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Artículos científicos

El uso de las TIC en la enseñanza de conceptos geométricos en la educación básica

The Use of ICT in the Teaching of Geometric Concepts in Basic Education

O uso das TIC no ensino de conceitos geométricos na educação básica

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Resumen

El presente trabajo se enfocó en el desarrollo de competencias mediante el uso de las tecnologías de la información y la comunicación (TIC), y de manera particular en el uso de GeoGebra (*software* educativo) como estrategia de enseñanza-aprendizaje de las matemáticas en alumnos de educación secundaria. El diseño de la investigación fue de carácter cuasiexperimental; permitió inferir las relaciones causales entre variables, una independiente y dos dependientes. La muestra estuvo integrada por 60 estudiantes de dos grupos del grado séptimo del Institución Educativa José Miguel de Restrepo y Puerta, del municipio de Copacabana, Colombia, cuyas edades oscilaban entre los 12 y 15 años, y

quienes cursaron la asignatura de Matemáticas, curso donde se implementó, para el grupo experimental, el uso del paquete informático GeoGebra y otras herramientas informáticas. Entre los resultados destaca la valía de las TIC para la enseñanza de conceptos geométricos y el desarrollo del pensamiento espacial, así como para que los estudiantes adquieran competencias necesarias para la vida.

Palabras clave: conceptos geométricos, enseñanza de las matemáticas, estrategia didáctica, tecnologías de la información y comunicación.

Abstract

This work focused on the development of competencies using information and communication technologies (TIC), and in a particular way on the use of GeoGebra (educational software) as a teaching-learning strategy of mathematics in secondary education students. The research design was quasi-experimental in nature; it allowed inferring the causal relationships between variables, one independent and two dependents. The sample was made up of 60 students from two groups of the seventh grade of the José Miguel de Restrepo y Puerta Educational Institution, in the municipality of Copacabana, Colombia, whose ages ranged between 12 and 15 years, and who took the subject of Mathematics, a course where the GeoGebra software package and other IT tools were implemented for the experimental group. Among the results stands out the value of ICT for teaching geometric concepts and the development of spatial thinking, as well as for students to acquire skills necessary for life.

Keywords: geometric concepts, mathematics teaching, didactic strategy, information and communication technologies.

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Resumo

Este trabalho centrou-se no desenvolvimento de competências através da utilização de tecnologias de informação e comunicação (TIC) e, de forma particular, na utilização do GeoGebra (software educacional) como estratégia de ensino-aprendizagem de matemática no ensino secundário de alunos. O desenho da pesquisa era de natureza quase experimental; permitiu inferir as relações causais entre as variáveis, uma independente e duas dependentes. A amostra foi composta por 60 alunos de duas turmas da sétima série da Instituição de Ensino José Miguel de Restrepo y Puerta, do município de Copacabana, Colômbia, com idades variando entre 12 e 15 anos, e que cursaram a disciplina de Matemática , um curso onde foi implementado o uso do pacote de software GeoGebra e outras ferramentas de TI para o grupo experimental. Entre os resultados destaca-se o valor das TIC para o ensino de conceitos geométricos e o desenvolvimento do pensamento espacial, bem como para que os alunos adquiram competências necessárias à vida.

Palavras-chave: conceitos geométricos, ensino de matemática, estratégia didática, tecnologias de informação e comunicação.

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Introduction

This work focuses on the development of skills through the use of information and communication technologies (ICT), and in a particular way on the use of GeoGebra (educational software) as a teaching-learning strategy of mathematics in secondary school students. The use of this digital tool by the teacher aims to project dynamics to improve student performance and promote significant learning in the short, medium and long term. It is a type of tool that alone is a source of motivation for students belonging to the basic level of studies.

The research question was formulated in the following terms: what impact does the use of ICT have on educational processes in the field of geometry? And from this question the following secondary questions arose: how is the traditional teaching of geometric figures and their transformations contrasted with a training supported in the use of ICT? What computer tool should be applied as a didactic strategy to help the student to make geometric modeling? What is the importance of ICT in the meaningful learning of students in the first grades of basic education and in the improvement of geometric comprehension processes?

From the design of these research questions, the following hypothesis was raised: the teaching of geometric figures and their transformations in the Cartesian plane have been unsuccessful due to the lack of pedagogical strategies supported by digital tools by the teacher that lead to modeling of each of the teaching-learning processes, as well as the acquisition of competencies that contribute to meaningful learning by students in the classroom.

Background and rationale

Quintero and Costas (1994) they affirm:

> The way to teach a subject depends, to a large extent, on the vision we have of it. Geometry is generally associated with deductive, exact, precise thinking. Given this way of looking at geometry, its teaching is mainly devoted to presenting the results in a deductive and rigorous way. (p. XI).

For Cabero and Duarte (1999), ICTs allow better interaction between teachers and students. Likewise, they facilitate the acquisition of new knowledge and enrich the teaching-learning process with images, videos, audios and other multimedia elements. (pp. 23-45).

Theoretical-contextual referents

From what has been said so far, it can be deduced that the theoretical bases of this research are the teaching-learning processes of mathematics, the use of ICT as strategies to generate meaningful learning, as well as the formation of mathematical competencies in students. basic education students.

Geometric concepts

Geometry is constituted as a very broad discipline within mathematics. It is a branch that gives great importance to the study of flat geometric figures, which are usually ordered according to the shape of their lines, whether curved or straight. Thus, for example, conic figures are those that are delimited by a closed curved line product of the intersection between a cone and a plane, such as the circle and the ellipse. It also makes a difference between fundamental actions such as showing and doing, observing and acting, symbolizing and contextualizing and includes the study of factors such as the plane, the point, the line, the

straight, the curve, the ravine, the surface, the segment and others from whose combination all geometric figures are born, without forgetting that these include sides, faces, similarities, congruences, transformations, elements necessary for a real world, full of two-dimensional and three-dimensional shapes. That is why geometry must be conceived as the learning of the organization and understanding of space through modeling and constructive experiences.

Regarding spatial thinking, Giraldo and Ruiz (2014) mention the following:

> The spatial thinking defined in the curricular guidelines as the set of cognitive processes through which the mental representations of space objects are constructed and manipulated, the relationships between them, their transformations and their various translations or material representations, constitutes a component indispensable of mathematical thinking, refers to the perception, intuitive or rational, of one's environment and the objects in it (p. 18).

Regarding geometric transformations, Crouch and Haines (2004) mention:

> In everyday life, movements and transformations are constantly made in certain spaces such as movements on bicycles, rotations when turning the body, observing oneself in a mirror. All of the above are clear examples of the practicality of geometry in the real world of subjects. Geometric transformations are an application of the plane in the plane such that each point of a plane is made to correspond to another point of the same plane (pp. 197-206).

Teaching mathematics

> [Mathematics is] a central discipline not only in our science and our educational system, but also in our entire cultural universe. They have multiple implications for multiple aspects of modern society: scientific theories, technological developments, economic and socio-political analysis, etc. (Díaz y Martins, 1982, pp. 368-373).

Mathematics summons the significance of something from any angle, and this is linked to the formation of everything that is found in the universe, since these are not associated only with quantity, but, through time, it has been achieved give a conception from

different systems and thoughts. They are useful for understanding measurements, interpreting situations, modeling concepts, identifying processes and even interpreting information.

Another aspect to highlight is the relationship between the teaching-learning process of mathematics and ICT. According to Bartolomé (1999, cited in Sarmiento, 2004), "the use of computer programs supposes the acquisition of a certain learning, but it should be noted that it is the use that the teacher makes of them that determines their instructive potential" (p. 88).

A teacher can have an optimal handling of the generative topics of the area, but if he does not have a methodology that allows him to reach the students in vain he does his work. To teach, it is necessary to be clear about what students require, their interests in knowledge, conditions to study, level of attention, cultural and social environment in which they operate, skills they may have in the use of ICT tools and access to these.

Andee Rubin (cited in López, 2007) raises five categories of tools to create learning environments enriched by technology: “dynamic connections; advanced tools; communities rich in mathematical resources; design and construction tools; and tools to explore complexity" (p. 45).

Didactic strategy

Every individual requires, from their conception, a training process that allows them to comply with the established norms of the world that surrounds them and comply with the demands of social life that they must assume throughout their existence. And although the first stage of training corresponds to contact with their parents and close people, the school is a fundamental element in the formation of skills. "At school, the person is provided with an education, but also a training, a certain conception before the homeland, before the elderly, before work and before life" (Piña, and Pontón, 2002, p. 65).

Through time, teachers have provided a knowledge of mathematics in many cases copied from models that others gave them and that involve only the notebook and the blackboard, where metacognitive processes are little or no involved.

> In learning mathematics, children must "think, form and rework schemes or mathematical knowledge structures", as indicated by Hernández and Soriano (1999, p. 27), and for this they must use cognitive processes such as observing,

> comparing , order, classify, represent, retain, retrieve, interpret, infer, evaluate and transfer (Sarmiento, 2004, p. 88).

The above suggests that it is necessary for mathematics to be taught as a comprehensive area. "The more abstract a subject is, the simpler it is to achieve integration" (Martinello and Cook, 2000, p. 91, cited in Sarmiento, 2004, p. 106). This integration is the perfect combination to enhance mathematical skills, and for life through multiple intelligences and critical thinking.

Teaching and learning

Teaching and learning are two processes that, although conceived as one, are different. By tradition, teaching is recognized as a teacher's own action; and learning, of the student. Teaching is the methodology that the teacher uses in his classes to deliver knowledge to his students. For many years, the teaching process has always been linked to the way in which the teacher addresses class topics, which, in general, is due to less didactic and more rote processes.

> "Teaching is to provoke dynamics and situations in which the process of learning can occur in students." So one of the essential characteristics of teaching is intentionality. The challenge (…) will be to ensure that those [students] are able to make sense of their knowledge so that it can be used for their own purposes, and not only for school purposes. (González, 2008, p. 29).

Learning strategies, then, are an accumulation of activities, techniques and means that are planned and whose goal is to satisfy the needs of the students, the objectives that are sought and the nature of the knowledge. When defining learning strategies, the teacher must be clear about the goal of the class, how he wants to teach, how he conceives of learning, since they have a great influence on the degree of motivation of students when learning.

> The formal object of didactics is "teaching-student activity with the appropriate methods." Another way of calling the communicative, bidirectional process that takes place in each didactic act. Or, put another way: the teaching-learning process that occurs when a teacher and a student (or more than one) are in relationship in which the former selects and uses various procedures, methods or strategies to help achieve learning of the second (Crisanto, 2019, p. 5).

Information and communication technologies

There are multiple definitions of ICT. One of them, Cabero's (1998), points out:

> In general terms, we could say that information and communication technologies are those that revolve around three basic media: computing, microelectronics and telecommunications; but they rotate not only in isolation, but what is more significant, in an interactive and interconnected way, which allows us to achieve new communicative realities (p. 197-206).

For Bartolomé (cited in Belloch, nd), ICT "finds its role as a specialization within the field of didactics and other applied sciences of education, (…) especially [in the] design, development and application of resources in educational processes "(p. 1).

According to the Organization for Economic Cooperation and Development [OECD] (2002, cited in Baelo and Cantón, 2009), ICTs are "those means and services that allow the collection, storage and transmission of information with electronic means" (p. 10) . And Aliaga and Bartolomé (2006) add:

> [The] ICTs have had different historical milestones in their development and social implantation, highlighting among the last (although by no means the only ones, as we will see) those that occurred during the so-called "digital revolution", especially those that refer to the dissemination of personal computers and, more recently, the internet. In any case, it must be borne in mind that technology must be conceived rather as a continuum that goes from books or blackboards, through radio or video, to computer elements or the most advanced internet applications (pp. 55-88).

Aviram (2002, citado en Marqués, 2012) identifies three possible reactions of schools to adapt to ICT and the new cultural context:

- Technocratic scenario: schools adapt by simply making small adjustments: firstly, the introduction of "digital literacy" of students in the curriculum so that they use ICT as an instrument to improve productivity in the information process and then progressively the use of ICT as a source of information and provider of teaching materials (learning from ICT).
- Reformist scenario: the three levels of integration of ICT pointed out by Patiño (2014) are given: the previous two (learning about ICT and

learning from ICT) and new constructivist teaching / learning methods are also introduced into teaching practices that contemplate the use of ICT as a cognitive instrument (learning with ICT) and for carrying out interdisciplinary and collaborative activities

- Holistic scenario: the centers carry out a deep restructuring of all their elements. The school and the educational system not only have to teach technologies, (...) but these, apart from producing changes in the school, generate a change in the environment " (Marqués, 2012, p. 3).

The school is one of the main educational agents, it is also involved in all this tidal wave that characterizes the information society.

Following all the aforementioned, ICTs are very supportive as tools within teaching and learning. The current life of human beings has presented great transformations that obey ICT, which provide the possibility of being interconnected, regardless of the location in which they are, which brings people closer to each other and with their work, study, home, among others.

Now, generally, mathematics is taught separately, according to the thoughts and systems and not as a coherent whole, with unremarkable and traditional strategies by the teacher, leaving aside the interests and needs of the student. This condition makes it unavoidable to encourage creative actions that seduce students in learning mathematics. Technological tools and computer programs promote critical thinking, the acquisition of life skills, the enhancement of multiple intelligences and meaningful learning.

Along these lines, one of the most common softwares in the area of mathematics is GeoGebra, a didactic program that contributes to the teaching and learning of mathematics at all levels of basic and secondary education, combining geometry, mathematics, and mathematics in its activities. algebra, analysis and statistics. GeoGebra contains numerous geometric constructions that facilitate the learning of geometry.

Methodology

The present research is cross-sectional and uses a quantitative methodology, with a quasi-experimental study design. Likewise, it is longitudinal, prospective with three measures: pretest, test and posttest, and compares two groups: one control and the other experimental.

This design is based on the assumption that the variation from one measure to another is due to the influence of the experimental variable, which will be directly evidenced in the analyzes of the control group and the experimental group. (Sierra, 2003).

Sample

This research project is a commitment to achieve a comprehensive training where mathematical skills for life are combined. It is important to emphasize that the research was possible not only due to the collaboration of the different teaching colleagues, but also of the school directives, who kindly opened the doors and facilitated the times to implement the investigative instrument. The following tables describe the student population in terms of gender (male and female) of the control and experimental groups.

Tabla 1. Población y género de los alumnos del grupo control

Población	Total	%
Alumnos	30	100
Hombres	16	53.3
Mujeres	14	46.6

Fuente: Elaboración propia

Tabla 2. Población y género de los alumnos del grupo experimental

Población	Total	%
Alumnos	30	100
Hombres	18	60
Mujeres	12	40

Fuente: Elaboración propia

Instrument description

This research focused on surveying a sample of 60 seventh grade high school students, whose ages ranged from 12 to 15 years, and who presented various levels of mathematical competencies. The assertions were made based on the pedagogical aspects of the teachers, as well as on the use of ICT to improve each of their teaching-learning processes

within their academic activity at the José Miguel de Restrepo y Puerta Educational Institution, from the municipality of Copacabana, Colombia. Initially, the survey asks the participants for some basic information, but important when it comes to understanding what is being asked later.

A survey or pretest was carried out on the entire sample (experimental and control group); There, they investigated the conception of geometry, the tools used in the construction and transformation of figures and the use of ICT in each of the teaching-learning processes by the teacher. Subsequently, a second survey was carried out, a post-test, to the students of the experimental group in order to evaluate the educational experience, how they considered the teacher's teaching methodology, what mediators they used in the practices and what opinion they have regarding the use of ICT.

Techniques for data collection

The techniques and instruments are the elements that allow to collect the adequate and necessary information to carry out any type of investigation. These mainly include surveys, questionnaires and official documents, as well as texts by authors who have developed a theme about the central issue. Specifically, the review focuses on determining how much the selected teachers use and master ICT within the teaching-learning processes in rural areas of the Tequendama region (Colombia).

Results

It could be said that the applied methods were successful, since they account for what the students think before and after the experience, they also generate in the teacher a need to qualify themselves in the face of ICT, to methodologically empathize with the students, because as Perceived in the graphs, the students urgently require learning that attracts them and links them to the real world, especially when the educational institution has the resources to optimize the work.

The implementation of the GeoGebra computer program allows students to perform geometric modeling accurately and have greater skill in the use of computer tools; thus, they manage to break with the traditional scheme of a flat geometry, when the world that surrounds the school has several dimensions. For all these reasons, the students applaud that

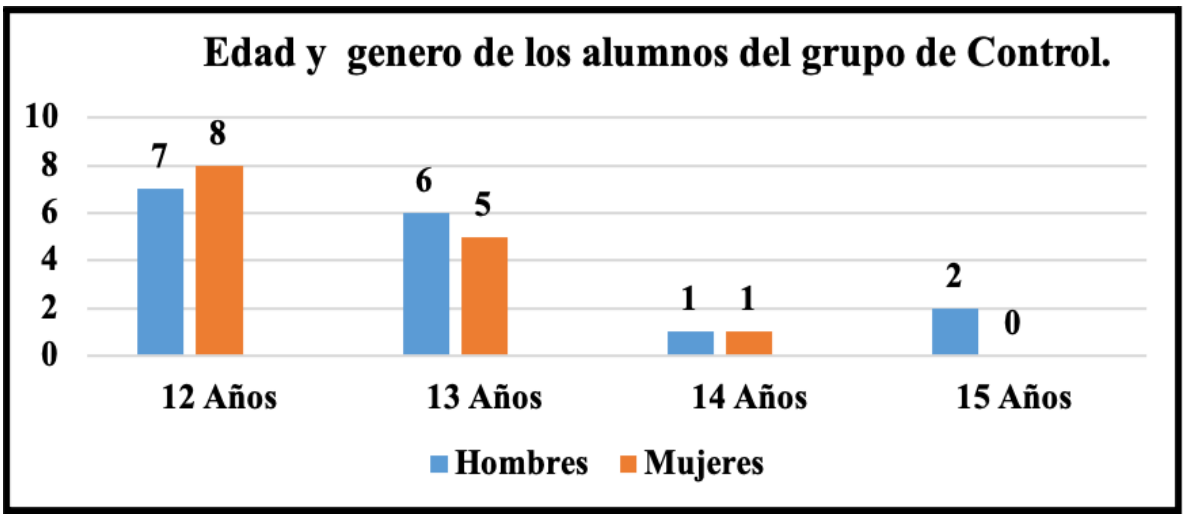
the classroom is an experimental laboratory that improves the understanding of reality and helps to establish solutions to situations of the geometric system.

Tabla 3. Rango de edades y género de los alumnos del grupo control

Edades	12	%	13	%	14	%	15	%
Mujeres	8	57.1	5	35.7	1	7.1	0	0
Hombres	7	43.7	6	37.5	1	6.25	2	12.5
Total	15	100	11	100	2	100	2	100

Fuente: Elaboración propia

Figura 1. Rango de edades y género de los alumnos del grupo control



Fuente: Elaboración propia

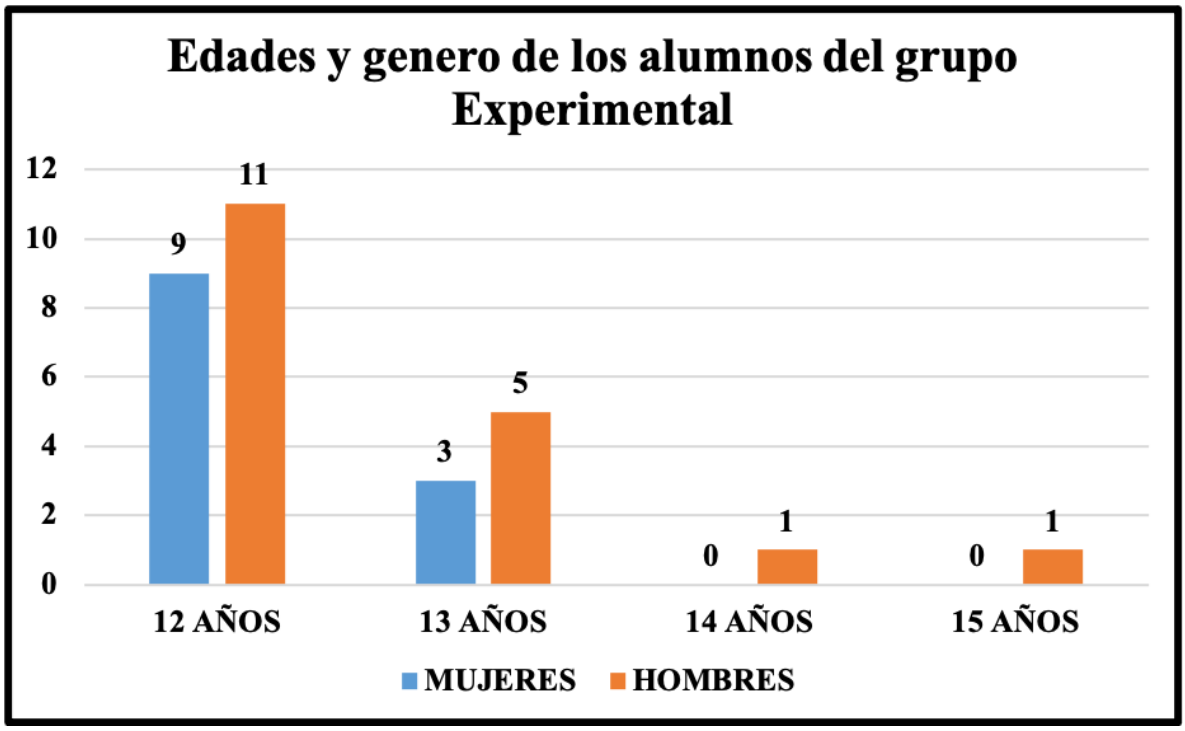
Figure 1 allows us to understand that the majority of students are of regular age for the current school grade, and also that women are younger, since there are students who have had repetitions, disabilities or entered the school late. school education and obey more to the masculine gender.

Tabla 4. Rango de edades y género de los alumnos del grupo experimental

Edades	12	%	13	%	14	%	15	%
Mujeres	9	75	3	25	0	0	0	0
Hombres	11	61.1	5	27.7	1	5.5	1	5.5
Total	20	100	8	100	1	5.5	1	100

Fuente: Elaboración propia

Figura 2. Rango de edades y género de los alumnos del grupo experimental



Fuente: Elaboración propia

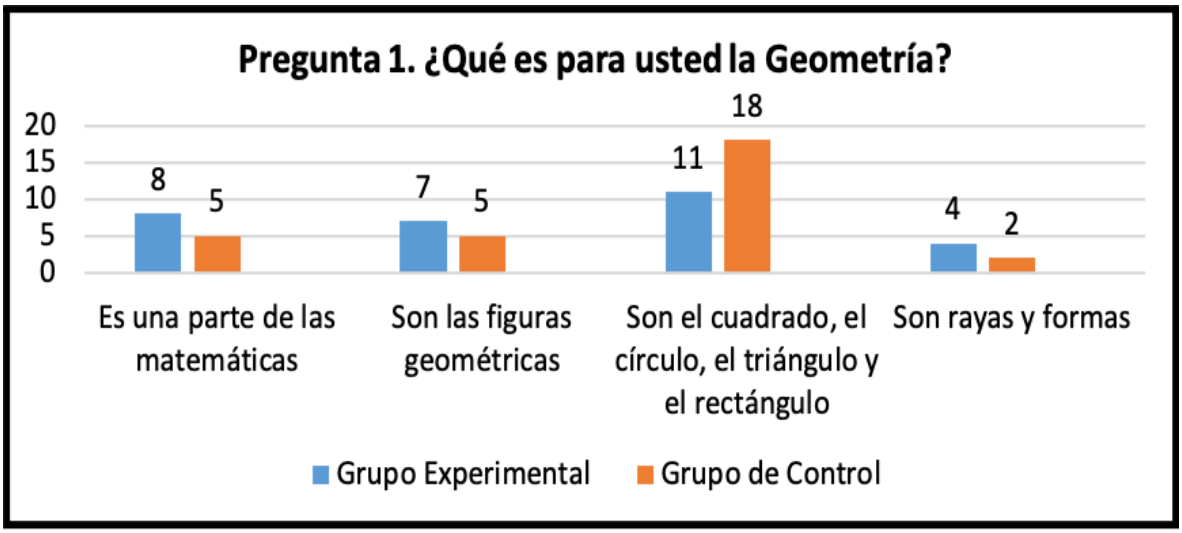
In the previous figure it can be seen that in the experimental group there are more men than women. The latter, in turn, have younger ages and more in line with the current grade, since students who are between 14 and 15 years old are male and this is because they have failed or have a disability.

Pre-intervention questions for both groups

- What is geometry for you?
- Do you identify geometric figures?
- Do you recognize the characteristics of geometric figures?
- Have you made Cartesian planes?
- What tools have you used to build geometric figures?

After applying the questions to both groups, experimental and control, it was found that the students are not very clear about the concept, they only relate the geometry with the figures, which they identify in their simplest and most general way, such as the figures of three and four sides, the others little or nothing recognize. In relation to the Cartesian plane, they identify it and enjoy making it, but they make it clear that it is difficult for them to have the same distance between each of the numbers in relation to the axes, but that they recognize the parts of the plane and enjoy making figures in it. using the ruler, although not much the protractor and compass, since, they argue, it is difficult for them to measure the angles or use the compass to make the circumferences.

Figura 3. Análisis de la pregunta uno

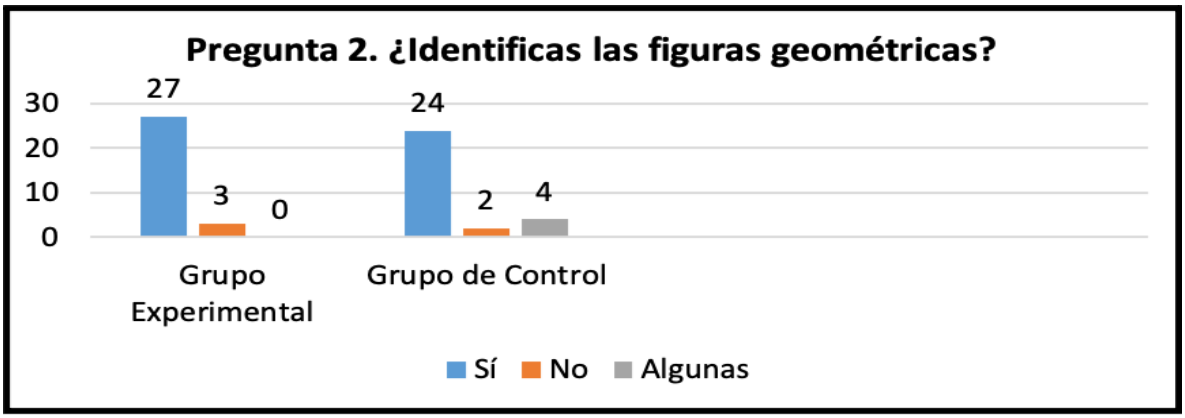


Fuente: Elaboración propia

These are the responses that were generated when applying the questionnaire to both groups, where it can be seen that, for the most part, the students are not clear about the concept of geometry, they simply associate it with geometric figures. It is a fact that geometric thinking is one of the least promoted by teachers, especially those in basic primary

education and preschool, since their knowledge is specific in one area and mathematics is seldom its strength, thus limiting the teaching the number system and only provide themes based on the main figures, without getting into the important elements that compose them, much less without making practical constructions that allow the significance of these elements of geometry and other important things in relation to the forms.

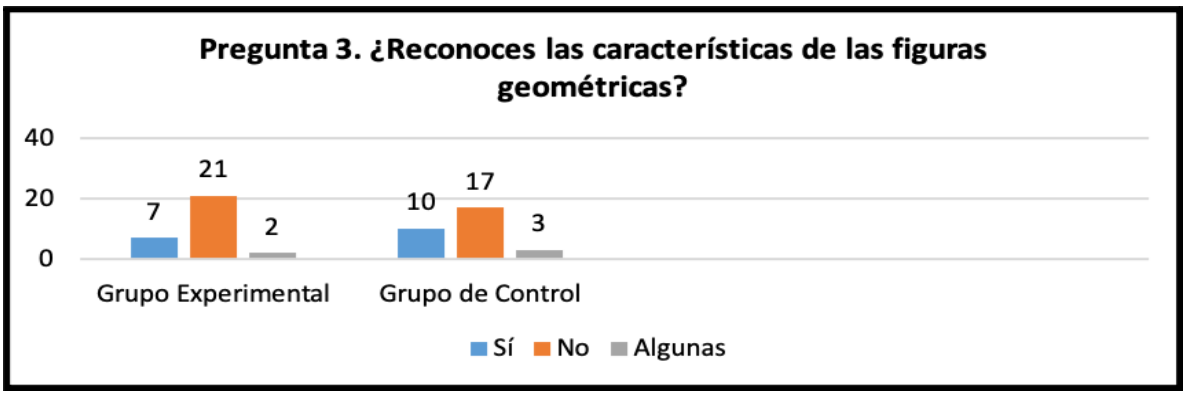
Figura 4. Análisis de la pregunta dos



Fuente: Elaboración propia

When asked if they identify geometric figures, the majority of students from both groups responded positively, taking into account that for them the figures are reduced to circle, square, rectangle and triangle, the others do not associate them with geometry. . It is understandable taking into account that the approach with these has been limited to the plane and they are the figures with fewer sides, which facilitates their drawing or their perception in simple forms of the objects in the classroom.

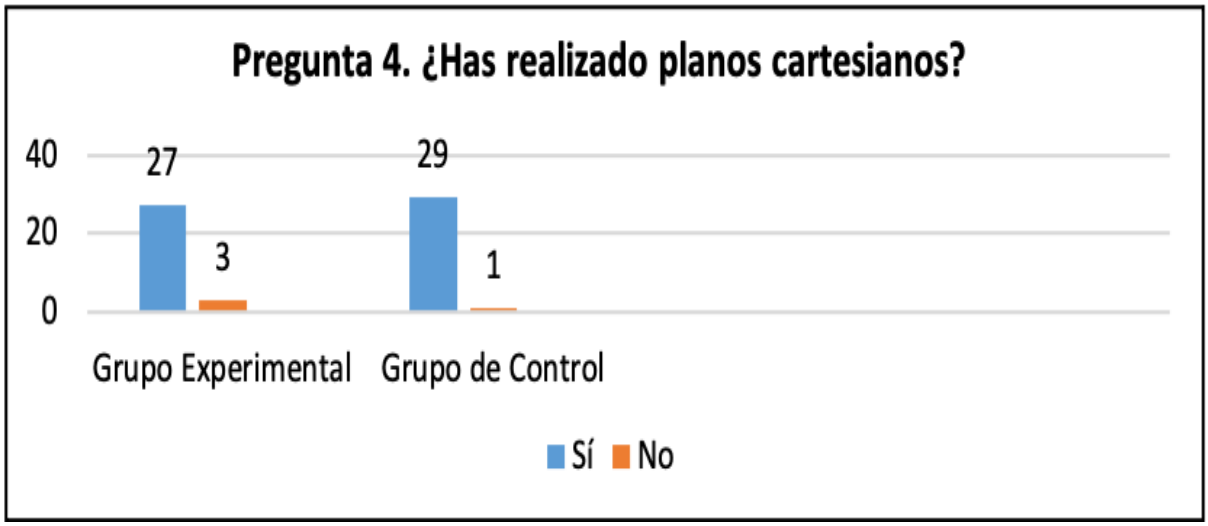
Figura 5. Análisis de la pregunta tres



Fuente: Elaboración propia

As Figure 5 shows, the students in both groups, for the most part, do not recognize the characteristics of geometric figures. Although they recognize the number of sides in the basic ones, in the three-dimensional figures they do not have notions of sides, edges, faces, vertices. Thus, it can be inferred that the teaching related to geometry is based on plane figures; with the three-dimensional, little or nothing has been contacted. It is a proof that mathematics education is very lacking in this aspect and, in general, the teacher leaves these subjects for the last academic period, and it is learned if the school time is reached or they are assigned as consultations.

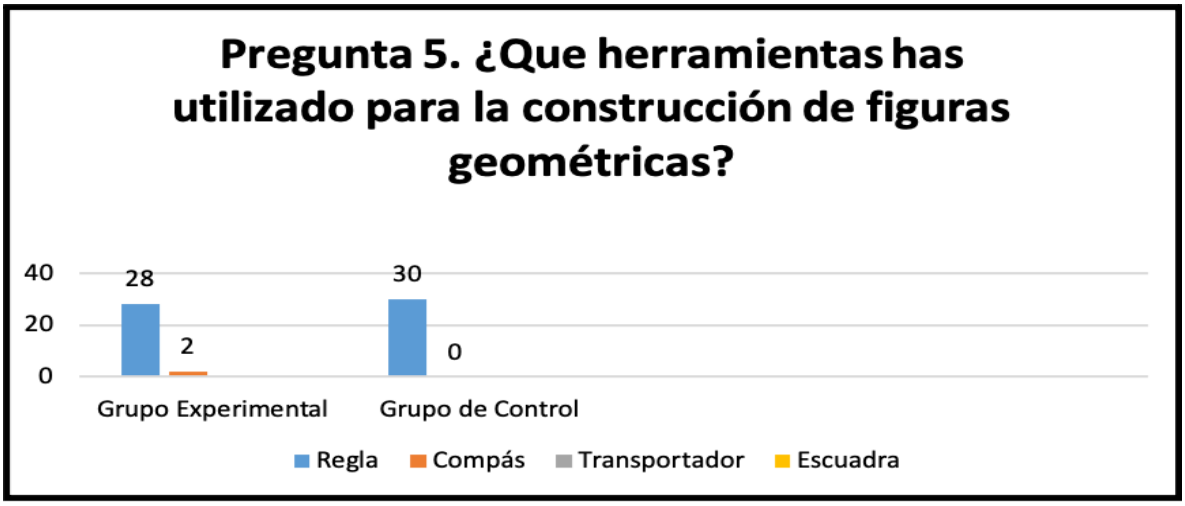
Figura 6: Análisis de la pregunta cuatro



Fuente: Elaboración propia

The students affirm that they have made Cartesian planes and, when conversing with them, they relate them to the number lines and are clear about the quadrants, the positive and negative axes and their respective names. They are clear when stating that the greatest difficulty is that they are equidistant and they learned them in the previous grade, that is, sixth, where the teacher has a degree in the area of mathematics and in planning shows compatibility with the basic learning rights of the Ministry of Education. National Education (MEN) for this thinking and mathematical skills.

Figura 7. Análisis de la pregunta cinco



Fuente: Elaboración propia

As the students mention, the tool they have used for the construction of the geometric figures is the ruler. In fact, they mention that they do not have good handling of the protractor and the compass and the square is only used as a measuring instrument, when they do not have a ruler. In handling the rule, it is noted that some students do not start counting from zero, but from one, and the lines sometimes do not coincide. It is urgent, then, how to make constructions using other tools.

Post intervention questions for experimental group

Tabla 5. Preguntas post intervención (grupo experimental)

Preguntas postintervención	Sí	No
1) ¿Tienes computador o tableta en tu casa?	23	7
2) ¿Tienes acceso a internet en tu casa?	19	11
3) ¿Consideras que la metodología del docente de matemáticas es buena?	14	16
4) ¿Conocías el programa "geogebra"?	17	13
5) ¿Habías utilizado el programa geométrico "geogebra" antes?	3	27
6) ¿Dónde has usado el programa Geogebra" …colegio?	3	27
7) ¿Consideras agradable realizar construcciones con Geogebra?	30	0
8) ¿Consideras que usar el programa es sencillo?	30	0
9) ¿Crees que el programa "Geogebra" permite aprender más?	30	0

Fuente: Elaboración propia

The José Miguel de Restrepo y Puerta Educational Institution has the largest number of students in the municipality of Copacabana, Antioquia, mainly due to its privileged location. In addition, it is certified as a quality school, which makes it very attractive. It could be affirmed that the students and their families belong to the middle class strata of the municipality, which is why the majority of those surveyed, 76%, have a computer or tablet at home. Part of their contact with the computer media is in the institution, where, although these elements are available, the Internet is lacking to make the teaching and learning processes more efficient.

In the experimental group, when applying the post-intervention, 100% of the students expressed that they had no knowledge about the GeoGebra program. However, by carrying out the practical activities, supported by an active methodology, the program in question contributed to assimilate the learning in a comprehensive way and they enjoyed the classes in the classroom.

Post intervention questions for control group

Tabla 6. Preguntas posintervención (grupo de control)

Preguntas posintervención	Sí	No
1) ¿Tienes transportador, regla y compás en tu casa?	9	21
2) ¿Tienes acceso a textos y material de consulta en tu casa?	23	7
3) ¿Consideras que la Metodología del docente es aburrida?	21	9
4) ¿Consideras que la Metodología del docente es diversa?	1	29
5) ¿Has utilizado herramientas como transportador, regla y compás?	26	4
6) ¿Has utilizado de manera creativa otras herramientas para dibujar figuras planas?	6	24
7) ¿Consideras agradable realizar construcciones con transportador, regla y compás?	4	26
8) ¿Consideras que usar estas herramientas es sencillo?	11	19
9) ¿Crees que la enseñanza de la geometría plana permite aprender más?	9	21

Fuente: Elaboración propia

The survey carried out on the students of the control group, after the intervention to the experimental group, shows that after performing traditional geometric practices with them, using tools such as protractor, ruler and shopping, they limit imagination, creative capacity and, therefore , the significance of learning, since there are only two-dimensional views that contribute nothing to the conception and contact with the real world.

Discussion

To answer the question of this research, the implementation of ICT in educational institutions has great relevance in improving the quality of education. To achieve this objective it is necessary to go beyond the mere incorporation of technological means in the classroom; It is essential that teachers are in continuous preparation and updating of technological tools, with the aim of improving the skills and mastery of each of the contents of the subject of mathematics within the teaching-learning processes, and thus the students are able to develop mathematical skills, as well as the acquisition of meaningful learning.

Another aspect that sheds light on the main question is that most students are not clear about the concept of geometry, they simply associate it with geometric figures. It is a fact

that geometric thinking is one of the least promoted by teachers, especially those in basic primary education and preschool, since their knowledge is specific in one area and mathematics is seldom its strength, thus limiting the teaching the numerical system and only provide themes based on the main figures, without getting into the important elements that compose them and much less without making practical constructions that allow the significance of these elements of geometry and other important things in relation to shapes.

In this case, the efforts for the instruction of geometric figures and their transformations in the Cartesian plane have been unsuccessful due to the lack of pedagogical strategies supported by digital tools by the teacher that lead to the modeling of each of the teaching processes -learning, as well as the acquisition of skills that contribute to meaningful learning by students in the classroom.

It is worth mentioning that the disciplines start from a very rich collection of knowledge, the teaching of which is linked to the knowledge acquired during a life cycle and to a social approach. This series of structured knowledge is given formality within the study plans and programs, which carry an intention, objective and purpose. The big question is what of all these knowledge, skills and abilities students should really know and for what.

Conclusions

The curricular commitment to teaching geometry in basic secondary education advocates processes focused on the needs and interests of students and their connection with the global world. It is a necessary challenge: to face, in a process of resignification, the new demands of society. The study carried out bets on the implementation of a didactic strategy in an area that many consider tedious, for which the task focuses on promoting creativity and motivation; a strategy for learning by doing in the various scenarios of the student's life.

The activation and enhancement of skills and abilities with ICTs is perceived in the experimental group, which generated greater critical thinking in the dynamics of the teaching-learning proposal supported by the Geogebra computer program. In addition, it allowed us to glimpse other geometric concepts that are not available in the traditional process.

According to the results achieved in this research, there is an urgent need to propose active strategies and the implementation of activities with ICT that lead the student to reflection and the appropriation of specific geometric knowledge that allow the development

of mathematical competencies and to life, favoring the integral formation of the same, so it is suggested that teachers should change the traditional way of teaching and make use, instead, of the resources that the educational institution has, generate didactic actions around computing , taking into account that students have a liking and interest towards technological tools.

It is necessary to train teachers in the management of didactic and computer tools, especially in the GeoGebra software, in order to streamline processes and make mathematics and geometry a portal to knowledge and the acquisition of skills for life, which it is full of shapes and movements that require human beings with the ability to shape and transform their environment. On the other hand, the institution has two computer rooms with Internet, one for elementary school and the other for high school, an electronic board, and a projector per area; however, it is only used by the teachers in charge of these classrooms.

In relation to the above, it is perceived that, although there are elements and spaces in the institution for the use and application of ICT, this is not reflected in the quality of the teaching-learning processes, because the teachers do not incorporate them into their pedagogical practices. Therefore, activities planned that positively impact the proper use of ICT and life skills in students should be introduced into the classroom.

Even from the perspective of most teachers, the use of ICT in class is an important resource for improving teaching-learning processes, and likewise, an alternative support tool for teaching the various contents . In addition, the age range of most of the teachers of this institution is between 31 to 50 years old, whose production stages are optimal, promotion and growth in their profession is sought, with knowledge in the use and ICT management; and in addition to maintaining the achievements and updating their skills, they also support the newest in this profession.

Contributions to future lines of research

As future lines of research, the training of teachers for the use of technological tools is proposed, with the urgent need for the implementation of active strategies, as well as the implementation of different activities with the support of ICT that invite students of basic education to the reflection and appropriation of specific geometric knowledge. In the same way, it is suggested that teachers should change the traditional way of teaching and make use of the resources that the educational institution in question has, generate didactic actions

around computer science, taking into account that students have liking and interest in technological tools.

Finally, it is necessary for teachers to use the programs for their mathematics classes, especially the GeoGebra software, in order to streamline processes and make mathematics and geometry a portal to knowledge and the acquisition of life skills.

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