



# Implementation of ICT in Active Methodologies for the Teaching of Mathematics



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## Abstract

The objective of the research is to analyze the incidence of information and communication technologies as active methodologies for teaching mathematics, based on the search of information from various contributions that have manifested the importance of technology in times of pandemic. In the educational field, its implementation has generated a positive impact on students, but not on teachers resistant to change, considering themselves a learner and avoiding training on virtual platforms, which allow individual and group interaction. Documentary research was applied to search for information, through a qualitative approach to content analysis and assessment. It was obtained as a result, that the implementation of innovative technologies currently represents necessary tools for the development of the teaching and learning process.

## Keywords

ICT;  
math;  
learning;  
teaching process;  
active methodologies;

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## 1 Introduction

In recent years, Information and Communication Technology (ICT) has generated an impact in classrooms that can be applied in the Mathematics subject, using as a resource tools to develop classes in an interactive and dynamic way; However, their integration is not fully contemplated due to the drastic change that education and the teacher have undergone as a fundamental entity, most of them have resisted the new paradigm, without taking into account that they must adapt to reality current. Implementing methodologies related to variations and problem solving in the teaching-learning process of mathematics, it has been taken into account that it produces a change in the way it is explained. ICT provide different ways of representing problem situations, which allow students to increase problem-solving strategies and improve understanding of math topics. Society is more demanding with the profiles of the actors who participate in the field of education, mainly teachers, who must apply a greater capacity of the type of technological and innovative tools for the well-being of education, the inculcation of Students or future professionals in the use, increase and improvement of these, will allow ensuring the best methods in the various areas of knowledge (Gallego, López, Cuellar, Bustamante, & Corredor, 2016).

Applying these competences helps students to carry out meaningful training actions with the contents that interact with interest and attention, in order to search for problem solving and the discovery of mathematical definitions in a given time (Pichardo & Puente, 2012) . You must know what the specific resources are to achieve the skills you want to develop in students and which serve as support to achieve a better capture and implementation of these. The XXI century is characterized by rapid technological and scientific growth, in which society is within this process of change in relation to the economic, political, cultural, environment; and with the ways of teaching, learning, communicating and working (Revelo, 2018). The evolution of ICT is taking ground in the academic field, educational institutions have the task of proposing new methodologies, which involve continuous and permanent training processes in teachers, promoting skills and capacities for application in mathematics. The role of the teacher is fundamental in the teaching-learning processes, to achieve the knowledge required in the student body.

In Spain, an investigation was carried out on the importance of implementing ICT in early childhood education in mathematics, highlighting the use of methodologies that strengthen the technological competencies of teachers and students, highlighting that their use makes possible more practical and interactive (Rey, 2016; D'Amore & Fandiño, 2015; Ghasemi & Hashemi, 2011). At the Latin American level, in Colombia the use of technological resources for the teaching of mathematics was investigated, ICTs do not replace the teacher, they are a resource that motivate students to build knowledge through simulations and interactive tools (Grisales, 2018). In Ecuador, the use of ICT in education was investigated, teachers who incorporated these technologies applied in a methodology in their curricular plans, improved the academic performance of the student body (Arane & Segarra, 2017).

## 2 Materials and Methods

Documentary research was applied; Obtaining descriptive information from reliable and updated sources, a qualitative analysis was carried out, the objective of which is to guide through rigid follow-ups that can be standardized (Martínez, 2011), in addition to the deductive method, where the problem presented by students, teachers and all the educational community by adapting technological tools in the classroom (Montequin et al., 2014; Consoli, 2012; Schaper & Pervan, 2007).

## 3 Results and Discussions

With the new methodologies, the subject of mathematics has benefited, fundamentally the use of ICT, because different types of them can be applied and they help students to create skills in the handling of numerical information through different processes improving their learning in all students.

*ICT in Education*

ICTs are technologies that have been developed over the years in different areas, such as ecology, medicine, economics, and education. Currently, it is unacceptable to have classrooms where they are not implemented. Educational centers have had to face the challenges of virtually to face the new changes, exposing learning models, processes, didactic resources and innovative methodologies that facilitate the integration of what to do in education (Roblizo & Cózar, 2015).

Teachers have had to change their role, ceasing to be a source of information to a facilitator of knowledge, which generates the necessary skills in the use and management of these, for the training of students (Hernandez, 2017). Students and teachers should focus on professional development, so that the use of ICT is favorable. Currently, a lack of training in technological skills of students and teachers can be perceived, there is a need for continuous training and thus implement it in educational processes (Morales, Trujillo, & Raso, 2015).

One of the main situations that can ensure the innovation practices, methodologies and teaching techniques of ICT in educational centers, is to improve the quality of education, based on the training and improvement of the teacher, in a different way than it was in the traditional way, creating interests that lead to digital culture and produce changes in administrative procedures (Cabero, 2015). The incorporation of these technologies into education can be used from three positions: Give meaning and concrete application to teaching-learning, its condition of creation, training and improvement of the teacher in the use of curricular resources (Cabero, 2015). In figure 1, the three positions for the incorporation of technology in the educational field are distinguished.



Figure 1. Three visions of ICT application  
Source: (Cabero, 2015)

From this vision these resources become fundamental, which are taken as residents, communicators of information; in addition to being educational resources for students, which can be applied to the different needs of each individual. The knowledge that must be possessed for the use will focus on the technological and material. Teachers must provide learning strategies where practice is encouraged, producing pedagogical proposals with the aim of training students in these technological tools, seeking to strengthen the learning and academic performance of students (García & Tejedor, 2017).

*Mathematics*

Teaching process, The teaching of mathematics is complex for most of the students of the different educational levels, at present the classrooms of the educational units are made up of digital natives, who are immersed in the era, at birth and growing up with technology (Jiménez & Jiménez, 2017). For the acquisition of mathematical knowledge, motor experience can be accessed, which allows children to enter an innovative environment, based on emotional stimulation by strengthening collaborative work, as the elementary component that generates interest and importance of the students (Rodríguez, 2017).

Mathematics is an important subject in science and culture, it is applied in all areas of daily life. Psychology gave a transcendental guide in the mathematical process by seeking the development of students' knowledge,

this information has been strengthened with cognitivist psychology and neurosciences, which study how the human being learns in education (Bravo, 2016). In the desired learning process; Assessment resources are relevant to the analysis of student understanding. Several of the elements of the practice can be applied as constant evaluation tools. In figure 2 the applications to develop a constant evaluation are presented.

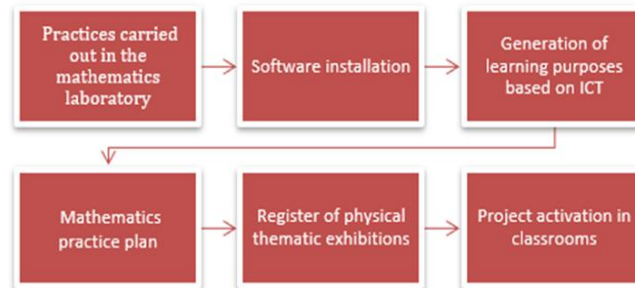


Figure 2. Elements of practice applied as constant evaluation tools

Source: (Flores, et al., 2015)

### *Change in education with ICTs*

The Information Society offers innovations in the field of education that lead to flexibility and accessibility, with lower costs and which people must be able to integrate into their daily lives. School institutions, responding to these challenges, analyze how to promote innovative strategies in teaching and learning, aided by ICT. With how contradictory the challenge that must be made in teaching is; in the variations of teaching strategies of teachers, in the communicational form and distributing learning resources, in dynamic environments (Domínguez, 2016).

### *Active methodologies for the mathematics teaching process*

They are characterized by their use in different educational environments, collaborative learning, prioritizing the teaching sequence in highly complicated subjects, such as mathematics. The purpose of this integration is to work together to obtain common good objectives, seeking satisfactory results for themselves and for the other members (Herrada & Baños, 2018). In most cases, teachers do not use the new methodologies, due to the lack of information or training necessary to positively influence the improvement of the educational unit and motivate students to build their knowledge through their abilities and skills. by this mechanism problem solving is stimulated (Puga & Jaramillo, 2017).

Teaching is learning in order for the student to build their own knowledge, they have their origin in the solution of current world situations or practice; causing the implementation of questionnaires of mathematical exercises, for the application of open educational resources, allowing teachers to use them for the development of the task in the classroom (Sartor & Favieri, 2016). The WebQuest is designed as a learning resource that is based on the activity used in tasks and evaluations, the same that affects an innovation in its specification or planning of the methodology within constructivism, which allows the understanding of mathematical issues on calculations of different study concepts included in the area of mathematics such as integrals, differential, among others (Masero, 2016).

Problem-Based Learning (PBL) focuses on solutions related to the interaction of students and the environment in which they live. The particularity of PBL consists in recognizing, reviewing, examining and solving various problems, which is achieved with the help of the teacher, who has a moderator role. (Castaño & Montante, 2015). It consists of three phases: prior discussion, independent study and subsequent discussion, where debate is essential for students to base their own thoughts under the teacher's supervision. (Cristancho & Cristancho, 2019).

Project Based Learning (or PBL, Project Based Learning) is a methodology where groups of students make a prototype in a given time on a real problem. It is characterized by giving the student freedom to determine their objectives, work plan and decision making (Flores-Fuetes & Juárez-Ruís, 2017). It consists of five stages: project planning and organization, research on the subject, definition of objectives and work plan,

implementation and presentation of results. It is advisable to apply the PBL throughout the semester and for the teacher to allocate class hours to monitor and evaluate the process (Cobo & Valdivia, 2017). This methodology has been investigated in some educational centers in the province of Manabí (López, et al., 2020). Team-based learning (ABE) focuses on creating opportunities where students use various materials and information to solve applied problems. Feedback is the cross-sectional component of this methodology, creating a space where students commit to attend the classroom and participate in the group debate (Martínez & Parra de la Rosa, 2017). The case method consists of providing students with situations that represent current problems, in order to observe and consider possible solutions. The teacher constantly interacts with the established groups promoting debate and reflection (González, 2015).

### *ICT in active methodologies*

The use of ICT leads to collaborative work providing tools that enable the interaction and contribution of a certain group, such as the use of virtual forums, which is a field where members can argue, interact, think, formulate Questions and give a criterion on various topics, provide a space for reflection that should be included in the mathematics course, so that each participant enhances their knowledge by understanding the criteria or position of the other (Canter, 2015; Harris et al., 2009; Mahayukti et al., 2017; Suweken et al., 2017). In virtual learning environments (VLE), its sections include the creation of educational forums, where the teacher raises a question relevant to the subject studied, getting students to comment, argue and debate with the knowledge they have acquired. In the didactic context, the WhatsApp tool operates in a communicative way, the same one that provokes collaborative work and the educational use of the mobile (Montes et al., 2018). In this it can be reflected that it is an instrument that in the pandemic stage is used by teachers to reach different places where communications are difficult.

Gamification is the incorporation of playful elements and strategies in non-playful environments to motivate and include users to achieve certain achievements, through the analysis of the game and all the possibilities it shows (Díaz Delgado, 2018). Play is one of the learning techniques, creating fundamental capacities with social integration. With this it adapts to different environments and is projected to other teaching scenarios, strengthening fundamental qualities. Innovations in this field have been incorporated into classrooms as tools that help online assessment in the teaching process (Loor et al., 2020).

GeoGebra is a free and easy-to-use program that allows you to show the graphic behavior of mathematical definitions, being the responsibility of the teacher to provide more interactive, attractive and entertaining classes, taking into account that currently it is teaching a student body that was born and is developing in the technological age; where the role of the teacher has to be innovative with the use of technological resources to obtain the teaching-learning process (Jiménez & Jiménez, 2017). New technological trends allow the use of the computer to improve the academic performance of students, GeoGebra is a tool that can configure algebraic and geometric calculations, allowing the student to think mathematically, some authors have raised in the educational context, the competencies in the mathematics that have been acquired motivated by the elevation of the level of demands towards students applying these methodologies that help to improve the assimilation of knowledge in the subject (Alcívar et al., 2020). Kahoot is an instrument that allows to assess in the student assimilating content at the moment, to provide feedback for learning, is entrepreneurial (recreational), individual and collaborative (Barragán & Elder, 2020).

Audiovisual mechanisms are used in 20%, in most cases, these media are important for students since they receive active technologies, the teacher must apply them in evaluations, to reinforce what the student learned or analyze other topics (Vidal et al., 2017). Genially is an attractive tool that teachers use to expose thematic concepts to students, due to its easy application. Its main objective is the creation of interactive content to improve presentation, teaching, advertising and expansion tasks (Catalán & Pérez, 2020). In Figure 3, you can see advantages with respect to the dissemination of application content.

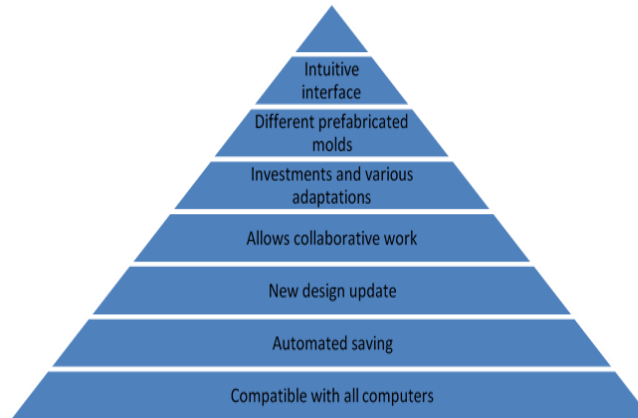


Figure 3. Advantages of the Genially tool  
Source: (Catalán & Pérez, 2020).

Innovation in the sequence of teaching and learning in the entire field of education is relevant, it aims to solve the difficulties of students with regard to technology because they are in the digital age, therefore, Teachers have the responsibility of implementing active resources in their daily planning to obtain the expected learning (Valencia & Guevara, 2020).

The active methodologies applied in the different disciplines and especially in mathematics, contribute to the acquisition of skills and abilities that the student develops together with the teacher, by applying resources and strategies through the use of the internet, such as gamification, whether theoretical or numerical, with the purpose that the student is interested in the subject by using games, questionnaires, among others. The development of ICT in society and in the educational field, has influenced a change in the methodology applied so far, highlights the relevance of the information provided by the teacher so that the technological and innovative have the acceptance of the necessary application and the introduction of ICT in the classroom is generalized (Sobol, 2001; Mavrotas, 2009; Raghubar et al., 2010; Chan & Elliott, 2004).

## 4 Conclusion

Active methodologies are significant at the time of teaching mathematics, through these the classes become more dynamic and make learning satisfactory for both the teacher and the student, by using appropriate strategies that facilitate the understanding of mathematical processes with inclusion of interactive games, gamifications, among others. One of the difficulties that active methodologies have is the resistance that exists on the part of the teacher when using innovative technologies in the teaching and learning process.

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