we can develop well in the future.

Although Lauro had a pragmatic vision of school ("we are there to learn"), he seemed to like being there and maintained a good relationship with his colleagues and teachers.

Leandro believed that the treatment he received from the teachers was discriminatory because he was not a high-performing student. In his words:

Leandro: It seems that the teachers were out to get me, I don't know.

This feeling, linked to his real situation of low performance in some subjects, seemed to discourage him even more in relation to his studies. In spite of this, he had a good relationship with his teachers, colleagues, and was very communicative.

In Gabriel's case, his school was a relatively hostile environment. The fact of having been retained twice during his academic life made him angry with the school:

Gabriel: I repeated the year two times there… and so, I got angry.

He didn't like participating much, and seemed to want not to be noticed:

Gabriel: I don't like participating, much. I am just there paying attention.

Nevertheless, shy and barely participating, he had a good relationship with the others. Asked about his relationship with the teachers, he just said: it was good.

The perception of the school was different for each student. The present authors believe that, given the better academic performances of Paulo and Lauro, compared with Leandro and Gabriel, the former had a friendlier relationship with the academic part of the school and, perhaps, greater commitment. As for the other two students, although with performance below what was expected, and with feelings of rejection by the school in Gabriel's case, they were still there, influenced by other factors.

One of those factors could be communication among peers and with adults, which would be highly understandable since, at this age, according to Elkonin and Dragunova (apud Davydov, 1988), communication is the most important form of interaction for young people. According to Davydov (1988, p.46), "in the communication that they establish with people of various collectives (collective work, school, etc.), adolescents dominate the rules of interrelationships of these collectives". Further, gains in this context "lead the adolescents to reflect on their own behavior, such that they become more capable of evaluating themselves according to certain, set criteria". Another factor is the social meaning of school, internalized by them, as a valued place where students go to learn.

From this perspective, it is understood that following the rules as a way of maintaining good communication among peers and with adults who are relevant to them is something that drove them during the investigative activity. In the school activity, then, it is believed that following the rules ended up driving the movement of the students toward performing the activities as a way of maintaining good communication with the adults. Therefore, 'fulfilling the role of the student performing the task' seemed to be, in the school activity as well as in the family activity, a rule that became a motive for participation in the investigative activity.

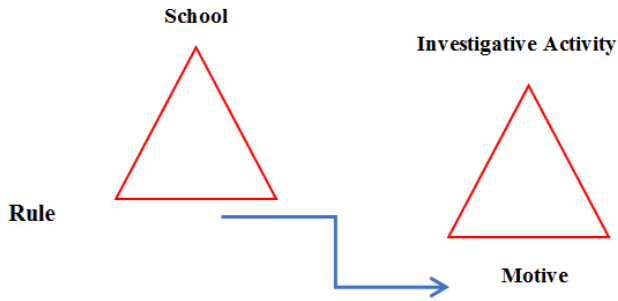

Figure 6. School rule becoming a motive.

The intention in these last paragraphs was to intertwine, now for the second time, the investigative activity with another activity of the students: school.

Family and school rules became motives for the students because, by accepting the invitation to participate in the tasks and thus fulfilling the role of student, to some degree they were trying to show their awareness of their own maturity in the communication with adults (Davydov, 1988). Performing the task could establish another level of the relationship between them and the latter. They would be judged by the adults as more responsible and this was important because it would allow them to occupy 'other space' in their social group. On the other hand, the social meaning of the student, historically, is that of fulfilling the role of the student.

The last category of responses shows the students' relationship with mathematics. Paulo seemed never to have had 'problems with mathematics'. His relationship with this discipline was as follows:

Paulo: My relationship with mathematics, until the 8th grade, was always normal. It was a subject that no was good to me. But, starting in the 8th grade, I fell in love with mathematics, the only thing I liked better was Physical Education. Now, in the Technical High School I still like mathematics a lot and this is important because this feeling helps me to learn things in class, and since I don't have a lot of time to study this stuff at home due to the fact that I put a lot of priority on the technical program. So, my feeling for mathematics has always helped me a lot.

Leandro said this about his relationship with mathematics:

Leandro: Mathematics and I don't get along well. Sometimes I make a lot of dumb mistakes and I get bad grades […] the subject was getting harder and I stopped liking it. Let me tell you something: I like the other subjects, but when… wow!... you're dumb… it beats you down. You see, like, everybody is getting a good grade and you see yourself… you try sometimes... and so sometimes I say: I'm done with this, I'm not studying for the test. If I know it, I know it. If I don't know it I'm not going to learn it in one day by studying.

Gabriel did not see himself as a good student in mathematics:

Gabriel: Like, I am not very good in mathematics but, like, if I have to choose between the sciences, humanities and these things, I think that I do better in the sciences. In mathematics I get sixty/seventy per cent […].

Lauro said the following about his relationship with mathematics:

Lauro: In school I was always good in mathematics. I always liked it, too. Only, in the ninth grade I had a really low performance in the first term because of family issues. My grandfather was hospitalized. I was upset and was also having difficulty with the material. Just, in the second term, when new material was introduced and I began to pay attention, then I got back to doing well.

In the cases of Paulo and Lauro, the image of good students in mathematics was reinforced every time they got good grades and were successful on the tests. This left them more comfortable and secure about their academic abilities in relation to mathematics. And why is that? Because, in the relationships, what Paulo and Lauro internalized was meaning the other for them. This is in accordance with Pino´s idea (2000) when he says this happens in the dialectical movement of the relationship that gives Paulo and Lauro the coordinates to know who they are, what social position they occupy and what is expected of them. Paulo and Lauro appropriated the vision that the others had of them, as good students, and this encouraged them to participate in the tasks, becoming motive. The same cannot be said in the cases of Leandro and Gabriel, since their academic histories in relation to mathematics did not move them at the time of the investigative activities.

FINAL CONSIDERATIONS

From the students' answers to the four categories identified, what can be concluded regarding their motives for participation in the investigative activity?

The main conclusion is that the students' motives are strongly influenced by appropriations occurring in other activities. In the first category, the responses seem to point to a strong relationship between the students' remarks and the social discourse about mathematics. They justified their participation in the tasks considering that the mathematics contained therein could help them in daily and professional life, which is proclaimed repeatedly in society about the importance of mathematics. In the second and third categories, the rule, 'fulfill the role of the student performing the task' of family and school activities was appropriated by the students and became a motive to participate in the activity. In the last category, for Paulo and Lauro the appropriation of the vision that others had of them as good students became a motive that encouraged them to participate. This means that if the judgment of others about us is positive, it can move in an activity. Otherwise, it may inhibit us. This may be the case of Leandro and Gabriel; and, if we are dealing with mathematics, commonly seen as a difficult subject, we must be careful with such judgments in order not to discourage students in school.

The authors of the present article believe that this way of understanding motives, although individual, shows that they have their origin in the social context of the individual. Furthermore, the article resumes the discussion about polymotivational activities.

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