MATHEMATICS EDUCATION IN A CULTURAL-HISTORICAL PERSPECTIVE: ELEMENTS FOR A NEW SCHOOL CULTURE

O ENSINO DE MATEMÁTICA NA PERSPECTIVA HISTÓRICO-CULTURAL: ELEMENTOS PARA UMA NOVA CULTURA ESCOLAR

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ABSTRACT

With this article we want to discuss, considering some pedagogical implications of cultural-historical theory, the necessity of a new school culture that encourages the creation of learning activity as the activity that guides and promotes the development of Higher Psychological Functions in the age corresponding from elementary to high school. To achieve this goal, we discuss some concepts of cultural-historical theory and point out its implications to direct thinking and acting of teachers committed to developmental education. In this perspective, we set learning and development of theoretical thinking as a goal for teaching mathematics, noting that theoretical thinking, as well as other human higher mental functions that shape human development, have education and teaching as their universal forms.

Key-words: mathematics teaching; theoretical thinking; school culture

RESUMO

Com este artigo queremos discutir, a partir de algumas implicações pedagógicas da Teoria Histórico-Cultural, a necessidade de uma nova cultura escolar que favoreça a constituição da atividade de estudo como atividade que guia e promove o desenvolvimento das Funções Psicológicas Superiores nos anos correspondentes ao Ensino Fundamental e Médio. Para isso discutimos alguns conceitos da teoria histórico-cultural e apontamos suas implicações na orientação do pensar e agir docentes comprometidos com a educação desenvolvente. Nessa perspectiva, colocamos como horizonte para o ensino da matemática a formação e o desenvolvimento do pensamento teórico que tem, como, aliás, o conjunto das funções psíquicas superiores humanas que configuram o desenvolvimento humano, a educação e o ensino como suas formas universais.

Palavras-chave: ensino de matemática; pensamento teórico; cultura escolar.

1. Introduction

Brazil will host the International Mathematical Olympiad in 2017 and shall receive young students from around the world that stand out in this field of knowledge. This could raise great hopes regarding the involvement of young Brazilians. Brazilians have stood out lately in the international scenery. We have a recent winner of the Fields Medal - the Nobel for young mathematicians - and researcher Marcelo Viana, current president of the Institute of Pure and Applied Mathematics (IMPA), is the first mathematician in the world to receive the Grand Prize Louis D. Scientific, France's main commendation in science. However, our mathematics teaching in elementary education, high school and undergraduate courses - as it happens in a greater or lesser degree in other subjects - has problems. This is not just our perception as two researchers working for decades with teacher training for early childhood education up to the first four grades of elementary school; is also the perception of the president of IMPA, mentioned above, in a recent interview to a large circulation newspaper.

In fact, we have one of the worst levels of performance in basic education, as it has been pointed out by international tests such as PISA (Programme for International Student Assessment) which, although worth of criticism for its content and methodology, indicates numbers that should concern all Brazilian teachers. Research conducted by the Institute Paulo Montenegro and the NGO Educative Action that lasts more than a decade now, created a Functional Literacy Index which was recently updated, with data from 2011 and 2012, the figures for reading, writing and mathematics skills among Brazilians aged between 15 and 64 years old. The data show that, over the past 10 years, there was a reduction of absolute illiteracy and rudimentary literacy and an increase in the basic level of reading, writing and mathematics skills. For the period from the year 2000 to 2010, IBGE (Brazilian Institute of Geography and Statistics) data show an increase of 30 million in the number of Brazilians with high school and college education.

However, Functional Literacy Index data for the period show that the increase in the education level does not correspond to an increase in the reading comprehension, writing and mathematics skills level. Only 62% of students with college diploma and 35% of students with high school diploma can be considered fully literate and - what seems to aggravate the situation - in both cases this proportion is lower today than in the beginning of the decade.

Data from INEP (National Institute for Studies and Research) about the Test Brazil 2013 reveal that most students do not learn the considered appropriate for the school year attended and even more serious is that the success rate falls as the years of schooling advance:

> For Portuguese Language: 40% is the proportion of students who have learned the proper reading competence and texts interpretation in the 5th grade in public school. Out of 2.443.581 students, 973.915 demonstrated the proper learning. The data for Portuguese Language on 9th grade is even lower: 23% of students have learned the proper reading competence and texts interpretation in public schools. Out of 2.589.764 students, only 610.893 demonstrated proper learning.
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> For Mathematics in the 5th grade has 35% of students who have learned the appropriate problem-solving skills in public school. Out of 2.443.581 students, 847.712 demonstrated proper learning. For the 9th grade, 11% of the students have learned the appropriate problem-solving skills in Mathematics in public schools. Out of 2.589.764 students, only 290.458 demonstrated proper learning. (BRASIL, 2015).

These data denounce the new forms of exclusion established by the Brazilian school system, where the exclusionary practice has a long tradition. As Meira (2012, p.75) states:

> Expressed initially by the lack of opportunity to school access for a large number of children, especially in the poorest areas of the country, and later expressed by high level of drop outs, nowadays the excluding policies reveal a more silent, although as violent form: children and youngsters remain in school for long period of time, but do not appropriate properly school subjects.

Facing this distressing picture for the present and for the future of Brazilian nation, a question arises: why students stay in school and do not learn? There is certainly not a single answer to this question, which involves from the objective teaching conditions to the subjective conditions of teachers and students, also influenced by the objective scenery.

In this complex context, we would like to highlight a specific issue that contributes for the bad results mentioned above for the teaching and learning of mathematics among us. That is the absence of a mathematics teaching system "sufficiently rational, and scientific and practically reasoned", as Vygotsky (1995, p.183) said about the problems of teaching and learning written language, and which can easily be transposed to the teaching and learning of mathematics. The author says,

> Students are not taught the written language. They are taught how to draw the words and, therefore, learning does not go beyond the traditional spelling and handwriting. This is explained, first, for historical reasons, because precisely the practical pedagogy, despite the existence of many reading and writing teaching methods, has not yet elaborated an educational system sufficiently rational and scientifically and practically supported for teaching how to read and write. Thus, the problem of education remains unsolved to this day.

From a cultural-historical point of view, school has an essential role on creating and developing intelligence and personality on each child or student. From this point of view, we agree with Davydov (1987) when he states that school today has directed the selection of contents, teaching methods and teaching organization in a utilitarian-empirical perspective.

This system teaches and cultivates in the students the laws of empirical and discursive thinking, good for approaching everyday problems, but not sufficient to understand and express facts and situations that belong to the higher sphere of human production, such as Arts, Science, Philosophy. Empirical and discursive thinking drives the student to classify and categorize the “external characteristics of objects and isolated phenomena of nature and society" indispensable to daily life, to routine work tasks and survival, which repeat themselves with a strong regularity in this sphere of one’s life. However, this thinking is "[...] absolutely insufficient to assimilate the spirit of contemporary science and the principles of a creative, active and deep content relationship in face of reality" (Davydov, 1987, p. 144).

Before entering the more specific matter of mathematics teaching, we will concentrate on some fundaments of cultural-historical theory seeking to emphasize its pedagogical implications for creating a critical approach to practices today. Such fundaments also enable the understanding of the school role in a developmental perspective, that is, an education to favor the acquisition of the best human qualities in children and students. In this sense, cultural-historical theory transforms the prevailing school culture that seems to still respond to mass school requirements in its early days - at the beginning of the industrial revolution - when the concern with the formation of an obedient labor force supplanted the concern with teaching students to think.

In this sense, we agree with Nascimento and Moura (2012, p.05), when they stress

> [...] We say that research on pedagogical activity, produced from the cultural-historical point of view, has a motive or a goal in common: to contribute for research in education to overcome the alienating conditions that prevent the full humanization of all human beings. And this research shares an action: to explain the reality to be known (in this particular case, the pedagogical activity), revealing the necessary conditions for the development of this reality as well as the possibilities and limits for its transformation in our society.

In this sense, we also agree with Angel Rivière (1984) when he states that Vygotsky - and the cultural-historical approach – crossed the twentieth century psychology like a thunder. And we wish that his theory also crosses the twenty first century pedagogy like a thunder.

2. A pedagogical theory for a developmental education

From a cultural-historical perspective, as we understand the role education has in the humanization process - that is, in the constitution of human subjectivity or in creating human intelligence and personality – we assume that teaching and learning mathematics must take a new direction, different from what we find held in our schools today.

Common sense deeply present in our current school culture guides teachers' thinking and acting that is essentially based on a biological conception of human development. According to this conception, each student brings from birth the human capacities that he will develop in his lifetime. From this point of view, development is guided by natural law and takes place as a maturation process. In this case, teaching and learning has to do with the external use of possibilities that arise with development: development always precedes and paves the way for teaching. From this perspective, there is not much to be done at school when the necessary learning skills are not naturally given for the students. Education and teaching are understood as a condition to adapt the educational process to the students' mental development. In other words, for this conception of human development, mental operations are independent from the contents of students' activity and knowledge. Intelligence is understood as immutable and hereditary. Thus, the student either has a gift for mathematics, or has not.

It occurs that the concept about the materialistic origin of psychic processes of human development has overcome – with the contribution of different fields of science - the concept based on the biological nature of human being. This new understanding demonstrated by the cultural-historical approach implies that the psychical processes take form throughout life, as the child or student socially experience contact with the cultural environment. These psychical processes are the higher mental functions such as speech, thinking, imagination, attention, voluntary memory, categorical perception and self-control of behavior that constitute intelligence and personality of every human being. This understanding shows an essential link between education and development processes of human capabilities, which makes education and teaching universal ways of promoting development of human mind. Intelligence takes form and develops in life - especially at school, whose essential function is to organize intentionally and systematically the objective and subjective conditions for such development, by presenting culture to children and students in increasingly complexity levels.

Cultural-historical approach reverses the relationship between development and learning and hence the relationship between development and education that has been guiding the teaching practices for long - and, in general, can still be found at school today. Replacing the old thesis that school education in general still supports that learning, and therefore teaching, follow the development processes and must respect the natural maturation of children and students, cultural-historical theory demonstrates "[...] the fundamental thesis that student mental development is mediated by education and teaching" (Davydov, 1988, p. 50).

This holds for education - and more specifically for school education, due to its necessarily intentional character concerning human development - a new responsibility and a new role in the formation and development of higher mental functions. It has to do with the proper organization of the objective conditions (the environment particularities: organization and access to cultural objects, organization and time management; relationships among students and between them and the teachers, activities proposed) and the subjective conditions (student particularities: needs and motives that affect the sense of proposed activities).

Considering this single aspect – the education role in the formation and development of intelligence - we have a new point of view from which to submit school educational practices to a critical analysis. Conceiving human development as a possibility - and the possibility of educating in each child the best human qualities - school practices, certainly not all but many of them, show themselves as poor and little developmental (Davydov, 1988).

Understanding how children learn - either in early childhood education, whether in elementary school - is another element that imposes changes in school culture. As stated by Leontiev (1978), the process of appropriation of human qualities - the higher mental functions that build up the intelligence and personality, and which were created throughout history in the same process of cultural creation: language, science, technology, habits and cultural attitudes, objects and instruments - brings together three key protagonists articulated in a dynamic movement for learning. First, but not in a hierarchal set, culture as the source of human qualities, as stated by Vygotsky (2010); a socially more experienced partner that presents cultural objects in their social functions (Leontiev, 1978; 1988) - at school, mostly the teacher - and the learner himself as an active agent that takes part in the process (Dusavitskii, 2014).

As stated by Vygotsky (2010), culture should not be considered as circumstances, context or background in the learning process, but as a source of human qualities. To create objects and instruments throughout history, humans have used the higher mental functions such as perception, memory, thinking, imagination - human capabilities and skills. These higher mental functions necessary for the creation and use of objects and instruments along human history are stored as human energy in these products of human activity. As new generations learn to use these objects (from an ax to an aircraft, from cutlery to computers) as social objects - that is, according to the function for which they were created - they reproduce for themselves these mental functions stored in these products of human activity as new skills and abilities. Leontiev (1978, p 268) explains the concept of instrument - material or intellectual - to the cultural-historical approach:

> The instrument is the product of material culture that stores in itself, in the most obvious and material way, the characteristic features of human creation. It is not just an object in a certain way, having given properties. The instrument is both a *social* object in which working operations historically developed are incorporated and fixed. (emphasis by the author)

However, these working operations fixed on objects as skills and abilities are stored in but they are not given by these objects. Their appropriation requires the learner to get in contact with these objects mediated by more experienced partners who know how to use them - and present the object in its social use. At school, this partner is ultimately the teacher, although in many cases the children themselves can perform this role in relation to other colleagues.

This socially mediated relationship with culture is necessarily active for the student. In Leontiev's (1978, p. 268) words,

> [...] this process is always active from the point of view of the human being. In order to master objects or cultural phenomena that are the product of historical development, it is necessary to develop an activity that reproduces the essential features of the activity embodied or accumulated in the object.

In other words, for cultural-historical theory there is no learning in the absence of learner's agency in the activity performed. The concept of activity in a cultural-historical perspective involves the meaning the activity has for the student who is performing it (Leontiev, 1988). This meaning is given by the relationship established between the motive that leads the student to act and the result of this process. The coincidence between reason and result moves the person to be intensively involved in the action: not only the intellectual, but also the emotional strength. For Vygotsky (2010), the concept of emotional experience is a unit that expresses the influence of the environment on human development; in other words, expresses the learning process. According to the author, the emotional experience mediates the environment/ consciousness relationship.

> The emotional experience (perezhivanie) arising from any situation, or from any aspect of his environment determines what kind of influence this situation or this environment will have on the child. Therefore, it is not any of the factors taken without reference to the child that determines how they will influence the future course of his development, but the same factor refracted through the prism of the child emotional experience. (Vygotsky, 2010, p. 683-684)

Defining the concept of emotional experience – *perezhivanie* in Russian - the author says,

> An emotional experience is a unit where, on the one hand, in an indivisible state, the environment is represented, i.e., that which is being experienced – an emotional experience is always related to something which is found outside of the person - and, on the other hand, what is represented is how I, myself, am experiencing this, i.e., all the personal characteristics and all the environment characteristics are represented in an emotional experience. Everything selected from the environment and all the factors which are related to our personality, all the features of its character, its constitutional elements which are related to the event in question. So, in an emotional experience, we are always dealing with an indivisible unity of personal characteristics and situational characteristics which are represented in the emotional experience. (Vygotsky, 2010, p.686)

This way, the author highlights the unity of cognition and affection - the place of emotion and "personal characteristics" in the process through which the student gets in touch with knowledge and learns. From our point of view, this revolutionizes the understanding that teachers have about the learning process and, consequently, the way they must conceive and organize teaching.

Human needs that influence the motives that move the activity are - as all higher mental functions - learned in socially mediated situations when the agent gets in touch with culture. In this perspective, it is a teacher's responsibility to create the need for knowledge in the

students. And teachers can do that according to the way they choose to present knowledge to the new generations.

The substantiation of the triple protagonism that promotes the emotional experiences requires, in school, proper organization of teaching to provide advances in learning. On the one hand, the teacher must conceive the student as someone able to learn. This new conception of child and student is a condition for proposing learning activity where the students are allowed to be agents in the activity they perform. However, this new conception must overcome speech and must be effective as concrete actions that promote students' agency.

In the words of Davydov, Slobodchikov and Tsukerman (2014, p. 101), to organize a developmental education, "[...] we strive to direct ourselves consciously towards the cultivation of a fundamental human ability, the ability to construct and transform independently one's own life activity, to be its true agent". According to the authors' long-term research, students who do not develop until the end of elementary school the ability to be agent of their learning activity "[...] resists studying in middle school, giving rise to a mass of adolescent problems".

Thereafter, the organization of appropriate teaching and learning conditions also implies the understanding that, as stated by Vygotsky (1988), good teaching focuses always on the student's zone of proximal development, once teaching must advance learning and development. With this new point of view regarding the student and his activity, one can organize the environment and objects available in school, share time management and define the relationships between teachers and students. On the other hand, the embodiment of activity or emotional experience requires an understanding about human development and about the activity that guides development in each period of life. For students in school age, from seven or eight years on, the activity through which the student best gets in contact with knowledge and best develops his intelligence and personality is the learning activity.

3. Teaching how to think and the learning activity

Contemporary knowledge assumes that human beings dominate the origin and development processes of objects and facts through theoretical thinking, which is described and studied by dialectic logic[1]. Theoretical thinking has its specific types of generalization and abstraction, its own procedures to form concepts and operate with them. Due to this, the formation of such concepts opens to students the possibility to master the fundamentals of the current theoretical culture. [...]School, in our opinion, should teach how to think theoretically (Davydov, pointed by Golder, 2002, p. 49).

If we understand that our mental operations depend on the contents of our concrete knowledge, then the intentional organization of educational processes to promote the best

[1] Dialectical logic, as the author points here, refers to mastering of processes that generate and condition the development of things in their multiple determinations, that is, refers to the apprehension of reality in all its concreteness, in its dynamism and multiple determinations. Formal logic performs a strict reduction of the contents and requires an understanding of the forms without all of its qualities, thus producing the understanding of reality in fragments.

conditions to form and develop mental operations is essential. In other words, the ability to think is not given to children at birth, not inherited from humans who came before us and is not the result of a maturation process. It is a possibility given by phylogeny - the history of the species - and takes form in ontogenesis - each person's experience - under the influence of life material conditions and education. Thus, the most important school task is to teach students to think. How to do this?

El'konin (pointed by Repkin, 2014) noted that what distinguishes learning activity of any other type of activity is the fact that its purpose and result print a change in the very agent of the activity and not on the object with which the person operates. In other words, learning activity should be understood as an activity for self-transformation of the agent.

We have seen above that the activity or emotional experience is characterized by the fact that the student acts with consciousness and affectively motivated, i.e., freely. In this case, the student does not study because the teacher imposes a task, but because to study and learn is for him a vital necessity. So, for Repkin (2014, p. 90), "[...] the concept of studying or learning and the concept of learning activity is not identical."

The author distinguishes different levels of learning. Learning at the level of operations happens when the student follows teacher's commands, "much like a puppet." In this process, one can reach a high level of performance, but his performance is purely mechanical, once operations are "just an executor response to an external signal, the teacher's command." Learning at the level of actions corresponds to a higher and more complex level of being active when the student knows why he is doing something. However, most of the time, he performs repeatedly standardized exercises applying a model in which "[...] the most important indicator of learning activity - creativity - is absent" (Repkin, 2014, p 90.).

Finally, the agency can happen at a top and more complex activity level, which involves, as we saw above, the establishment of a coincident relationship between the motive and the result of the process. That is, to understand activity one should "[...] look at the development of the activity of an agent through the prism of his needs" (Repkin, 2014, p. 90), which defines his status as an agent.

Besides the self-transformation of the agent, learning activity is characterized also by the goal of taking the student to master theoretical knowledge – to master theoretical generalization of knowledge - the concepts, laws and principles on which knowledge is based (Davydov, 1988). In other words, one must master the procedures of action, but also the most complex field of theoretical foundations that support these procedures. For Repkin (2014), these processes come together: when the student masters theoretical knowledge, he masters the theoretical principles for the construction of action's procedures. Similarly, when the student masters principles, he changes as an agent, because he learns "the ability to find, by himself, ways to solve a broad class of tasks" independently.

The student cannot master a principle through demonstration and training. To master a principle, it is necessary to analyze and generalize the fundaments of action, and to form a generalization and analysis mechanism. According to Repkin (2014, p. 94), "[...] to master a principle, the agent must conduct an investigation, make a discovery. In this sense, learning activity is analogous to research activity."

Pre-school children are especially known for their curiosity and their desire to know. The transformation of this desire in a vital necessity to learn is a prerequisite for the establishment

of the learning activity. For this necessity to install, children and students must live learning experiences that strengthen these needs. As we have seen above, the need to learn that substantiates the motive for learning is the first element to be guaranteed in this complex process. Elementary school must have learning activity as the essential language for the student's relationship with the cultural-historical world that surrounds him: culture or knowledge.

Another essential condition for organizing learning activity is the formulation of learning tasks that require students to conduct mental or physical experiments. An example on mathematics teaching in elementary school freely translated from Davydov (1987) demonstrates this process from an early stage.

> *We want to measure a large object and we only have a small measuring instrument. How can we reduce the time of measurement and present the result in terms of the small instrument?*

The solution of this task will require a set of experiments. First, to realize the need for a measuring instrument that is larger than the small instrument we have in hand and smaller than the large object. This will require some experiment. Then, to realize the need to know the relationship between the small measuring instrument and the intermediate object adopted to reduce the measuring time. Having understood this relationship, the student should use the intermediate measuring instrument to measure the large object in less time. With this data, he will have to use the relationship between small and intermediate measuring instrument to present the results in the small measuring instrument unit. At the end of this process, the student may resume the steps taken in the problem solving process as a way to control and evaluate the solution. This awareness of the procedures performed introduces students to learning generalized thinking procedures for problem solving. And, in the example, even if student may need different levels of teacher's help for solving the task, with the experience of the procedure, he discovers the need to use multiplication to find an answer to a practical question. This will help him in new situations to use different scales of measurement, having mastered generalized procedures of thinking and acting.

4. Some considerations to think about education and the teaching of mathematics

Research by Davidov, Repkin, Tsukerman, Dusavistskii over decades have shown that dialectical thinking can and should be thought to students in different educational levels. The formation and development of their creative abilities, initiative, understanding of themselves and, in one word, their personality, depend on it. A proper education organized with learning activities is a prerequisite for achieving this goal. As stated by Leontiev (1988), the agent's role in social relations in which he participates has driving force in his development: in this sense, learning activity potentiates the agent's role in activity opening possibilities for explorations and experiments that lead to transform the agent, that is, his personality.

We understand, from our teaching experience as teachers responsible for the supervised teachers' training, that mathematics taught in the early years does not advance the instrumental, empirical level. It allows students to successfully solve certain problems, but do not ensure the effective understanding of its contents.

As a result, this "learning" does not cause the development of superior capabilities of the students' thinking. For the cultural-historical approach there is real learning only when there is agency in the performed activity, but the way the schools are, in general, organized do not provide significant advance in understanding the contents of knowledge.

Although current education programs announce pedagogical innovations, students and teachers relationship with mathematical knowledge is still on empirical level. Superficial concepts are usually presented from early childhood and do not provide tools for complex thinking. Hobold (2014) conducted a research on methods to teach multiplication, and sought to reveal the types of abstraction, generalization and concepts produced by such methods, adopted in mathematics education in the state of Santa Catarina, which can be generalized to our country. According to the results, the logic underlying this teaching is formal logic, which works with the external characteristics of objects developing the empirical and intuitive thinking. Dusavitskii (2014, p 79) highlights the consequences of this practice: "By teaching the concrete and practical content of the knowledge, teachers cultivate and strengthen the empirical thinking, which creates a barrier to further attempt to reach theoretical content". In this perspective, mathematics taught in school promote only the possibility of its application, but do not provide students with the possibility of mastering new psychic abilities intrinsic to the appropriation of cultural tools. As stated by Leontiev (1988, p. 287/288),

> The acquisition of a tool [...] is a process of active formation of new skills, higher functions that "humanize" our motor skills. This applies also to the phenomena of intellectual culture. [...] The main feature of the process of appropriation or "acquisition" is, therefore, that it creates new skills, new psychic functions in human beings [...]

In this sense, it is urgent to think critically and radically the pedagogical practices, starting from early childhood education, once, as stated by Hobold (2014, p.185),

> For children to develop theoretical thinking in elementary school, it is essential to develop from kindergarten the higher mental functions involved in this process. This means, to address adequately the affections, playing with objects and tools, with traditional games, especially roleplay, drawing and modeling, which enable the development of representative thinking or thinking with images.

Also, Davidov (pointed by Dusavitskii, 2014, p. 79) points out the urgent need and criticizes the concept of child as incapable inhabiting common sense ideas present in the school today. According to the author,

> When the student is presented to science in fifth or sixth grade, and he was trained previously to believe only in practical experience, which has specific practical significance, there is no physics or chemistry that might interest him. This results from not considering the student's true skills in previous ages of his development.

We understand, therefore, that the current education programs, generally found in schools, only offer a new look to an archaic conceptual body, or offer new practices to the same conception of mathematics, which does not really change the meaning of teaching practices.

Thus, traditional teaching methods, presented through activities often called "recreational" focus on algorithms, on procedures for solving problems that are based on solutions through exercises that stimulate memory, but do not stimulate theoretical understanding of concepts, nor the establishment of connections between concepts and possibilities of creation and autonomous application of mathematical problems resolutions.

Numbers and operations with the numbers that constitute the language in the field of mathematics have a symbolic function, and mastering these instruments created by human culture extends the process of development of higher mental functions.

> When students learn and master reading, writing and arithmetic, they learn definitely to work with signs and meanings. The objects are now the words that they know how to write or read, or the numbers representing the amounts, and things or objects order. They have now a better mastery of signs and meanings, although for them objects or things specifically keep on exiting. (Beaton, 2012, p.157)

Therefore, it is evident the role of education in the internal language and verbal thought development, which is the highest stage of human psychological development. As stated by Beaton (2012), such functions result from learning how to read, to calculate and other learning related to the understanding of reading content, mathematics and social and natural sciences that students should perform and which must be learned at school.

We understand that, promoting the means for the students' learning activity is essential part of teacher's role. Understanding the development of the symbolic function as a unit of analysis of the educational content of mathematics is a condition in order to develop new teaching practices to promote effective learning of its symbolic content and, consequently, promote psychological development in increasingly complexity levels. This new organization of the student's activity should consider that

> [...] The object of teaching is not the laws of phenomena themselves, such as "definitions" of reality, but working with these laws (with the *general* or *universal*) in its relationship with the *particular* and the *singular*. Working with the theoretical concepts corresponds to work with the *universal* in the movement of its *realization* in the singular, mediated by the particular (Nascimento; Moura, 2012, p.12, emphasis by the authors).

In other words, mathematics education which promotes the development of theoretical thinking cannot focus on operation techniques, algorithms, systems and formulas, but must emphasize analytical and synthetic actions on contents, allowing the student to understand the processes that led to its development. The student must be taught to think about the contents and their genesis to understand their implications and thus be able to translate the contents into formulas and algorithms when bringing them to his reality.

In this perspective, developmental education acquires meaning.

> The discovery of the objective and necessary relationship between the structure of education and the students psyche development process means, in our investigation, that the structure of education may generate students' general development. (Zancov, 1984 pointed by Aquino, 2013 p. 241)

For this reason, structuring pedagogical practices on consistent theoretical basis to seek the maximum development of human potential, emerges, according to Aquino,

> [...] when we assume the correlation between education and development as a pedagogical problem; the search for pathways on education that lead to the achievement of a better general development acquire fundamental importance. (Aquino, 2013, p. 246)

Therefore, teaching engaged with developmental education has a substantial theoretical framework that understands the education system as a system of learning and development and establishes as goal the mastering of the learning activity and the foundations for theoretical consciousness and theoretical thinking, which implies new content and a radically new teaching method.

According to Dusavitskii (2014, p. 80/81), this method

> Envisages the organization of independent acts by the children that ensure their substantive analysis and generalization of the study material. In the process of analysis, the children discover the initial matrix or common foundation that reflects the content and structure of the object of the given knowledge. Finally, the objective assessment of the results of the system of teaching is secured by a set of especially devised diagnostic tests of children's mental and personality developed.

Thereby it is urgent to rethink the contents that constitute the learning of mathematics in its various manifestations, as well as the ways in which such education must be organized in order to promote the symbolic function development in the students. This is an essential condition for the development of other psychic functions in a systemic way, considering the most complex forms of theoretical thinking.

This can only be effective if the organization of teaching practices occur as activities in the historical-cultural approach sense, that is, when the objective of the learning pursued is known by the student, when motive and objective coincide and there is an epistemic involvement of the student in the implementation of actions and tasks.

5. Final considerations

Throughout this article, we sought to present some elements of the cultural-historical approach about human development. In addition to the role that education plays in this development process, we highlighted how children or students learn. The cultural–historical approach teach us that children and students learn when they are inserted in meaningful activities that make sense to them, involving them in procedures that promote the development of their personality and intelligence.

The studies mentioned here, considering the cultural-historical point of view about human development and its pedagogical implications – a few among many developed by Brazilian researchers and by researchers directly involved in the implementation of developmental education in Russia and Ukraine - involve learning activity or more specifically the teaching of mathematics. They all call for an urgent new school culture intentionally focused on the presentation of more elaborate levels of knowledge, marked by a triple pedagogical role played at the same time by the child or student – as active agents in their learning process -, the teacher - also as agent that organizes learning activity - and culture – the source of historical and socially accumulated human qualities.

This new school culture supporting a developmental education requires a child or student's conception as someone able to learn. Similarly, the teacher occupies a new place in this relationship, as more experienced partner that overcomes situations when he solves problems for the students and starts doing it with the students, in a shared situation, with the purpose of advancing what students already know, considering that the good teaching focuses always on the students proximal development zone. In this perspective, the teacher organizes problem situations, give students time to advance from what is known to the unknown in a movement of self-development of thinking (Poddiakov, 1987). For such cases, the teacher does not forego the students making the problems solution easier, but follows them in their activity offering different levels of help, as necessary and according to the students request (Galperin, 1987) to make them advance in the field of theoretical thinking. In this sense, the teacher never withdraws the role of students in problem solving, but organizes the set of conditions for the exercise of thinking as individual activity or as a shared activity with the teacher and with peers.

As stated by Leontiev (1978ª), the historically and socially accumulated knowledge educates, however, it is necessary to educate the new generations with knowledge with sense. New teaching methods should be concerned, then, not only to teach mathematical knowledge, but also to create in children from early childhood education and students in the early grades of elementary school "a set of elementary reading and calculation habits". In addition, this process must be concerned with forming "a broad orientation in the language area and quantitative relations, thus creating the necessary basis for the subsequent formation of their language and math skills" (Zaporozhets, 1987).

Regarding the specificity of mathematics teaching, we tried to bring elements that contribute to the overcoming of pragmatic and techniques actions that have prevented the advancement of more complex forms of thinking. These elements indicate that the basic conditions for the formation of theoretical thinking can and should be presented from kindergarten once educating perception, attention, language development and curiosity depend on the quality of the relationships we teach children to establish with the other children, with adults and with cultural tools available in school. Analysis, synthesis and generalization are typical characteristics of human activity and must be taught at school from early childhood.

6. References

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