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Active Methodologies in Mathematics Learning

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Abstract---Active methodologies are necessary in the educational process because they comprise a fundamental tool for the student to achieve an adequate level of success in their educational process. It is important to mention that the student plays a very important role, where students build their knowledge based on scenarios and activities designed by the teacher. Analyzing the impact of the implementation of Problem-Based Learning, the research is relevant because active methodologies include interactive teaching-learning processes that are based on active communication and the interconnection between teachers, students, and teaching material. Its advantages lie in the application of methods where the role in the classroom passes from the teacher to the student, who must adopt a greater degree of involvement than in more traditional or classic classes. The objective of the research is to know the impact they produce between the use of active methodology in learning mathematics in students at the basic general education level, and upper basic sublevel of the Eloy Alfaro de Chone Educational Unit, during the 2023 school year, where the inductive method was used for the investigation Development. Obtaining as a result that the application of active methodologies in curricular programs and the classroom generates cognitive, social, and motivational advantages for students, providing improvements to the educational system.

Keywords---Active methodologies, educational process, learning environments, learning, teaching-learning process.

Introduction

Active teaching methodologies are learning strategies focused on the student and achieving their training in a certain discipline through an active and constructive process. These methodologies act in contrast to traditional teaching, where students are limited to receiving, in a rather passive manner, a series of concepts and knowledge presented by teachers.

Its use is widely associated with mathematics where it contributes to achieving adequate learning, being essential for the development of cognitive skills, critical thinking and practical application in different disciplines. This learning provides a solid foundation for abstract reasoning and strengthens basic mathematical skills that are fundamental in daily life, education and professional careers, learning that can be strengthened through the applicability of active methodologies (Caleyo et al., 2002; Bezanilla et al., 2019).

In the Eloy Alfaro Educational Unit, poor use of active methodology is observed, this is a consequence of an inadequate application of methodological strategies, which generates the development of monotonous and unattractive classes for students, in addition, there is insufficient teacher training for the use of methodologies applicable to the teaching-learning process in the area of Mathematics, which affects student learning because the established parameters are not achieved.

In the current era of technological revolution, the understanding and development of complex problems demand people with outstanding cognitive qualities who have full command of the basic precepts of the exact sciences. According to Hossein (2022), to achieve this goal, active learning methodologies have been incorporated that incorporate ICT tools that enhance the student's comprehension and deduction capabilities to develop habits of self-learning and teamwork that allow them to function based on the deontological precepts of society (Friz et al., 2021).

In Ecuador, the low mastery and understanding of mathematics by students is an example of the existing deficiencies in teaching methods where dynamic methodologies accompanied by teacher participation are not yet incorporated to enhance the skills, knowledge and behaviors of the students (Intriago & Naranjo, 2023).

New technologies in the local environment lead to a harmful effect on the concentration and learning of the exact sciences, due to many factors that affect it, such as the precarious basic training of the student that prevents him from understanding complex processes of logical-mathematical, as well as the application of traditional methods by the teacher, as well as their poor training in the use of ICT tools that facilitate the understanding and teaching of mathematics in the classroom (Cano de la Cruz et al., 2019).

The academic deficiency in the exact sciences is a problem that goes beyond the teaching methodological reform, which lies in the educational system itself that is outdated and alien to current needs to enhance certain general cognitive skills (Macías & Arteaga, 2022), generating little motivation in learning the exact sciences or any subject, in which education is seen as an obligation but not as an opportunity for development.

The lack of resources and training marginalizes the use of technological tools as mere distraction instruments and not as support instruments (Molineros & Suástegui, 2022). Active methodologies are a means by which educational institutions respond to adapt to societies of constant change thanks to information technologies (Rocha, 2020). In the teaching and learning process within active methodologies, the student is the protagonist of the generation of his knowledge and the teacher is a guide to guide and clear up questions.

Teaching didactics must apply examples of the knowledge taught, to promote the student's curiosity and development of practical skills, improving their self-taught ability (Villalobos, 2022). Taking into account that within these methodologies, social coexistence and cooperation to carry out tasks and activities are encouraged, giving way to the ability to generate collective knowledge (Juárez et al., 2019).

Learning mathematics is a complex process that transcends the objective of developing the student's logical-mathematical thinking through axioms or postulates, where it seeks to instill a scientific conception in which it is customary to estimate, quantify, extract and process information to search causes and solve everyday problems (Encalada, 2021). Mathematics is more than mere techniques and tools, it is a science that consists of searching for and obtaining answers through logical-mathematical thinking, where using a correct teaching-learning methodology contributes to a high development of the personality and character of the student (Molineros & Suástegui, 2022).

Materials and Methods

The research had a quantitative and qualitative approach that sought to solve problems or produce knowledge in the scientific field (Delgado, 2021), integration was planned with a multiple disciplinary perspective to know the impact that occurs between the use of active methodology and learning of mathematics which will be done through a process of description, understanding and interpretation of ideas. The research is field-based through which data is collected from the Eloy Alfaro Educational Unit, which is the context where new knowledge is sought to be generated by applying the scientific method. Field research is useful to directly know the realities, interact with social actors, and know the perceptions and voices of their processes and dynamics (Sandoval, 2022), its nature is descriptive, this method involves observing and describing the behavior of a subject without influencing him in any way (Sandoval, 2022), served to describe the categories that make up the active methodology and mathematics learning, the methods used are inductive, deductive, analytical and synthetic that helped establish conclusions, The techniques used were the survey that was applied to the 132 students, an interview with a teacher and authority of the Educational Unit.

Analysis and Discussion of Results

In the Eloy Alfaro Educational Unit, no research has been carried out on this topic, and since its development it seeks to fulfil the mission of the school to stimulate students to think and act creatively, being the protagonist of their learning through meaningful activities. In addition to offering children an emotional, healthy climate that favors their physical, emotional, moral, intellectual, and creative development, it is known that there are difficulties in learning mathematics (Bravo-Velásquez & Reyes-Ávila, 2023).

Active methodologies

The active methodology is an interactive process based on teacher-student, student-student, student-teaching material and student-media communication, which enhances the responsible involvement of the latter and leads to the

satisfaction and enrichment of teachers and students (Juárez et al., 2019). In Figure 1, some active methodologies that help the teaching process in mathematics are shown.

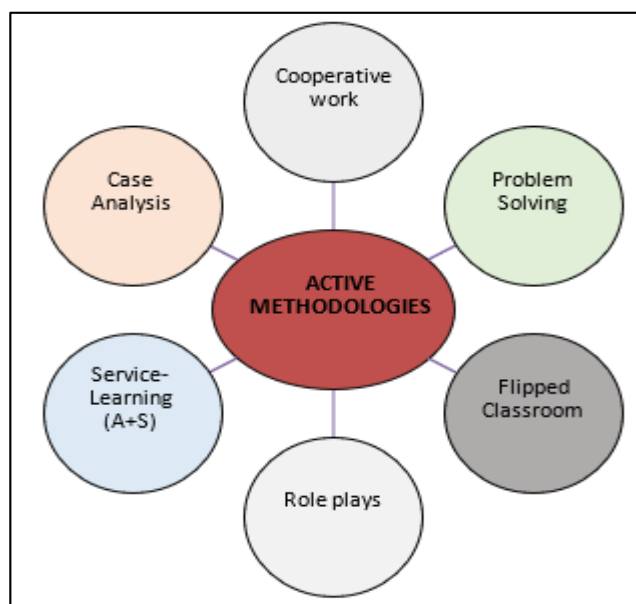


Figure 1. Methodologies that are implemented in the mathematics subject

Teaching based on active methodologies is focused on the student, in their training in competencies specific to the knowledge of the discipline (Arteaga et al., 2021). These strategies conceive of learning as a constructive and not a receptive process. Cognitive psychology has consistently shown that one of the most important structures of memory is its associative structure (Peralta & Guamán, 2020).

Active teaching methodologies are learning strategies focused on the student and achieving their training in a certain discipline through an active and constructive process (Chávez et al., 2019). These methodologies act in contrast to traditional teaching, where students are limited to receiving, quite passively, a series of concepts and knowledge presented by the teachers (Caudal, 2020).

Benefits of active methodologies

Construction of significant knowledge: Active methodologies encourage the construction of significant knowledge, where students actively participate in the construction of their understanding through reflection, critical analysis and the practical application of concepts (Lara & Schimiguel, 2020). This goes beyond simply memorizing information and promotes deeper, lasting understanding.

Development of relevant skills: Active methodologies gained opportunities to develop a wide range of skills and competencies needed in the 21st century, such as problem-solving skills, critical thinking, effective communication, teamwork and creativity. By actively engaging in collaborative activities, students acquire transferable skills that are practical and applicable in various situations (Dabbagh & Kitsantas, 2012; Davies et al., 2013).

Greater motivation and commitment: Active methodologies involve students actively and personally in their learning, which increases their motivation and commitment. By participating in hands-on activities, debates, discussions, and projects, students find a sense of purpose and relevance in what they are learning, resulting in greater interest and commitment to the educational process (Offir et al., 2008; Sang et al., 2010).

Collaborative learning: Active methodologies encourage collaborative learning, where students work together to solve problems, discuss ideas, and share knowledge. This allows them to learn from their peers, develop social skills, and strengthen their ability to work as a team—skills that are essential in academic and professional settings.

Practical application of knowledge: Active methodologies obtained opportunities for students to practically apply the concepts and theories learned in real or simulated situations. This allows them to link theoretical knowledge with practice, facilitating the transfer of skills.

Learning mathematics refers to the process of acquiring knowledge, skills and competencies related to this discipline, all of which involve understanding and using concepts, developing calculation skills, solving problems

and applying principles in various contexts (Lin et al., 2003; Ainsworth, 2006). Learning includes the process by which human beings can acquire knowledge, skills, attitudes or values, through study, experience or teaching, this process causes a persistent, measurable and specific change in the behavior of an individual (Flow, 2020).

The importance of learning is that it leads to long-lasting changes in a person's possible behavior. Technically, it is defined as a stable change in the subject's behavior as a result of the experience, which is a consequence of the establishment of associations between stimuli and responses through practice at an elementary level (Castro & Rivadeneira, 2022).

This learning leads to long-lasting changes in the possible behavior of a person that favors the development of logical thinking and encourages deductive reasoning (Selpúveda et al., 2019). When solving mathematical problems, students must analyze information, identify patterns, formulate hypotheses, and reach conclusions based on evidence. This promotes the development of critical thinking skills and the ability to approach problems in a structured and systematic manner (Escalante, 2020).

Improving problem-solving skills, mathematicians learn to decompose complex problems into simpler steps, identify appropriate strategies, apply concepts, and evaluate their solutions. These skills are essential not only in mathematics but in other fields of study and everyday life.

Application in other disciplines: Mathematics has a wide application in various areas of knowledge, such as physics, engineering, economics, computer science and social sciences. Mastery of mathematics provides a solid foundation for understanding and using concepts in these disciplines, expanding educational and career opportunities.

Development of abstract reasoning: Mathematics involves the manipulation of symbols, the understanding of abstract concepts, and the application of rules and properties. These processes develop abstract reasoning, which is the ability to understand and work with non-concrete ideas and concepts. Abstract reasoning is fundamental for mathematical thinking and also has implications for solving complex problems in different contexts.

Strengthening basic mathematical skills: Learning mathematics provides a solid foundation of basic mathematical skills, such as arithmetic, geometry, algebra, and statistics (Nolasco & Hernández, 2019). These skills are essential for performing daily tasks such as managing money, calculating measurements, interpreting graphs and data, and making informed decisions in various contexts. Learning mathematics is essential for the development of cognitive skills, critical thinking and practical application in different disciplines (Peralta & Guamán, 2020).

Conditions for learning mathematics

Learning requires basic conditions so that it can develop satisfactorily, one of these conditions is the appropriate school environment, in this environment the teacher exerts a decisive influence on the learning process, due to the psycho-pedagogical and effective treatment that these students of the level elementary obtained through the methodological means of preparation for learning (Selpúveda et al., 2019).

The preparatory process must be equipped with adequate procedures that guarantee effective learning and assist with the necessary techniques and means to facilitate the assimilation of knowledge (Asiú et al., 2021). Through the application of different methodological strategies and procedures that translate into a true direction of learning; whose basis must be focused on the experiences that students already have, which must be expanded within the understanding and perception of the real world, conceptualized with the help of school experiences and the practice of knowledge (Caicedo, 2019).

Results of the data obtained from the surveys applied to 132 students from the Eloy Alfaro de Chone Educational Unit are shown to identify the methodologies that teachers apply in learning mathematics. The objective was to determine how the applications of active methodologies behave in the mathematics learning of upper elementary students. Below, the data obtained based on the implementation of the surveys is detailed. Table 1 queried whether the class provided the appropriate amount of theory and practice.

Table 1
Contributions of the methodologies in class to the students

Options	Amount	Percentage (%)
Yes	127	96,21
No	5	3,79

96.21% of the students indicated that the teacher does provide the appropriate amount of theory and practice in the classrooms, however, 3.79% mention the opposite. However, it is important to mention that educational practice in the school is conceived as a type of critical educational research, which leads the participants of the instructional act, from a present didactic praxis to a new pedagogical practice in which they want or need to be (Romero & García, 2010; Moreno & García, 2010). It was also consulted related to the usefulness of the methodology for the growth of your career, observing the results in Table 2.

Table 2
Usefulness of methodologies in class for the growth of your career

Options	Amount	Percentage (%)
Yes	130	98,48
No	2	1,52

98.45% of those surveyed indicated that the teaching of the classes will be useful for the growth of their career, however, 1.52% consider that the content taught in the classrooms is not useful. For them, Ruiz & Del Valle (2014), mention that education can be understood as a socialization of students or as the main means by which the learning of knowledge or skills is carried out. At this point, it is necessary to point out that this way of understanding it has purposes and goals that must be achieved, but they are not the ultimate goal of education.

The incorporation of dynamic teaching-learning methods together with everyday examples of application have become the pedagogical mechanisms that generate the greatest interest in students when learning mathematics, motivating the personal and cognitive development of the student to understand phenomena. From logic to providing a concrete solution to a problem in their environment, keeping in mind the guidance of teacher tutors who enhance their skills by fueling their curiosity and correcting their errors, the deontological use of knowledge that benefits society is highlighted.

Table 3
Teaching strategies used during class hours

Options	Amount	Percentage (%)
Summaries	70	53,03
Previous organizers	36	27,27
Conceptual maps	22	16,67
Comparative tables	4	3,03

According to the surveys applied, it can be seen that 53.03% and 27.27% indicated that some of the most used teaching strategies during class hours are summaries and prior organizers, in the same way, 16.67% were able to indicate that concept maps are also one of the most used strategies, however, with 3.03% they indicated that one of the least used strategies is the use of comparative tables during class hours.

Table 4
Teaching strategies in the teaching-learning process

Options	Amount	Percentage (%)
Totally agree	97	73,48
OK	27	20,45
Undecided	7	5,30
Disagreement	1	0,76

73.48% of those surveyed totally agree that teaching strategies are useful to conduct the teaching-learning process, in the same way, 20.45% agree, however, 5.30% and 0.76% consider that teaching strategies are not useful to conduct the teaching-learning process. Results of the data obtained from the interviews applied to the teacher and the authority of the Eloy Alfaro de Chone Educational Unit are shown to identify the methodologies applied in learning mathematics. Figure 2 shows the techniques used for meaningful learning.

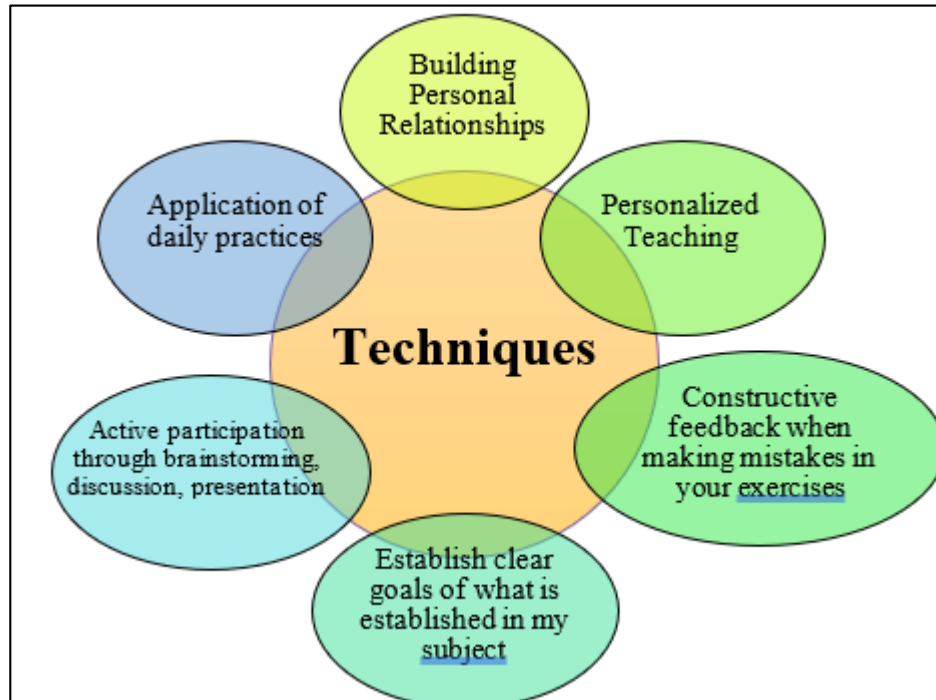


Figure 2. Techniques used for meaningful learning

To achieve good meaningful learning, different techniques can be applied such as personal relationships, personalized teaching, constructive criticism when making mistakes in their exercises, goal setting, use of brainstorming, debate and presentation, all of which can have a positive impact by implementing them daily. In general, adequate preparation of teachers is essential to offer quality education. This includes not only a solid knowledge of the subject they teach but also pedagogical skills to convey information clearly and effectively. Continuing education, professional development, and constant updating are key practices to stay informed about educational best practices and adapt to the changing needs of students (Nithyanandam, 2020).

In addition, warmth in treatment and empathy are fundamental aspects of creating a positive learning environment. As a teacher, you demonstrate interest in the well-being of students, establishing emotional connections, and fostering a supportive environment to significantly contribute to educational success. As an educator, one reflects on the effectiveness of methodological strategies through various methods, such as observing student performance, direct feedback from students, and reviewing the results of evaluations and tests. Also, adjust approaches based on students' individual needs and learning styles.

Continuous improvement is essential in teaching, and I often look for opportunities to update and adapt strategies in response to feedback and observed results. Collaborating with colleagues, participating in professional development programs, and monitoring educational trends are also common practices to refine pedagogical strategies. Didactic and methodological materials are important so that the teacher can better relate to students, so they can serve as methodological strategies that are crucial components to facilitate effective interaction between teachers and students. These elements play a fundamental role in the teaching and learning process (Mishra et al., 2020).

Conclusions

An analysis of the difficulties of the upper basic students of the Eloy Alfaro de Chone Educational Unit was presented during 2023 in learning mathematics, as well as the recent incorporation of active methodologies in the academic study programs demonstrating that the problem lies in the very structure of the educational system, where teachers in various areas of the exact sciences continue to apply traditional teaching methods that do not resonate with the majority of students and in turn generates apathy and disinterest in a science that is the pillar of the scientific conception and knowledge of the current era, where all new knowledge begins with estimating, understanding and deducing causes and problems.

The application of active methodologies in curricular programs and the classroom generates cognitive, social and motivational advantages for students, contributing to the improvement of the educational system, where the dynamism of the methodology and the teaching reinvention as a pedagogical guide enriching skills creative, analytical, reflective and critical that allow meaningful and practical learning, ensuring that the graduated professional can function in their environment and be self-taught to solve every day and complex problems

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