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Theoretical Foundations of Education: contributions of the Psychology of Mathematics Education of the Early Years of Elementary School L

Fundamentos Teóricos da Educação: contribuições da Psicologia da Educação Matemática nos Anos Iniciais do Ensino Fundamental L

Fundamentos Teóricos de la Educación: contribuciones de la Psicologia de la Educacion de Mathematics de los Primeros Años de la Escuela Primária L

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Abstract

The central scope of this research addresses the Psychology of Mathematics Education for professionals with a degree in Pedagogy courses, focusing on teachers who exercise the teaching of mathematics teaching in the early years of elementary school I. This article analyzes and presents the potentialities and contributions of this theoretical field of knowledge in the teaching-learning process of Mathematics. Education aiming at improvements of the Brazilian student in the external evaluations of the Brazil Test published by the SAEB of 2017 and 2019, as well as the pedagogical practice between teacher-student-knowledge. It was justified the insufficient proficiency in mathematics of Brazilian students of about 70%, as well as the reduced number of scientific productions on the theme of this article. The objective of this study was to present contributions of the Psychology of Mathematics Education in the early years of elementary school I. On the methodological path, it was characterized within the qualitative approach and in the procedures of bibliographic research. Among the main results were the discourses of the interviewed subjects pointing out

the potentiality of the theoretical basis of Psychology of Mathematics Education in their pedagogical knowledge/doing. It was found that the psychological, cognitive and affective-social dimension have implications for students' learning. It concludes an emergence of a further discussion of this field of knowledge in the degree of pedagogy courses in Brazil to increase the quality of pedagogical intervention of pedagogue teachers in mathematics classes, aiming to increase the quality teaching-learning process of mathematics in the early years and the results of institutional and large-scale evaluations.

Keywords: Psychology; Mathematics education; Education; Pedagogy; Early years.

Resumo

O escopo central desta investigação aborda a Psicologia da Educação Matemática para profissionais com Licenciatura em cursos de Pedagogia, tendo como foco professores que exercem o ofício do ensino do ensino da matemática nos anos iniciais do ensino fundamental I. Este artigo analisa e apresenta as potencialidades e contribuições deste campo teórico conhecimento no processo de ensino-aprendizagem da Educação Matemática visando melhorias do alunado brasileiro nas avaliações externas da Prova Brasil divulgados pelos AEB de 2017 e 2019, bem como da prática pedagógica entre professor-aluno-conhecimento. Teve como justificativa a proficiência insuficiente em matemática dos alunos brasileiros de cerca de 70%, bem como do número reduzido de produções científicas acerca da temática deste artigo. Objetivou-se apresentar contribuições da Psicologia da Educação Matemática nos anos iniciais do ensino fundamental I. Sobre o caminho metodológico, caracterizou-se dentro da abordagem qualitativa e nos procedimentos da pesquisa bibliográfica. Entre os principais resultados destacaram-se os discursos dos sujeitos entrevistados apontando a potencialidade da base teórica da Psicologia da Educação Matemática no seu saber/fazer pedagógico. Constatou-se que a dimensão psicológica, cognitiva e afetivo-social têm implicações na aprendizagem dos alunos. Conclui-se emergência de maior discussão deste campo de conhecimento na licenciatura dos cursos de Pedagogia do Brasil para aumentar a qualidade da intervenção pedagógica dos professores pedagogos nas aulas de matemática, visando aumentar a qualidade processo de ensino-aprendizagem da matemática nos anos iniciais e dos resultados das avaliações institucionais e as de larga escala.

Palavras-chave: Psicologia; Educação matemática; Educação; Pedagogia; Anos iniciais.

Resumen

El alcance central de esta investigación aborda la Psicología de la Educación Matemática para profesionales con un grado en cursos de Pedagogía, Enfocado en profesores que ejercen la enseñanza de la enseñanza de las matemáticas en los primeros años de la escuela primaria I. Este artículo analiza y presenta las potencialidades y contribuciones de este campo teórico del conocimiento en el proceso de enseñanza-aprendizaje de la Educación Matemática con el objetivo de mejorar el estudiante brasileño en las evaluaciones externas de la Prueba Brasil publicadas por la SAEB de 2017 y 2019, así como la práctica pedagógica entre profesor-studiante-conocimiento. Se justificó el insuficiente dominio delas matemáticas de los estudiantes brasileños de alrededor del 70%, así como el reducido número de producciones científicas sobre el tema de este artículo. El objetivo de este estudio fue presentar las contribuciones de la Psicología de la Educación Matemática en los primeros años de la escuela primaria I. En el camino metodológico, se caracterizó dentro del enfoque cualitativo y en los procedimientos de investigación bibliográfica. Entre los principales resultados se encuentran los discursos de las asignaturas entrevistadas que señalan la potencialidad de la base teórica de la Psicología de la Educación Matemática en sus conocimientos/cosas pedagógicas. Y descubrieron que la dimensión psicológica, cognitiva y afectiva-social tiene implicaciones para el aprendizaje de los estudiantes. Concluye un surgimiento de un nuevo debate de este campo del conocimiento en el grado de cursos de pedagogía en Brasil para aumentar la calidad de la intervención pedagógica de los pedagogistas en las clases de matemáticas, con el objetivo de aumentar el proceso de enseñanza-aprendizaje de calidad de las matemáticas en los primeros años y los resultados de las evaluaciones institucionales y a gran escala.

Palabras clave Psicología; Educación matemática; Educación; Pedagogía; Primeros años.

1. Introdução

The proposition of this article was to present the intersection between the field of knowledge of Psychology, Education and Mathematics Education in the teaching-learning process. Having as object of study the Psychology of Mathematics Education applied to the teaching and learning of the contents of teaching school mathematics of the early years of elementary school I. The scope of the study was based on discussing its contributions in the

initial training of professionals in Pedagogy who practice the pedagogical practice of teaching in this aforementioned learning cycle.

Mathematics Education schooled in Brazil begins in Early Childhood Education and its continuity and density in the initial years (1st to 5th grade) of Elementary School I, being one of the attributions of the Professional Licensed in Pedagogy, as supported by the current educational legal documents, including the National Curriculum Guidelines for Teacher Training (Brazil, 2015) and the National Curriculum Guidelines for Pedagogy Training (Brazil, 2006). These professionals play a fundamental role in pedagogical mediation to construct the basic mathematical skills and competences of the teaching contents provided for in the reference curriculum matrix of the current Common National Curriculum Base (BNCC).

In the national literature, consistent works by Curi (2004) and Pereira & Pereira (2020), have had as a point of convergence to point out the incipient mathematical training of teachers trained in Pedagogy being one of the factors associated with this training the recurrent unsatisfactory performances of students in the national evaluation of large scale called Brazil Tasting applied in the 2nd and 5th year that aims to evaluate the level of knowledge of the Brazilian student in the areas of knowledge of Portuguese language and mathematics 53% of students obtained a satisfactory level of mathematical knowledge.

The discussion in this article is based on the Psychology of Mathematics Education and its implications in the pedagogical relationship, which involves the triad of teacher-student-knowledge, in particular the construction of knowledge and mathematical thinking in basic education involving psychological, affective-social and cognitive aspects.

It is assumed here the importance of the teacher's knowledge about the content of teaching for the regency, but there is important complexity in the teaching-learning process, which requires other professional knowledge of the teacher inherent to pedagogical practice, among them the field of knowledge of Psychology of Mathematics Education to help with an appropriate theoretical basis the pedagogical intervention.

In the Brazilian educational field, the phenomenon of the difficulty of the Brazilian student in mathematics disclosed by large-scale educational indicators points to the lack of mathematical skills in the early years in: mathematical operations, percentage, geometry and problem solving difficulties in the daily life of problems that require mathematical knowledge, these recurrent unsatisfactory results in mathematics signal poor quality of public elementary school in Brazil and the negative impacts in the early years have an influence on

the construction of mathematical knowledge in elementary school II, in high school and higher education.

The acquisition of insufficient mathematical skills and skills disclosed and categorized in the large-scale evaluations of Brazil Tasting 2017 and 2019 applied by the Basic Education Assessment System (SAEB) revealed an emergency in rethinking the teaching-learning of mathematics in the Brazilian public school according to data from these educational indicators cited 71.67% of the Brazilian student have insufficient proficiency in learning mathematics. In 2018, the international large-scale quality indicator known as the International Student Assessment Program (PISA) showed results similar to the national one, signaling the same weaknesses of knowledge. In this world reference indicator, Brazil in mathematics, since 2005 has been occupying the last positions, precisely the 66th among the 70 countries participating in the area of mathematics in the last two external evaluations.

These results have been the scene of debates and reflections among researchers in Mathematics Education in Brazil, in scientific events specific to the area (National Meeting of Mathematics Education), (Brazilian Society of Mathematics Education) and in the public domain database of the Coordination of Higher Education Personnel (CAPES) an important volume of master's dissertations and doctoral theses has sought to deepen the factors of the failure of Brazilian students to learn mathematics.

In Brazil we have significant scientific production on the stagnation of mathematics education and in the reality of the classroom has had little positive impact to improve teaching-learning according to the results published by external evaluations. It is observed that despite extensive research on the phenomenon of insufficient learning in mathematics, the focus of scientific productions has been on teacher education and teaching methodologies. In this article we point to the Psychology of Mathematics Education, this innovative direction still little debated among researchers in the area and in teacher training courses, in particular in the degree in Pedagogy.

The originality of this article consists of pointing out contributions from the field of Psychology of Mathematics Education with a look at the initial years, in this learning cycle students begin the process of psychological construction of negative or positive attitudes towards mathematics, bringing reflections in the teaching-learning process throughout the path of basic education.

The social relevance of this article comes from the emergency in Brazilian education, with emphasis in the initial years of increasing the quality of mathematics teaching and learning of students. In this sense, the articles, bringing to light theoretical subsidies about the

contributions of this field of knowledge to pedagogueteachers aiming at appropriate pedagogical, didactic and methodological interventions in mathematics classes.

In this sense, the renowned research group in Psychology and Mathematics Education (PSIEM) of the State University of Campinas-São Paulo (UNICAMP), has produced investigations indicating that the psychological, cognitive and affective-social dimension has implications for teaching- learning of mathematical contents.

In the reality of the classroom, according to the research by Pereira and Pereira (2020) based on the methodology of phenomenology, they showed prevalence in the discourses of students of negative social representations about mathematics, and many of them of family origin, socially and gradually being crystallized in school. Being one of the factors the incipient formation of the teacher, the teaching method in association with the affective-social aspects inherent to pedagogical mediation. This crisis of teaching-learning mathematics in Brazil generally portrays the reality of Brazilian public education.

In higher education has received students with lack of previous mathematical knowledge, this scenario has been observed in the courses of Exact Sciences and in the Degrees in Mathematics, Physics and Chemistry, high retention and evasion rates mainly in disciplines that requires mathematical knowledge and algorithmic abstraction, in short the phenomenon of the problem of the difficulty of learning mathematics is configured as an emerging problem of Brazilian education , and one of the possible factors for the high rate of retention and dropout in this area of knowledge would have a result of the poor quality of mathematics teaching-learning of primary education, particularly in the early years of this study.

The personal motivation for this study is the result of our experience in the exercise of teaching in mathematics classes of basic education, in the higher teaching in the teaching of the discipline of Mathematics in the degree course in Pedagogy and in continuing education courses in mathematics for pedagogues of a municipal public school system. It observed that the difficulties of teachers were not restricted only to the lack of mathematical knowledge or didactics of mathematics, but rather in the absence of theoretical training in Psychology of Mathematics Education, to understand the influence of the psychological, cognitive and affective-social dimension in the process of construction of knowledge and mathematical thinking.

The study is justified by the incipient quantity of scientific productions on the Psychology of Mathematics Education in the teaching of basic education.

It is also justified by the absence among the curricular components of pedagogy courses in Brazil analyzed from the discipline Psychology of Mathematics Education.

In view of the above, the problem of teaching and learning Brazilian school mathematics present numerous factors. Delimited to the investigation; can the Psychology of Mathematics Education for the early years contribute to improving the teaching-learning of mathematics in the early years of elementary school I?

For this study, we sought in the theoretical literature that have produced consistent studies on the Psychology of Mathematics Education, among them: Falcão (2003,2008), Spinillo (1994), Igliori (2004, 2013), Brito (2005, 2011), Meira (2013, 2016), Cury (2014), and Carmo (2012) among others. And about the mathematical training of the pedagogue teacher Curi (2004), Pereira & Pereira (2020) and Tardif (2014) about teaching knowledge.

The aim of the study was to present the contributions of the field of knowledge of Psychology of Mathematics Education in the initial formation of pedagogy courses and in the teaching-learning of mathematical contents of the early years of elementary school I.

2. Theoretical Framework

In the definition of Myers and De Wall (2019), the word psychology has its origin in two Greek words psyché (soul) and logos (study, reason and discourse), phyché + logos= Psychology. "Psychology is a science that studies the emergence and development of psychological phenomena and processes that motivate and guide human behavior."

The term Psychology was first used in 1590 as the title of a work written by Rudolf Godenius (1547-1628). Early on the history of Psychology was associated with the history of philosophy until the mid-twentieth century.

In myers & de wall 's (2019) statement, psychology was recognized as a science detached from philosophy in the early 20th century, having psychological phenomena as its object of study. For this same theoretician, according to his explanation, Psychology was considered a source of information for the elaboration of an educational theory, and the object of study is the psychological dimension of the individual and its implications in teaching and learning.

In Brazil, as well as in Europe and the United States, Psychology developed closely in conjunction with the educational field, with emphasis on the teaching and learning process of basic education and teacher training courses, advising on psychological knowledge in intervention and pedagogical mediation (Goulart, 2011). In the exhibition of Igliori (2004), on

historicity, Psychology and Mathematics Education developed as scientific knowledge in the nineteenth century and had visibility in the international scientific community in the mid-twentieth century. The intertwining between these two fields of science had a greater focus on the field of Psychology of Education, Developmental Psychology, Learning Psychology and Cognitive Psychology.

The understanding of the application of Psychology of Education in Brazil according to the brief historical picture exposed, this science only instituted in the 60's, when the first psychology courses were implemented. Focusing on psychological and educational phenomena (Myers & De Wall, 2017). Still according to these aforementioned theorists, psychological thought has its origin marked by the contribution of different fields of knowledge concerned with topics such as emotions, the education of children, the teaching-learning process, affectivity, cognitive among other fields.

According to the theoretical explanations of Goulart (2011), in undergraduate courses in Brazil, the discipline of Psychology of Education has been the discipline of intersection between Psychology and Education, having as theoretical deepening to empower teachers on the themes related to psychological and pedagogical processes inherent to the process of human development, psychological theories and the teaching and learning process. For the aforementioned author, Psychology of Education has implications for teacher education and teaching, because one of the current premises in teacher education has been the theoretical understanding of mental processes of how the construction of mathematical knowledge occurs.

It is worth commenting on the important theoretical-based contribution on the psychological, cognitive and affective-social dimension of Psychology of Mathematics Education to the professional pedagogue, due to the unsatisfactory results of learning in Mathematics of the Brazilian student, being among the worst in pisa assessments, this educational indicator pointed out that in Brazil 2/3 of brazilian students of 15 years know less than the basics in mathematics. In this sense, seeking innovative actions to reduce the current reality of this discipline, which has been the focus of debates among researchers in the area and has been one of the goals of the MEC, investing in research as presented in this scientific production of wide national scope.

Dialoguing with Spinillo, Falcão & Meira (1994) and Brito (2011), the important theoretical discussions in the field of Psychology of Education could not respond to the pedagogical and psychological problems of school mathematics involved in teaching and learning detected at all levels and modalities of basic education teaching. For the authors, the

precarious training of teachers about specific knowledge about educational psychology, school mathematics in association with incipient mathematical training, as pointed out by curi's doctoral studies (2004), further aggravates the situation of teaching this discipline responsible for an important index of retention of students and the absence of the construction of skills and skills of the mathematical contents of the early years, essential for the construction of knowledge of the mathematical contents of the curricular stages of the following stages of basic education.

In falcão's statement (2003), Brito (2011), point out that the theoretical foundation in Psychology of Mathematics Education is a significant contribution to the teaching and learning of students in mathematical contents, promoting meaningful learning and intrinsic motivation to apprehend the mathematical contents of the early years that will have psychological impact on the whole educational process in the learning of basic education school mathematics.

In the theoretical proposition of Brito (2005), Spinillo, Meira & Falcão (2003), the Psychology of Mathematics Education is conceived as a field of study or as a discipline in undergraduate courses in Mathematics. However, in pedagogy degree courses, discussions have been held in the discipline of Psychology of Education at specific moments or in continuing education courses.

In falcão's assertion (2003), the Psychology of Mathematics Education has been internationally recognized for some decades as an area of interdisciplinary knowledge, having as object of study the psychological, cognitive and affective-social processes related in the teaching and learning process of mathematics schooled basic education, configuring itself as an area that intersects the Psychology of Education and Mathematics.

In Goulart's statement (2011), the Psychology of Mathematics Education has still been little widespread in teacher training courses in Brazil. This gap in the training of mathematics teachers explains the important difficulty of these professionals to understand the psychological aspects that directly influence the teaching and learning process of students.

In the view of Spinillo & Lautert (2012), one of the contributions of Psychology of Mathematics Education as an interdisciplinary area focused on the psychological dimensions inherent in the complex process of construction of mathematical knowledge provides theoretical support to teachers in pedagogical intervention.

It is very well placed by Cavalcanti (2011), that the field of development of Mathematics Education and Psychology of Mathematics Education has as a point of convergence about the mobilization of the psychological and cognitive dimension of the

higher mental structures by students for learning the school mathematical contents. For this author, the understanding of how in higher mental structures mathematical knowledge is gradually constructed, assists the teacher in the didactic-pedagogical actions of the classroom day to day.

According to (Falcão,2003, p. 24), the Psychology of Mathematics Education seeks "To understand the construction of knowledge of school mathematical knowledge with regard to the psychological aspect to respond to current learning problems of teaching contents". It is understood that the high rates of insufficient proficiency of the Brazilian student in all stages of basic education, as pointed out data from 2017 and 2019 from the SAEB, has as its origin the difficulty of learning in the correlations of psychological, affective-social, cognitive, family, emotional aspects, negative attitudes in relation to mathematics and the incipient mathematical ability to assimilate the contents of curricular teaching.

In the proposition of Falcão (2008), the Psychology of Mathematics Education has brought important contributions to the educational field by promoting changes in the conceptions of mathematics teachers by presenting numerous factors cited above as possible causes of the student's failure in Mathematics.

To broaden this discussion in the studies of Pereira & Pereira (2020), supported by the Theory of Social Representations of Serge Moscovici, it is evident that the negative social representations about Mathematics are initially constructed in family relationships then social and crystallized in the school context. In the representations and attitudes towards the word "Mathematics", the students' discourses have been: crying, sadness, frustration, failure, aversion, horror, fear, disapproval, "I can't learn", recovery, low grades, rigor, reasoning, blocking, "lack of teacher affection", intellectual disability, "the contents do not enter my head", equations, trigonometry, depression among others.

In the sense of Falcão (2003), Carmo (2012), the Psychology of Mathematics Education offers a solid theoretical basis, nodding that the psychological dimension has implications in the learning of students of the curricular contents of mathematics, especially in the early years learning cycle in which the student is in the process of constructing mathematical thinking and the formation of mathematical scientific concepts that will be used throughout the course of basic education.

In the same line of thought in Cury's notes (2014), the negative emotional impact on the teacher (mathematics) directly affects the three types of memory windows, namely: neutral, lights and killer, these three types of memories represent all the memories of the subject. In the educational field, Psychology explains that all areas of memory that have

emotional content associated with traumatic events cause blockage to learn and especially for correct answers in stressful situations, an example in explaining new content and during evaluations. Thus, the student will always associate traumas with certain school subjects or disciplines, including aversion to mathematics.

In the same direction Ferreira (2020), among these memories mentioned, the killer is directly associated with the educational field, because the student's learning is worth highlighting those of an affective order, especially in the positive or negative impact of teaching pedagogical practice. And in the teaching-learning process the student associates mathematics with traumas, which are triggered by killer memory. One of the teaching strategies pointed out by the author would be changes in teaching strategies, treat the student with social affection and value the student's effort in the acquired learning.

On the discussion exposed in the previous paragraph, Falcão (2003) and Brito (2005) report the agreement that an important number of students carries with it negative attitudes about mathematics, bringing implications in the teaching and learning process. The authors affirm that it is in this sense that the Psychology of Mathematics Education contributes to assisting the teacher through the theoretical foundation in pedagogical mediation, promoting the construction of positive attitudes about mathematics.

Endorsing the discussion, Meira (2016, p.37) stresses that psychology of mathematics education "Is configured as a possibility and potentiality for theoretical explanation about the psychological, cognitive and affective-social dimension in the teaching and learning process of school mathematics". According to tardif notes (2014), in teacher education the curricular, disciplinary, professional and experiential knowledge about the psychological theories of development and teaching and learning of Mathematics Education corroborate for the promotion of teaching and learning in mathematics classes based on this field of knowledge, until then superficially presented in professional training in Pedagogy.

In this same wake of thought it is worth mentioning the psychologically focused writings of Piaget (1990), when the researcher already announced to the scientific community a theoretical basis validated to the present day on psychological theories, in particular the theoretical perspective entitled psychogenetic theory, bringing significant contributions related to the process of accommodation performed under two operations, the assimilation and accommodation of knowledge built on the superior mental structures and a new more complex knowledge causing imbalance causing imbalance , which in his theory shows the important role played by psychological processes for learning the contents of teaching and learning of the mathematics curriculum of basic education. The postulate of epistemology of

psychogenetics corroborates on a theoretical basis to pedagogueteachers for appropriate pedagogical interventions.

According to Ibid (1990), psychogenetic theory establishes theoretical elements about the four stages of psychological development of students (sensório-motor, preoperative, concrete operations and formal operations). These contributions currently recognized in international literature are the theoretical basis of mathematics teachers in Developmental Psychology of how the student constructs mathematical thinking, enabling him to organize appropriate teaching strategies (Piaget, 1990).

Following the theoretical assumptions of Falcão (2008), recent studies have evidenced from theoretical studies in the field of Psychology of Mathematics Education the cognitive aspect has been an important correlation with the unsatisfactory performance of students, as well as the learning difficulties of students in the mathematical contents of the bncc reference matrix. In this same direction the theoretical contributions of Piaget (1990), on the aspects of cognitive development points out the cognitive dimension represents the set of mental abilities that are basic for the construction of mathematical thinking and knowledge. These cognitive aspects are all those related to the development of reasoning, thought, memory, abstraction, imagination, language, imagine figures (geometric thinking), perform operations mentally, define distances, measures, height, construction of scientific concepts among others.

To explain intellectual development, the aforementioned researcher stated that the adaptation process is the essence of intellectual functioning, as well as biological functioning. In his considerations, the process of organization in mental structures integrates physical and psychological structures, which are essential for the construction of the student's mathematical knowledge (Piaget, 1996).

On the contributions of psychogenetics to Mathematics Education, it is agreed with Meira (2016), where in pedagogy courses the main psychological theories are discussed superficially in the discipline of Psychology of Education with emphasis on the general processes of teaching and learning, with a workload between 60 and 72 h. In this sense, one-off discussions on the Psychology of Mathematics Education are ensured in alignment with the discipline menu. It is very well placed by the researcher that this discipline mentioned most of the time has been taught by professionals with training in Pedagogy with incipient knowledge about the Psychology of Mathematics Education, bringing with it many times negative attitudes about itself in relation to Mathematics.

In the positioning of Igliori & Meira (2013), anchored in piagetian and vigotskian psychological theory in association with Mathematics Education, they contribute to teacher

understanding about psychological development, the stage of mathematical thinking and the construction of scientific concepts in the higher mental structures and then evaluate the levels of cognitive development, considering the schemes and cognitive structures of the student, aiming at the gradual construction of mathematical knowledge.

In vygotsky's theoretical contributions, Leontiev & Luria (2017), describe that superior psychological processes have their origin, in social processes, in the relations between the individual and the outside world, which develop in a historical process. In this sense, the social representations about Mathematics Education are constructed even before the student's insertion in school, and many mathematical knowledge constructed by the students as explained by the implicit theories and explicit theories.

In the first, it values the mathematical knowledge acquired in the sociocultural experiences of the students; In the second, the school recognizes and values and reproduces the curricular mathematical knowledge of Greco-Roman epistemologies. A common aspect of the historical-social theory postulated by these researchers is the occurrence of interactionist pedagogical actions to promote the construction of mathematical scientific concepts in higher mental structures.

According to Moysés (2004) follows the theoretical perspective of the aforementioned theoretics, stressing that the psychological approach in Mathematics Education values the methodology of contextualization in teaching the mathematical contents of the policy of the official curriculum of the BNCC. It is very well placed by this same author, about the contribution to the Psychology of Mathematics Education about what the type of mental operation mobilized by the student in performing mathematical operations, especially in the early years, a stage considered fundamental for the mathematical literacy of the contents predicted by the curriculum, which will be fundamental for new mathematical knowledge in basic education.

In the theoretical aspect ibidem (2004, p.137) the psychology of mathematics education promotes improvement in teaching and learning because it allows "The development of the student's psychic functions, these are the psychological foundations for assimilation and accommodation of mathematical knowledge".

According to falcão's proposition (2003), the Psychology of Mathematical Education focuses on aspects of psychological development correlated with the process of construction of mathematical knowledge. This contribution is relevant in that it provides solid theoretical basis for explaining the difficulties of students to learn the teaching contents of school mathematics. As already mentioned in the stage of formal operations, the student is required

to have hypothetical-deductive mathematical thinking, that is, it requires the superior mental structures capacity to solve complex mathematical problems.

In the same wake of Meira's thinking, Spinillo & Falcão (1994), assert that one of the contributions of Psychology of Mathematics Education to the mathematics teachers of basic education that cognitive processes have implications for teaching and learning in school mathematics. Agreeing with these authors of this field of knowledge from educational psychology to mathematics, students' learning problems sometimes worsen to the detriment of inadequate pedagogical intervention, due to the absence of disciplinary, curricular and professional knowledge of this field of knowledge of Psychology and Mathematics Education and also vigotskian psychological theory.

In the theoretical aspect of Brito (2011), the researcher considers relevant the relationship between mathematical learning from sociocultural experiences with those of the school context. For her, with regard to the learning of mathematics, the knowledge of less complexity of mathematical logical thinking such as the mathematical operations of addition and subtraction in the 1st and 2nd of the initial years, new more complex knowledge is incorporated to promote new learning, but these mathematical knowledge of greater complexity is constructed from sociocultural experiences, because mental schemes are constituted in an increasingly complex hierarchy , requiring the student to have a higher level of mathematical knowledge and the formation of mathematical scientific concepts in the higher mental structures.

Dialoguing with Tardif (2014), the curricular, disciplinary, experiential and professional teaching knowledge of pedagogues who teach mathematics in the early years, the Psychology of Mathematics Education configures as a corpus of knowledge that allows a theoretical basis to analyze and consider psychological, affective-social and cognitive aspects as inseparable factors in the pedagogical relationship. It should be emphasized that in the school trajectory most often of the professional in Pedagogy was marked by negative attitudes towards mathematics, among them stands out traumas, aversion and fear. Thus, this area of knowledge of Psychology has theoretical frameworks that enable the process of negative dissociation built on mathematics.

According to Lopes, Faustino & Ciríaco (2019), about teacher training assert that the domain on the Psychology of Mathematics Education in psychological, cognitive and affective-social aspects corroborate for the teaching and meaningful learning of students, because learning Mathematics has a correlation between how the construction of

mathematical thinking occurs and then proposes appropriate teaching strategies with the mathematical knowledge of the student.

These authors, supported by Edmund Husserl's phenomenology, highlight among these three aspects the affective-social dimensions as triggers of feelings, traumas, emotions, and positive or negative attitudes towards learning the contents of mathematics teaching, since the individual experiences that students carry with them on mathematics classes have repercussions in teaching and learning.

The authors also emphasize the importance of the affective-social relationship between teacher-student in the educational process. Many students fail to establish social affection with the mathematics teacher, triggering blockage to learn and gradually building aversion to mathematics classes. Another example mentioned by the authors is the negative affective-social relationships of a family nature. In these examples mentioned and common in the experiences in the school trajectory of each student, Falcão (2003) points out the pedagogical intervention based on the Psychology of Mathematics Education.

3. Theoretical-Methodological Framework

The study fits within the qualitative method. In relation to the approach, it is located in qualitative research. On the procedures, the study had a design in the bibliographic research according to Trivinõs (2017). This type of research allows a wide range of information collected from numerous scientific productions in the area of knowledge researched. The field research was conducted in 2019 on a continuing education course for mathematics in the early years. As a technique of data collection, we used bibliographic survey and semi-structured interviews with 27 teachers with a degree in Pedagogy who practice teaching in basic education. The objective was to collect data using the methodology of discourse analysis of Moraes & Galiazzi (2016) on the discourses of these research subjects on the contributions of Psychology of Mathematics Education in their pedagogical practice.

4. Results and Discussions

The teachers surveyed when asked about the contributions of Psychology of Education to improve teaching and learning, the discourses revealed that:

"the discussions on the Psychology of Mathematics Education were punctual, since the teacher had a degree in Pedagogy and incipient theoretical training on this area of knowledge

of Psychology". In the discourse of the 100% of teachers, the Psychology of Mathematics Education contributed to pedagogical interventions to improve teaching and learning.

In teaching the teaching exercise in the 6th grade class, the theoretical contributions of Psychology of Mathematics Education carried out in continuing education courses contributed to the reorganization of didactic-pedagogical actions based on psychological, cognitive and affective-social processes.

"Teacher C- I noticed that in the 1st year class of the early years, a student came to the classroom with negative social representations about mathematics that was manifested in crying, sadness, aversion and fear, because in the family the parents said that learning mathematics was very difficult and in the family everyone failed in mathematics."

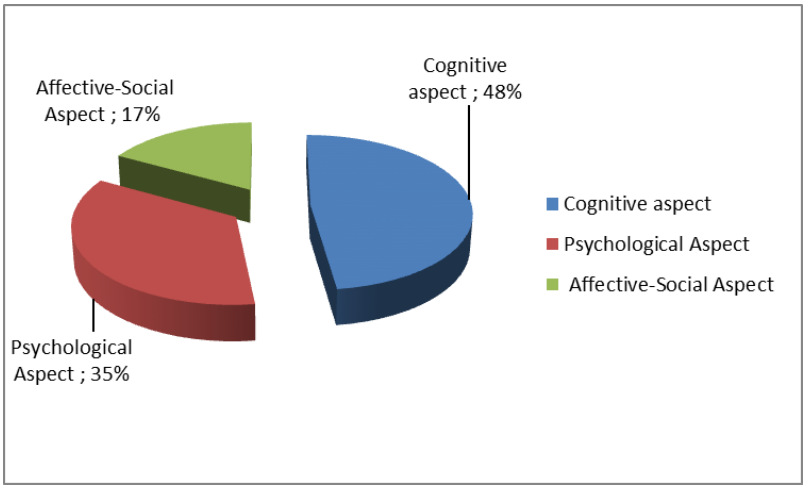
In the discourse of Professor E- the Psychology of Mathematics Education addressed in the menu of initial formation had theoretical deepening the contributions of psychological theories with scope in Psychogenetics, Historical-social and Developmental Psychology.

In the discourse of 100% of the interviewees revealed the following:

"In the initial training discussions on Psychology of Mathematics Education despite its relevant contributions it was silenced because the teacher with a degree in Pedagogy in one of the classes reported her negative experiences with mathematics in her school and academic trajectory and in classes she outsourced her traumas, aversion, blockages and negative attitudes about mathematics. It was found in the discourse of the 27 professors subject of the research the affirmative that in the continuing education in mathematics that had deepened on the contributions of psychology of mathematics education in the teaching-learning process.

It was verified in the discourses of the interviewed teachers when asked about the three objects of study of the Psychology of Mathematics Education the students, what their representativeness in the learning difficulties of the students. The collected data were presented in the following (Graph 1).

Graph 1 - Representation of the student's difficulty in mathematics in the three aspects of Psychology of Mathematics Education.

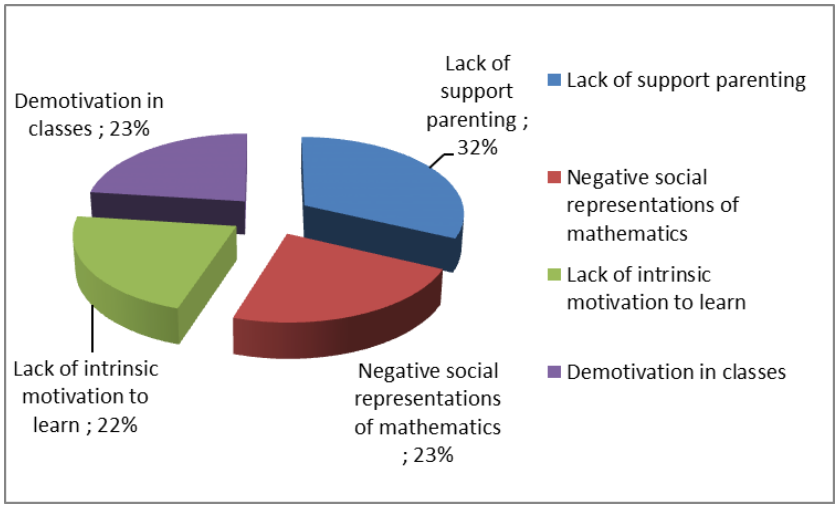


Source: Research Date (2019).

To comment on the collected data, we used piaget's theory of psychogenetics (1990), in his theoretical explanation learning in mathematics the cognitive aspect assumes an important role in the student's difficulty to learn the contents of teaching, because it involves the cognitive aspects of development, that is, the set of mental skills that are basic for the construction of mathematical knowledge in the higher mental structures.

The research subjects were asked to write in their opinion one of the reasons for the lack of mathematical skills of the students that was observed in the classes. The following discourses were categorized as shown in the following (Graph 2):

Graph 2 - Main factors associated with the unsatisfactory performance of students in mathematics in the initial years.



Source: Research Date (2019).

For theoretical explanation of the response of the interviewees Falcão (2003) and Meira (2016), they nod to the responsibility of a family or student's own order due to the difficulty to learn. They evidence the absence of factors related to the Psychology of Mathematics Education. According to Tardif (2014), the teachers who attest to the absence of theoretical knowledge about the field of knowledge of Psychology of Mathematics Education did not recognize the absence of disciplinary, curricular, professional and experiential knowledge as one of the reasons.

Each research subject was asked to describe an account of how the Psychology of Mathematics Education contributed to the improvement of their pedagogical practice.

Table 1 - Contributions of Psychology of Mathematics Education in the early years in the discourse of pedagogue teachers.

. I realized that many difficulties of students with learning in mathematics had association with my fears, traumas, aversion, failures and blockages;
. Today I have a theoretical basis that the aspect of social affection established with students corroborates their self-confidence and interest to learn;
. In parentmeetings, I could observe that many had the same traumas and negative social representations about mathematics.
. Many parents said that in front of their own son he was unable to learn mathematics because he was an imbecile. In the Psychology of Mathematics Education that has commitment to the psychological, cognitive and affective-social dimensions I was able to perform successful pedagogical interventions;
. I was able to learn the negative or positive emotional impact of my pedagogical mediation in the mathematics classes that influenced the students' learning;
. I had a lot of mathematical anxiety and with study in Psychology of Mathematics Education I could not teach the contents of mathematics mainly those of the 4th and 5th grade;
. I began to categorize in pedagogical practice students who had learning difficulties related to the fields of study of Psychology of Mathematics Education;
. Greater understanding of the multiple factors of the field of study of Psychology of Mathematics Education associated with the student's difficulty in learning the teaching contents.

Source: Research Date (2019).

For theoretical understanding of the discourse of the interviewed teachers, we used the theoretical contributions of Falcão (2008), Igliori (2004) and Brito (2011), we verified in the writings of these thealythed theorists support about the contributions of the field of study of Psychology of Mathematical Education. For Campos (2012), Ferreira (2019) and Cury (2014) the discourses explain that the difficulty of learning mathematics originates even before the student enters the process of institutionalized schooling. And, they explain that many traumas, negative attitudes and negative family and social representations are triggers of killer memories that cause trauma scans and blockages to learn mathematics, these have a negative emotional impact on the whole school trajectory of the subject, especially in the moments of evaluation that requires memory of the teaching content proposed in mathematics classes.

Teachers were asked if they had incipient theoretical deepening on the Psychology of Mathematics Education, how they mobilized to understand the students' unsatisfactory results? In the discourse of the 100% of the interviewees in the initial formation the discipline of Psychology of Education the discussions were punctual and, due to the majority already acting as contractors in the municipal school system. In pedagogical meetings, the discussion stage centred on the difficulty of students in mathematics and unsatisfactory results.

A specific training in Educational Psychology for mathematics was requested. In this course we had deepened with the object of study of the field of this field of knowledge of Psychology. In the studies of Meira (2016) similar data were found with teachers with a specific degree in mathematics. For Tardif (2014), among the knowledge disciplinary, curricular, professional and experiential teachers the absence of Psychology of Mathematics Education did not corpus professional knowledge.

In Brito's theoretical explanation (2005,2011), the theoretical basis of this field of knowledge mainly the psychological and affective-social aspects corroborates a lot for the teacher's understanding of the complexity of teaching and learning mathematics.

4.1 Analysis of results

The general theoretical discussion of the collected data was sought by the theoretical perspective of Igliori (2004,2013), Meira (2016), Spinillo (1994), Brito (2011) and Falcão (2003). In the explanations of these researchers, the Psychology of Mathematics Education has still been a recent field of knowledge, which shows its absence in the curricular matrices of these analyzed courses. The work of these researchers has as a point of convergence the problem of the crisis of Brazilian school mathematics with close correlation with the

psychological, cognitive and affective-social dimension and its reflexes in teaching and learning.

The theorists point out that the negative representations and attitudes about mathematics constructed by the subject have family and social origins. In the works of Igliori (2004) and Meira (2016) similar results of this study were found by pointing out the contributions of Psychology of Mathematics Education as a possibility to understand the learning difficulties of students who in Brazil reach about 71.67% have insufficient proficiency in learning the curricular contents of mathematics (BRASIL, 2017).

In Falcão's explanation (2008), the Psychology of Mathematics Education contributes to teaching and learning and provides theoretical support for how the student builds mathematical knowledge in higher mental structures to then develop teaching and learning strategies to promote meaningful teaching.

In the studies of Lopes, Faustino and Ciríaco (2019) and Pereira & Pereira (2020), it was evidenced that the negative or positive attitudes of teachers about mathematics have repercussions in the teaching and learning of students throughout the educational process of basic education, portrayed both in institutional and broad-spectrum evaluations.

5. Final Considerations

The study showed the relations between Psychology and Mathematics Education in the process of construction of mathematical knowledge, having as proposition to present the contributions Psychology of Mathematics Education in the formation of teachers and their implications in the teaching and learning process in basic education.

The research showed that one of the significant contributions of this field of knowledge consists of the theoretical evidence presented about the construction of the student's mathematical knowledge and its correlation with the psychological, cognitive and affective-social dimension.

In this research, we observe the emergence of the implementation of Psychology of Mathematics Education in the curriculum of the undergraduate courses of Mathematics and Pedagogy in Brazil in order to provide a theoretical basis for pedagogical intervention in the teaching of the school mathematical contents of basic education.

The social relevance of the study was to elucidate the contributions of the Psychology of Mathematics Education to improve the quality of teaching and learning of school mathematics that has received unsatisfactory results in institutional and large-scale evaluations.

The contribution provides the theoretical contributions to peers on the Psychology of Mathematics Education and also increases the number of studies on this topic in Brazil, and serves as a theoretical support for all researchers in Brazil in Mathematics Education, as well as the secretary of education and family members to consider the complexity of learning mathematics.

We conclude by suggesting that future studies can compare the pedagogical practice of teachers who had in the initial education in Pedagogy the discipline of Psychology of Mathematics Education with those who did not have

References

Brazil (2017). *Basic Education Evaluation System*. Brasília.

Brazil. (2019). *Basic Education Evaluation System*. Brasília.

Brazil. (2006). *National Curricular Guidelines for Graduation in Pedagogy*. Brasília.

Brazil. (2015). *National Curricular Guidelines for Teacher Education*. Brasília.

Brito, M. R. F. D.(2005). *Psychology and Mathematics Education: Theory and Research*. Florianópolis: Publisher: Insular.

Brito, M. R. F. D. (2011). *Psychology of mathematics education: a point of view*.*Magazin* Educationo. 1(1), 23-33.

Cavalcanti J. D. B. (2011). *Dialogues between psychology and mathematics education: possibilities of cooperation between CCS and CFP*. *Revise*. 2(2), 1-14.

Carmo, J. S. (2012). *Psychological foundations of education*. Curitiba: Editora: Intersular Saberes.

Curi, E.(2004).*Mathematical formation of pedagogical teachers*.(Doctoral Thesis) Pontifícia Universidade Católica de São Paulo.

Cury, A. J. (2014). *Anxiety: how to face this evil of the century the accelerated thought syndrome*. São Paulo: Publisher: Saraiva.

Falcão, J. T. D. R. (2003). *Psychology of mathematics education. Education in Journal*. Belo Horizonte. 1(1), 205-221.

Falcão, J. T. D. R. (2008). *Psicologia e educação matemática: uma introdução*. Belo Horizonte: Editor: Autêntica.

Ferreira, F. (2020). Learning difficulty due to negative emotional impact on the student teacher relationship. *Revista psicologado*. 1(1), 1-13.

Goulart, I. B. (2011). *Psychology of education: theoretical foundations and applications to pedagogical practice*. Petrópolis: Publisher: Vozes.

Igliori,S. B. C.(2004). *The mathematical education: brief history and implemented actions and questions about its discipline.* Anais do Anped. 27(1), 1-15.

Lopes, B. G., & Faustino, A. C., & Ciríaco, R. T. (2019). *Psychology of mathematics education*. XIII SESEMAT. Mato Grosso do Sul. 13(1), 1-3.

Meira, G. D., & Igliori,S. B. C. (2013). *Psychology and Mathematics Education: a Necessary and Continuous Dialogical Relationship.* VII CIBEM. Montevideo, 2013.

Meira, G.D. (2016). *Formation of mathematics teachers: a study of the contributions of the psychology of mathematics education* (PhD Thesis) PUC-SP.

Myers, D. G., & De Wall, N. C. (2019). *Psychology of teaching*. Rio de Janeiro: Publisher: LTC.

Moraes, R., &Galiazzi. A. M. (2016). *Discursive textual analysis*. (4a ed.) Ijuí: Publisher: Unijui.

Moysés, L.(2004). *Applications of vygotski to mathematical education* Campinas: Publisher: Papirus.

Piaget, J.(1990). *The genetic epistemology*. São Paulo: Editora: Martins Fontes.

Piaget, J.(1996). *The equilibrium of cognitive structures: a central problem of development*. Rio de Janeiro: Editora: Zahar.

Pisa (2018*). International Student Assessment Program*.

Pereira, C. L., & Pereira, M. R. S.(2020). Mathematics education in the early years: social representations of its protagonists in teaching and learning. *RSD Magazine* . 8(8), 1-27.

Spinillo, A. G., & Lautert, S. L. (2012). *Research in psychology and its implications for mathematical education*. Recife: Publisher: UFPE.

Spinillo, A. FalcãoJ. R. & Meira, L. (1994*). Studies in psychology of mathematics education*. Open Journal. Brasília. 14(1), 106-116.

Tardif, M. (2014). *Teachers' knowledge, professional knowledge*. (14a ed.) Rio de Janeiro: Publisher: voices.

Trivinõs, A. N. S. (2017). *Introduction to social science research: qualitative research in education.* (2a ed.), São Paulo: Publisher: Atlas.

Vygostky, L. S., Luria, R. A., Leontiev, A. N.(2017). *Teaching, learning and development*. São Paulo: Publisher: EDUSP.

Percentage of contribution of each author in the manuscript

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