


THE MATHEMATICS ENIGMA: DIFFERENTIATED METHODOLOGIES FOR MEANINGFUL LEARNING <https://doi.org/10.63330/aurumpub.046-015>**Wilson Carlos Rodrigues de Matos¹****Abstract**

The student is the principal protagonist within an educational formation, and it is up to us, educators, to observe these changes surrounding their learning, thereby generating new possibilities in their experiences in the practices of knowledge. To this end, teaching models are necessary that promote methodological strategies that make learning more attractive and personalized, with more audacious proposals in relation to the instructive method—blackboard and chalk. Thus, pedagogical projects, as well as other techniques, may prioritize knowledge in the use of technological resources, in the solutions to these problems directed toward cognitive development, adjusted to more efficient management in the educational base. Furthermore, projects linked to the media may be adjusted, within a real scenario, for a leap forward in favor of education in Brazil and in the social and global context.

In view of the foregoing, this article aims to demonstrate that the theme “Mathematical Enigma: differentiated methodologies for meaningful learning” explores the challenges of mathematics learning in the school environment, and its importance within educational management in addressing these difficulties in students’ overcoming of them, experienced within complex challenges, but which can be demystified through innovative pedagogical methodologies and strategic school management in connectivity with social networks, platforms, and software as teaching instruments, in order to facilitate the learning of Mathematics in basic education, thus encompassing secondary, technical, and undergraduate education, as classroom strategies that are more motivating than the current traditional transmissive teaching model.

Keywords: Platforms, Software, Teaching-Learning, Methodological Strategies, Mathematics.

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INTRODUCTION

Teaching in the Brazilian public school system appears to be insufficiently encouraging for students, especially for those who study areas of knowledge such as mathematics. There is little motivation and few studies that awaken in students the competence and ability to verify responses and to know how to solve equations, resolutions, operational calculations, and problems, without which meaningful learning does not occur.

The lack of students' own production in learning, as well as the excessive use of cell phones in the classroom and other media resources, are factors that do not contribute to meaningful learning when they are not directed toward quality studies. Thus, the low performance analyzed by government agencies in the field of education, and particularly in mathematics, can be observed.

The aim is to present, as an alternative, solutions intended to contribute to the study of mathematics through authors who invest in the development of students' educational learning.

According to the author Ubiratan D'Ambrósio, we have:

“[...] throughout the existence of each one of us, one may learn Mathematics, but one cannot lose knowledge of oneself and create barriers between individuals and others, between individuals and society, generate habits of distrust of others, disbelief in society, disrespect and ignorance toward humanity, which is one, toward nature, which is common to all, and toward the universe as a whole.” (Ubiratan D'Ambrósio, 1996, p. 13).

It is observed that D'Ambrósio establishes that learning, above all, must be connected with people's well-being, a principal attribute for initiating learning. In this way, the experience acquired in society and through student life is of utmost effectiveness for fruitful formation within mathematical logical thinking, in parallel with values learned in family experience within our social and cultural environment, received in the classroom by these young students.

In this context, the term “**Mathematical Enigma: differentiated methodologies for meaningful learning**” is used to justify the methodologies applied, in which the student is truly the protagonist of this learning and can understand and use efficient methodologies for solving

mathematical challenges in distinct disciplines, but which awaken and contemplate the student inside and outside the classroom for problem solving and decision-making in their personal, student, and civic formation.

In this way, Edgar Morin (2005) enlightens us on complex thinking within an equally complex reality, in order to direct us toward contextualization in relation to the interdisciplinarization of knowledge in favor of teaching and learning in a society. Thus, the author states:

[...] the necessary reform of thought is one that generates a thought of context and of the complex. Contextual thought always seeks the relationship of inseparability and the inter-retroactions between any phenomenon and its context, and between this and the planetary context. The complex requires thought that captures relations, interrelations, mutual implications, multidimensional phenomena, realities that are simultaneously supportive and conflicting (such as democracy itself, which is the system that feeds on antagonisms and, at the same time, regulates them), that respects diversity at the same time as unity, an organizing thought that conceives the reciprocal relationship among all parts. (p. 23)

From the foregoing, the author is analyzed as establishing interdisciplinarity among areas of knowledge, thus aiming at a partnership in this conjunction of knowledge, in the integration of the science of knowledge, in the improvement of cognitive and socioeducational development, and in social, educational, and civic construction. As an author, innovative methodologies are sought in relation to learning in different disciplines, focusing on the same central axis of the object under discussion with colleagues and teachers: the knowledge to be acquired, in favor of the quality of teaching.

In this context, it is verified that transformations have been manifesting themselves rapidly throughout the educational scenario, especially with science directed toward technology in its applicability to teaching, information, and communication in media, where they have repercussions in modifications within teaching and learning systems, with new contents, whose curricular materials have become increasingly necessary within normative systems and educational vehicles for our student citizens. Thus, educators need to work on the practical aspects of interculturality in classrooms, so that

connectivity occurs between the school context and intercultural values within curricular spheres, in relation to the learning of the cultures of these students who are connected and interlinked within the school space.

Therefore, the current instructive model is analyzed, observed through the presence of challenges such as students' apathy and lack of motivation, which portrays the need to redefine the role of the educator in the teaching and learning process. Teaching and learning must be understood as a proper and active act, making the student the protagonist of their own development, and not merely a passive receiver of information, shifting the central axis of school activities from the teacher to the student.

In this line of thought, this article justifies the search for school-management strategies and practices and their methodological and pedagogical didactics in the continuous qualification of teachers, aiming at the construction and permanent formation of projects for the improvement of educational learning, given the instructive scenario that is elevated.

JUSTIFICATION

Within the importance of the theme under observation—education—the enigma of Mathematics, in view of the performance indicators presented such as IDEB², SAERS³ and ENEM⁴, there is a need to reflect on educational learning within schools. Thus, the term under study may be used to represent the complex and current challenges in the context of mathematics teaching and learning. In this way, the reasons stand out because of the current instructive model, students' intrinsic motivation, authorship, and

² The Basic Education Development Index (Ideb) was created in 2007 and combines, into a single index, the results of two concepts that are equally important for the quality of education: school retention rates and average performance scores on assessments. The Ideb is calculated using data on school promotion rates, obtained from the School Census, and performance averages from the Basic Education Assessment System (Saeb). <https://www.gov.br/inep/pt-br/areas-de-atuacao/pesquisas-estatisticas-e-indicadores/ideb>

³ The project arose from the need to develop a network-specific tool to assess students' learning in Portuguese and mathematics in the final grades of each stage/cycle, in order to guide public policies aimed at improving the quality of basic education provided by the state. The Rio Grande do Sul State Department of Education administered the SAERS in 2005, 2007, 2008, 2009, 2010, 2016, 2018, 2022, and 2023. <https://educacao.rs.gov.br/saers-sistema-de-avaliacao-do-rendimento-escolar-do-rio-grande-do-sul>.

⁴ The National High School Exam (Enem) was established in 1998 with the aim of assessing students' academic performance upon completion of basic education. <https://www.gov.br/inep/pt-br/areas-de-atuacao/avaliacao-e-exames-educacionais/enem>

self-learning, in which teaching is centered on the teacher, with a focus on memorization and repetition, where the student presents severe difficulties in understanding mathematical resolutions and problems, expanding the feeling that Mathematics is an “inaccessible enigma” in the eyes of students.

Thus, a profound review of the methodologies applied in the classroom becomes necessary, and active methodologies and others that encourage innovative pedagogical practices may be used, such as problem solving, mathematical games, and inquiry-based teaching, making the student the subject of this educational process, in view of the challenging and engaging experience of the usual blackboard and chalk, with tools that awaken learning directed toward applicability of variables in strategies for teaching and learning with other pedagogical platforms within knowledge. Therefore, the educational learning process becomes necessary with the realization of everyone in this formation of values, in which the principal protagonist is the student in their learning, showing in their evolution significant data in their school and social formation, empowering them as the main subject of this process of transformation and growth in their student and civic formation.

Along these lines, we have principles and values that prioritize education within the public and democratic sphere, in the participation of all collaborators, also in the consolidation of the Federal Constitution of 1988, the Law of Guidelines and Bases of National Education (9.394/96), and the National Education Plan (10.127/2001), aiming at the democratic construction of the public school in its renewing, participatory, collaborative process for all, anchored by constitutional pillars.

In this line of thought about education, Paulo Freire preserves “Education as the practice of freedom,” in which the conception of democracy is deepened, and he advocates that:

Democracy, which, before being a political form, is a form of life, is characterized above all by a strong degree of transitivity of consciousness in human behavior. Transitivity that is neither born nor developed except under certain conditions in which human beings are brought into debate, into the examination of their problems and of common problems. In which human beings participate. (Freire, 2007, p. 88).

From the foregoing, we experience the lack of students' own authorship in teaching-learning, an instructive method centered on the teacher, as well as the excessive use of cell phones outside the classroom context and other media resources as active factors that contribute to the low level of learners' performance, outside the context of learning and learning. For this, a deep analysis and reflection within the theoretical frameworks of the Brazilian educational system is necessary, showing important pathways of transformation in the school environment, as well as in all educational activities in the teaching-learning process.

Furthermore, it is observed that there is a gap in the lack of stimulation of learners in their learning due to the applicability currently presented by educational managers, as indicators for reviewing educational management strategies in favor of the student, the subject of this process.

As the illustrated indicators point out, we have the low performance of students still experienced today within the quality of education in Brazil.

THEORETICAL FOUNDATION

We begin with the teachings of the author Ubiratan D'Ambrósio in his statements concerning the learning of mathematics:

[...] throughout the existence of each one of us, one may learn Mathematics, but one cannot lose knowledge of oneself and create barriers between individuals and others, between individuals and society, generate habits of distrust of others, disbelief in society, disrespect and ignorance toward humanity, which is one, toward nature, which is common to all, and toward the universe as a whole. (1996, p. 13).

It is observed that the author establishes that learning, above all, must be linked to the well-being of the citizen, but integrated with self-knowledge and the understanding of others, thus characterizing a process of studies that generates pathways and strengthens learning in a more objective and practical manner. In this way, learning cannot create obstacles among individuals or generate social disagreement, concepts, and attitudes, but rather must seek more effective methodologies, bringing the student into

their school space, since it is noted that the student is often physically present in the classroom, but distant and dispersed from the school environment, due to lack of interest or even because they do not know the content presented, having advanced to another grade without prior knowledge.

In this view, the teacher directs their action toward the search for learning and teaching, prioritizing quality teaching with efficiency and making teaching robust. Thus, the student must be encouraged to be critical and reflective in their decision-making, in order to consolidate an autonomous and proactive being. Thus, we have the authors:

Teaching and learning activities are not inseparable; however, in each one there is the mark of the subjects in their processes. In teaching activity, the importance of the teacher in the organization of teaching stands out and, in learning activity, the schoolchild is evidenced as the subject of their actions in the process of appropriating theoretical knowledge—the content of teaching and learning activity (Moraes; Moura, 2009, p. 102).

With regard to the cited authors, the relationship between teaching-learning is analyzed as interdependent processes, but marked by their own characteristics, centered on different matters. Therefore, the importance of methodological processes that value the proactive role of the learner within educational management is reinforced, with active methodologies and others, reconciled with the use of platforms within artificial intelligence for the intellectual enrichment of the student, promoting a more reflective and autonomous formation in proposed activities, together with the assistance of their teacher and friend.

In view of the facts, D'Ambrósio (2001, p. 15) tells us:

The Mathematics teacher is assigned a great challenge, that of “making mathematics interesting, that is, attractive; relevant, that is, useful; and current, that is, integrated into today’s world.”

However, for this to occur, teaching must make real sense to the student, awakening curiosity and the spirit of being inserted in the social and school context, making learning more engaging and pleasurable through dynamic methodologies, such as the use of games, challenges, and practical

activities that stimulate students' interest and active participation and that relate to their reality within the contemporary world.

The author D'Ambrósio strengthens this idea, emphasizing that the teaching of Mathematics needs to have meaning for the learner, demonstrating the applicability of the proposed content within lesson planning. This can be studied in practical contexts, with studies directed toward finances for personal and operational didactic use, calculations of average household or even business energy consumption, water consumption and projects, or in the interpretation of statistical data graphs to be worked on as a case-study sample through the school. In this regard, if no methodological change in pedagogical didactics persists, we will have Mathematics that is not attractive and not efficient for the student.

Therefore, alternatives are sought for solving obstacles within school education, modeling and improving methodologies within courses, including Specialization in Media in Education, digital technologies, and the use of artificial and emotional intelligence within mathematics learning, with the applicability of new technological tools available on the Facebook social-network platform, Educar-RS platforms of the federal and state government secretariats, encouraging the learner within these curricular structuring bases, together with managers, pedagogical supervision, and teachers in the formation of improvements in the quality of teaching, in the refinement directed toward teaching-learning strategies for the learner, with a view to the discipline of Mathematics.

In this scenario, Bonna (2011) states that digital technologies intensify the methodological process in learning in a meaningful way, in the exercise of its practice in Mathematics when affirmed and experienced within an innovative, robust pedagogical teaching didactics that stimulates the learner in their learning with autonomy in their own construction of this learning.

According to Freire (1979), "education is what transforms the world, makes the culture and history of a people. It is what moves any educator to struggle in the area of knowledge." In relation to the author, his thought is analyzed:

It is necessary that education be, **in its content, in its programs, and in its methods, adapted to the end being pursued: to allow human beings to become subjects, to build themselves as persons, to transform the world and establish relationships of reciprocity with other human beings, to make culture and history...** (1979, p. 21).

Given the author's thought, it is verified that technologies are still necessary in their use as an active process within the didactics of teaching-learning for learners, providing new connections between the school environment and teaching to be linked in a natural way, making more playful teaching activities necessary in the learning process, centered on the student in their cognitive study as a motivating and meaningful factor.

This article proposes to show that the term mathematical enigma identifies and suggests practices that lead the learner in their construction and production of knowledge, within a reality that proposes how to use the experiences of the author and of other authors so that there may be new learning in the teaching of Mathematics, always mentioned by students as a discipline with difficult and unmotivating content, thus illustrating a new thought: that mathematics is experienced in the entire context of our life, in actions and especially in the decisions we make every day through its natural use.

In this reasoning, according to Gomes (2006, p. 57), "The way in which the National Curricular Parameters were presented demonstrates that the teacher should have knowledge not only of their own area, but a much broader knowledge capable of mastering various situations."

On the other hand, Villas Boas (2008) reflects on how mathematics education should be practiced in modern times, adjusted to traditional practices, in which the teacher teaches with ready-made theories and brings students an entirely theoretical learning experience, through copying and the use of a whiteboard, which does not produce efficient and practical learning in mathematical learning with the world in which the student lives.

[...] attention is drawn to the need to relate Mathematics to the other sectors of society, above all recognizing the new developments in science and technology. The great challenge that we, mathematics educators, encounter is to make Mathematics interesting, that is, attractive; relevant, that is, useful; and current, that is, integrated into today's world. D'Ambrósio (2001, apud Villas Boas, 2008, p. 2).

The author D'Ambrósio (2001) emphasizes that Mathematics should be taught in such a way that the student is adjusted within their social and cultural context, directed within science, with pedagogical methodologies and worked together with technological tools in favor of the educator.

In this way, D'Ambrósio's view is observed, which Villas Boas (2008, p. 3) shows us as follows: "Currently, what matters is making teaching pleasurable, interesting, creative, and as close as possible to the student's reality."

According to Matos (2015), corroborating the authors above, it is analyzed that the teacher should reevaluate their teaching methodologies so that the student may be a subject and proactive in relation to learning mathematics, thus seeking classes differentiated from the current blackboard-and-chalk model with the purpose of making teaching "pleasurable, interesting, creative, and as close as possible to the student's reality." Thus, efficient and robust teaching-learning is sought, making the student an active subject of this methodological and pedagogical process in relation to the knowledge acquired through technological tools in the exercise of their learning and learning, within their knowledge and the environment in which they live.

STUDY OF APPLICABILITY IN DIFFERENTIATED METHODOLOGIES AS A FORM OF LEARNING

Current education faces increasing challenges, such as students' lack of interest, the need for differentiation and reformulation of teaching, and the development of competencies and skills imposed by the professional market and by society in the face of the existing scenario. The instructive teaching model, based on teacher centrality and the transmission of content, has shown its limitations, especially in the face of an increasingly competitive and digitized world.

In this scenario, differentiated methodologies emerge as alternatives capable of transforming teaching, making it more robust, interactive, and aligned with the realities and needs of students. This study seeks to understand the applicability of these methodologies in different educational contexts, exploring how they may contribute to more meaningful, didactic, and efficient learning.

Thus, a constant process of transformation is sought in relation to education, in order to observe changes in awareness surrounding learning, generating new challenges in methodological didactics in the form of learning—the student. To this end, Pedagogical Projects are promoted, prioritizing areas of knowledge and technologies in the solutions to problems experienced in the educational base. Moreover, projects linked to the media may be fundamental and educational, within a concrete scenario in favor of teaching in Brazil and in the social and civic context, in order to impose a new approach to teaching.

In view of the indicated propositions, flexible methodologies are suggested, applicable in studies directed toward methodological pedagogical didactics of teaching-learning, such as: mathematics games in continuous use, bringing students to the use of projects, active methodology resources, and the use of artificial intelligence for more robust connectivity in this proposal that awakens and drives the interactive mode of class studies, so that students interact, think, and reflect on existing tasks as a mechanism for absorbing more efficient teaching for young people in their intellectual cognition.

In this context, an initial pre-test is indicated within an application in the didactics of strategies in school learning, in view of an initial survey of information collected from the process to be studied, identifying the difficulties relevant to each student and their domains in the cognitive field of this learning, as well as other procedures to be constructed within the didactics of teaching and learning through ways of diversifying innovative methods in school environments and platforms.

Thus, classes with computers are introduced in a continuous and harmonious manner, with software such as GeoGebra, graph construction, calculation of the distance between two points, and

spatial geometry, together with the teacher, practicing and experiencing this teaching tool as a way of learning and teaching through the sharing of this information with classmates. Thus, the Winplot software allows graphs to be constructed using elementary functions, and others that may sharpen, awaken, and motivate teaching in an efficient, practical, and differentiated manner in relation to the current instructive model, prioritizing collaborative and participatory studies, in a relaxed atmosphere within playful learning strategies, directed toward understanding the proposed activities in class meetings. Along this path, it is assessed that the student learns in a manner determined differently from the traditional blackboard and chalk, sharpened and motivated through the teacher, the mediator of knowledge, in a playful, magical, and relaxed way for them—the student.

In this scenario, the teacher is understood as a link of guidance and approach for carrying out activities that are motivating and meaningful, giving active reinforcement as the student reaches progress in their decision-making as a student. Therefore, the teacher, in their professional formation, transfers tips to the student on how to direct and sharpen their studies, signaling procedures of simple reasoning, but which bring significant gains in the construction of values achieved. Thus, we have as examples: study tips as a way of guiding the student toward having a more structured methodology; studies with conceptual maps; playful activity with games, aiming at decision-making in the construction of a more critical, reflective, and autonomous being; the use of software in the interaction between the student and the computer with its languages; the use of the internet as a source and research for personal and collective studies on content already worked on in the classroom, making a comparison with videos that address the same subjects, conference videos, and/or any other activity related to learning, thus making such procedures much more accessible and attractive in this methodological learning strategy. Finally, there are numerous facilitators that serve as pedagogical didactics and study techniques, as neuroscience explains, as a way of enriching and going beyond the teaching proposal on the theme **“Mathematical Enigma: differentiated methodologies for meaningful learning.”**

According to the author Monereo (1999, p. 12), his study analyzes:

The quality of learning does not depend so much on a supposed intellectual quotient, nor on mastery of a good set of techniques and methods for studying exercises profitably, but rather on the possibility of grasping the demands of a given learning situation and controlling, with appropriate means, those situations.

In this analogy of reasoning, study techniques are modeled for the applicability of the use of procedures of a certain study practice, combinations for student and teacher, and intellectual development in their decision-making. Thus, they are always directed toward the general objective: the student as an autonomous, proactive, and participatory being also before the family and society as a whole.

METHODOLOGY

In order to make viable the methodologies of application for students, it is intended to establish, within the school's educational, secondary, and technical formation, a program for the implementation of free software and the platform of the government application Escola RS, Google Classroom, in which the students themselves will be involved in this construction. The free software downloaded through the Google Chrome platform or another to be built and researched by the students will be consolidated by their mediator, the teacher.

According to Paulo Freire (2013), pedagogical methodologies, within didactic-pedagogical practices, should be included in monthly meetings established in the school calendar, with the management team, pedagogical coordination, and teachers, where they discuss, plan, and exchange ideas in order to review the objectives that are worked on during the school year, namely:

“[...] in the permanent formation of teachers, the fundamental moment is that of critical reflection on practice. It is by thinking critically about today's or yesterday's practice that one can improve the next practice.” Freire (2013, p. 40)

As a didactic and methodological form, other examples that contemplate the student's reality are analyzed, namely: set theory, in which the ideas of set, family, characteristic, and theorem are related; civil construction with regard to Bhaskara's formula, the distance between two points, and applicability in areas of study; analytic and geometric geometry, the chord, giving the idea of length, the roots of these equations in buildings, calculation of soil deepening; in aviation, in the part of calculations referring to Physics, astrology; in biology, regarding cells and chromosomes; knowledge that already comes in its creation and gives a new vision through studied and differentiated classes compared to the traditional model.

Thus, we have guided, differentiated learning directed toward the student, evidencing an autonomous, independent, creative being who uses strategies to take advantage of the models taught, in view of study methodologies, in favor of the student body, the subject of this learning and teaching.

Finally, the methodologies seek to address the theme **“Mathematical Enigma: differentiated methodologies for meaningful learning”** in such a way that the learner may evidence compensatory data in their construction, student and civic formation, and educational development, where student and teacher have a significant leap, since these are applicable methodologies, which represent an opportunity to transform the educational scenario, making it more inclusive, competitive, dynamic, and robust for the student.

FINAL CONSIDERATIONS

Through this article—“The mathematics enigma: Differentiated methodologies for meaningful learning”—compensatory results experienced by the student and teaching bodies are sought, so that they may have a significant leap, since these are applicable methodologies, which represent an opportunity to transform the educational scenario, making it more inclusive, competitive, dynamic, and efficient.

By promoting protagonism—the subject of this educational and student process—interdisciplinarity, and the integration between teaching and technology, they meet the needs of the current society.

This study aims to contribute to the dissemination and application of these practices, outside and inside the school environment, adjustable with differentiated methodologies also in the use of the EducAR platform and educational platforms.

In this context, we have the use of other areas of knowledge adaptable to students' learning within interdisciplinarity, with the specific and unique objective of learning and relearning content in different areas of knowledge.

Along these lines, the learner's performance in the discipline will have a conclusive result by other educators in using educational tools as facilitators in learning, as subject and proactive in this cognitive line of knowledge—the student.

Thus, as a public-school teacher in education, the author teaches Mathematics for elementary, secondary, and technical education at a school in the city of Porto Alegre. Over the years of teaching, it has been possible to observe an expressive number, especially in the discipline of Mathematics, in which cognitive knowledge is predominantly low within the educational scenario illustrated by this educator, Doctor of Educational Science.

This observation involves a reflection that goes beyond the limits of the classroom. Often, teaching problems are already inserted in the student's family daily life, that is, the lack of discipline and the lack of school material as support in this student's learning, together with the absence of study habits, give rise, as a whole, to low performance both cognitive and in terms of self-esteem.

In view of these factors, it is observed that failure and students' low performance are reflected in an entire social, moral, and psychological conjuncture. The educator, with only their knowledge, and not using effective didactics but only blackboard and chalk, feels small before an entire structure that needs to

be motivated in favor of their student, in the art of teaching and learning, the transformation of this sad and chaotic scenario: teaching.

However, it is up to us teachers to seek variables in terms of differentiated methodologies for those who need them, motivation, and to use their own mechanisms of easy access to communication, using the available and necessary technology in the improvement and intellectual development of our young people, in relation to their learning.

Along these lines, the existing difficulty is by no means simple, but if we combine efforts and work as a team, we can make what is difficult pleasurable, using the media through website games, software in motivational classes, feedback from previous classes, linked with virtual objects, and other applications that will help in the logical and cognitive development of the student, the subject of this learning.

Finally, there is an urgent need for a review of the pedagogical processes in the teaching of mathematics, where it is fundamental that managers, teachers, and the school community be adaptable and engaged in this process of pedagogical innovation, ensuring more meaningful and transformative learning for students, thus enabling greater meaningful learning in this process of learning and teaching, in view of the theme under study: the enigma of mathematics: differentiated methodologies for meaningful learning.

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