THE INTERACTIVITY OF TECHNOLOGICAL TOOLS IN THE DEVELOPMENT OF LOGICAL THINKING IN SECONDARY BASIC EDUCATION

LA INTERACTIVIDAD DE LAS HERRAMIENTAS TECNOLÓGICAS EN EL DESARROLLO DEL PENSAMIENTO LÓGICO EN EDUCACIÓN BÁSICA SECUNDARIA

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ABSTRACT

The project showed the incidence of the interactivity of the technological tools in the development of logical-mathematical thinking in students of Secondary Basic Education seventh grade. The objective was to establish the incidence of the interactivity of technological tools in the development of logical-mathematical thinking in students of Secondary Education. To this end, the research question was as follows: How does interactivity with technological tools promote logical-mathematical thinking in the students of Secondary Basic Education seventh grade of the Higher Education Institution of Pitalito - Huila during the 2019-2020 academic period? The individuals studied were 41 students between 11 and 13 years old from social strata 1 and 2 without any disability or learning problem. The type of research used was the qualitative one as it interprets observing and analyzing the population in a way that contributes to the development of the processes to obtain the results of the research through the action research approach. The techniques that were used were: the observation with his instrument, the observation card, the interview with his instrument, the interview guide, the questionnaire with his instrument, the personal experiences, and the group discussion.

KEYWORDS: Logical thinking, software, mathematical reasoning, ICT, game.

RESUMEN

El proyecto demostró la incidencia de la interactividad de las herramientas tecnológicas en el desarrollo del pensamiento lógico matemático en estudiantes de Educación Básica Secundaria grado séptimo. El objetivo era establecer la incidencia de la interactividad de herramientas tecnológicas en el desarrollo del pensamiento lógico matemático en estudiantes de educación Básica Secundaria. Con este fin la pregunta de investigación fue la siguiente: ¿Cómo la interactividad con herramientas

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tecnológicas promueve el pensamiento lógico matemático en los estudiantes de Educación Básica Secundaria grado séptimo de la Institución Educativa Normal Superior de Pitalito IENSP – Huila durante el periodo académico 2019-2020? Los individuos estudiados fueron 41 estudiantes entre los 11 y 13 años provenientes de estratos sociales 1 y 2 sin ninguna discapacidad o problema de aprendizaje. El tipo de investigación utilizada fue la cualitativa ya que interpreta observando y analizando la población de manera que contribuye al desarrollo de los procesos para obtener los resultados de la investigación mediante el enfoque investigación acción. Las técnicas que se utilizaron fueron: la observación con su instrumento la ficha de observación, la entrevista con su instrumento la guía de entrevista, la encuesta con su instrumento el cuestionario, las experiencias personales y la discusión en grupo.

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1. INTRODUCTION

During the school life of people, there is always a continuous discovery, every day we go from simple things to more complex ones, among them "mathematics" are highlighted that help man understand by giving him the ability to think abstractly, face problems and make decisions in various life situations among many other utilities. For this reason, it is necessary to discover it in a fun and interesting way, with the help of technologies that is what moves the world today and captures the attention of a large part of the population. These tools help to show the great utility that the area has in many aspects of life and that is why it is necessary to stimulate mathematical thinking through the development of mental structures, which help to improve the interpretation and analysis of various daily problem situations in the search for solutions of all kinds.

Today technologies provide diverse opportunities and different styles of learning that are used to communicate, entertain, and teach among many other applications. They influence all aspects of life and offer the required information to any type of person regardless of their condition, location, or capabilities. For this reason, technological tools must be implemented in the learning process to achieve the development of logical thinking of each student.

This research project presents a proposal with a different methodology for the seventh-grade students of the IENSP in Colombia, to be carried out with the help of

interactive game software, which generates a degree of satisfaction when acquiring new knowledge in the area of mathematics.

2. OBJECTIVES

2.1. General

Establish the incidence of the interactivity of technological tools in the development of mathematical logical thinking in students of Basic Secondary education of the IENSP during the 2019-2020 school period.

2.2. Specific

1. Describe the technological tools used in recent years in the Educational Institution in the area of mathematics.
2. Identify the development of logical thinking of students through a diagnostic evaluation according to the curriculum in the area of mathematics.
3. Recognize technological tools that allow interactivity pertinent to the context for the development of logical-mathematical thinking of students.
4. Integrate the technological tools that facilitate the development of mathematical logical thinking in students of Basic Secondary education of the Normal Superior of Pitalito.
5. Analyze the results obtained on the use of the interactivity offered in the institution for the improvement of mathematical logical thinking.

3. METHODOLOGY

Today, education is a process of teacher-student interaction so that the former can make them understand and the latter can understand the world; This process is carried out with an innovative, transformative, and up-to-date teacher resulting from the observation of his students as unique and different beings. That is why qualitative research does not insist on representation but interpretation through observation and analysis of the population; it studies reality in a context, producing descriptive data and building knowledge.

As the research is qualitative, it is worth mentioning various authors on its history and definition, which are presented below. Qualitative research emerged from the birth of the human sciences in the last century and has been maintained throughout the 20th century. The heyday of the positivist current overshadowed it, however, the crisis experienced by the human sciences since the 60s and 70s and the epistemological and methodological rethinking that has been carried out from it contributed to its resurgence. (Martínez, 2011).

Two periods in the history of Qualitative Research have been known; a first period that goes from the end of the 19th century to the 1930s, where the first qualitative works are presented and various qualitative techniques such as participant observation, in-depth interviews, or personal documents acquire their maturity, the School of Chicago imposes its imprint, and the birth of the sociology of education takes place; a second period that ranges from the 1930s to the 1950s, in which there

is a decline in interest in the qualitative approach. A third moment occurs around the sixties, a time marked by social change and the resurgence of qualitative methods. (Qualitative Research; n.d).

According to Bodgan and Biklen (1982), qualitative research or qualitative methodology is a research method that is based on methodological cuts based on theoretical principles such as phenomenology, hermeneutics, social interaction using data collection methods that are non-quantitative, to explore social relationships and describe reality as the corresponding ones experience; it requires a deep understanding of human behavior and the reasons that govern it (Alarcón, 2012).

According to Maanen, the qualitative method can be seen as a term that covers a series of methods and techniques with an interpretive value that aims to describe, analyze, decode, translate, and synthesize the meaning of facts that arise more or less naturally. (Maanen, 1983).

For qualitative researchers, talking about qualitative methods is talking about a way of researching social phenomena, in which certain objectives are pursued to respond to some specific problems that this research faces. (Denzin, 1994).

This approach is characterized by being descriptive, inductive, holistic, phenomenological, structural-systemic, and, above all, flexible, it emphasizes validity more than replicability, it tries first of all to identify the deep nature of realities and their dynamic structure; However, the qualitative as an integrated whole is not opposed to the quantitative, to be considered only as an aspect that it implies and integrates where necessary. (Mesías p.2).

Qualitative research is considered a way of thinking because apart from the fact that the information is gathered or collected, it must be interpreted in such a way that it contributes to the development of each of the processes that are carried out to achieve the adequate results of the research. It is fundamental since it is inductive, it analyzes realities, it explores and describes through observation and analysis, a work that is carried out daily in the Institution because what is important is what the student says, thinks, feels, and does, that is, the student is involved in the process.

They are studies of daily work carried out at the Higher Normal Educational Institution, which is interested in what the student says, thinks, feels, and does; This is why this project that involves the student, a vital part of this process, is important. What the study does is describe or generate a theory from the data obtained, how students actively participate during the process to transform reality is the most appropriate because what is intended is to see the impact that the use of technological tools to teach in a useful and fun way mathematics has in students and to develop their logical thinking.

The objective of this research is to understand the world from the point of view of those who live it. They are subject-centered research; the inquiry process is inductive and the researcher interacts with the participants and with the data, seeking answers to questions that focus on social experience, how it is created, and how it gives meaning to human life. (Taylor and Bogdan, 1984).

In qualitative research, there are descriptive and interpretive studies. Descriptive studies include ethnographic, biographical, phenomenological, and documentary designs, and action research, and interpretive studies include based theory and analytical induction. (Polit and Hungler, 2006). For this project, the descriptive approach of participation action will be used.

Participation Action research is a method of research and collective learning of reality, based on a critical analysis with the active participation of involved groups, which is aimed at stimulating the transformative practice and social change. Furthermore, it is necessary to know that it combines two processes: knowing and acting, both involving the population whose reality is being addressed. (Eizagirre and Zabala, 2019).

It is a research method in which the researcher has a double role, that of researcher and that of a participant. It combines two types of knowledge: theoretical knowledge and knowledge of a specific context. It is a method in which the validity of the results is checked as long as how many of these results are relevant to those who participate in the research process. (EcuRed, 2005).

The participation action is the research to be used since it produces knowledge and systematizes experiences to change the social situation through research where the researcher and the community are involved, the latter being the one that guides the work. This research allows that, from observation, the study of a particular situation is carried out to improve the quality of its action, which is based on a need of the involved subjects, in this case, the students of the Higher Normal Educational Institution of Pitalito.

There are many types of research, but where the community is really involved and appropriates the processes and the results is the PAR, which studies the realities of people, this type of research is concrete and is face-to-face, which leads to changes involving the entire community and any type of social class. As the name says, it is the action that is carried out taking into account the theory with the practice leading to a social transformation, taking into account reality and it is not necessary to wait until the end. PAR starts from the community to be studied, in this case, the educational community where the problem to be researched is solved by the participants themselves, that is, by the students.

This is based on a critical analysis with the active participation of involved groups that are oriented to stimulate the transformative practice and social change working two processes: knowing and acting, involving the population in both, addressing reality, and planning actions and measures that allow to improve it by combining theory and practice. This approach will allow the proposal to determine the appropriate strategies in the development of logical thinking in the area of mathematics through games and interactive software in the seventh-grade students of the Higher Normal Educational Institution.

It will be carried out in 5 phases:

1. The initial step is to analyze the role of educational actors, the content, and the environment, the result of which will be the description of a situation and its training needs.
2. According to the analysis, the proposals that take into account the pedagogical approach and the way of sequencing and organizing the content are projected.
3. The creation of the contents and learning materials based on the previous phase.
4. The execution and implementation of the education action with the participation of the levels of the Educational Community.
5. The evaluation that consists of carrying out the formative evaluation of each of the phases.

To carry out the PAR in the project there are various moments such as:

The analysis implies the immersion of the problem that will be carried out through observation, that is when the behavior of the students that are going to be researched, interviews, questionnaires, and personal experiences are systematically looked at to determine the logical thinking in the area of mathematics to be able to analyze it and create an intervention plan to develop motivation and improve the results obtained.

The Design will be oriented to establish a proposal, directed towards the research problem, oriented to the use of educational software and games on platforms, taking into account the research background and the needs of the educational community. Development is the phase in which educational software and platform games will be evaluated for their adaptation and creation of the intervention proposal.

Implementation is the start-up of the research proposal, where data is collected to evaluate the implementation, and decisions are made regarding the plan.

Evaluation is the feedback when collecting data, evaluating the plan, and reporting the results and actions to the entire educational community.

4. THEORETICAL FRAMEWORK

Over time, education, models, strategies, and tools have evolved to be at the forefront and face challenges of today's society; technology has transformed information showing social changes, improving education and the way of learning worldwide, articulating the apprehension of concepts with immediate reality, which leads to the formation of an integral human being.

Games are an activity used for recreation, motivation, entertainment, and fun in different moments of life; on many occasions, they are an educational tool to make classes different and livelier for the type of population being educated. Games differ from work in the way they are done, attract attention, motivate, create an application of concepts beyond solving exercises in a notebook; With games, you can determine the use of concepts in solving everyday problems and referring to the immediate social and cultural context.

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For Jean Piaget (1956), games are part of the child's intelligence, because they represent the functional or reproductive assimilation of reality according to each evolutionary stage of the individual. The sensory-motor, symbolic, or reasoning capacities, as essential aspects of the development of the individual, are those that condition the origin and evolution of the game. According to Piaget's evolutionary phases, games are classified as functional, symbolic, regulated, and of construction. (p.1).

Vygotsky saw games, "as a socio-cultural instrument and resource, the joyous role of being a driving force in the child's mental development, facilitating the development of higher functions of understanding such as attention or voluntary memory; games are a changing reality and, above all, a driver of the child's mental development, concentrating attention, memorizing, and remembering is done, in games, in a conscious, fun way, and without any difficulty ". (Vygotsky, 1924, p26).

From pedagogy and psychology, learning, if it is interactive, is long-lasting since the child externalizes his skills and abilities without the need for an order, language is facilitated, and he does not lose heart because he is not negatively called to attention. Games include essential elements that help the child's growth and this is how it is usually indicated that socialization is the most important element for the child to learn to differentiate between what is acceptable and what is not acceptable.

Interactive games allow the student to participate from his computer while learning technologically- related concepts in line with the advancement of today's world; created for all ages, and not only for the acquisition or reinforcement of knowledge but also as entertainment from anywhere in the world. Games are useful tools in the pedagogical training or teaching-learning process since they help to acquire knowledge and develop skills.

The technological tools with the interactive game are a great complement to the teaching-learning process and allow to strengthen logical thinking in students that "is the one that is acquired from the relationship between objects and leads to the individual's own elaboration" (Pérez and Merino, 2008, p15); It is a tool for human beings to solve everyday problems of all kinds through various processes, that is, logical thinking develops the ability to analyze, argue, reason, and propose, it is analytical and sequentially follows rules. For this reason, teachers are in charge of promoting activities, games, projects, and experiences that allow the development of logical thinking through exploration, observation, comparison, classification, and manipulation of objects so that the knowledge acquired is durable and can be applied in all areas of their life, especially in solving everyday problems adequately and rationally.

According to Baroody (2005), logical thinking arises when the student starts from a reflective thought, building solutions in his mind through relationships with objects, always starting from the simplest to the most complex and understanding that the acquired knowledge, once it is processed, cannot be forgotten because the experience does not come from the objects but the actions on them.

According to all this, logical thinking is useful to science, which is why it is immersed in the development of mathematics, a word that comes from Greek and means "learn," being the basis of many knowledge and, although many see it as complicated, it is easy and fun if learned correctly. As logical thinking can be developed in various fields, it is important to develop it in a science as useful as mathematics; Therefore, the strengthening of the logical thinking developed in the students will be an ally at the time of forming people with integrity and capable of living in today's society, since this area is a fundamental part of everyone's life and always accompanies us in any situation, even if it doesn't seem like it.

On the other hand, Vada (2014) "the importance of using games as a teaching tool is undeniable; Not for nothing games are the basis of all learning activities in Early Childhood Education. This didactic method helps children to develop their capacities and stimulate their interest in discovering things, since it is an activity that amuses them and which, therefore, they do not want to do without". These are the reasons why, through this project, it is intended to strengthen logical thinking through games and the development of different activities aimed at the use of technological tools using interactive games software as the main resource.

5. DISCUSSION

5.1. Hypothesis

The technological tools encourage the development of logical thinking in the students of Secondary Basic Education of the Higher Normal Education Institution of Pitalito through the use of interactive games in the classroom, which means a positive contribution to the learning process of the students.

5.2. Stages

To carry out the project, the following activities will be carried out:
1. Open interview to teachers and students of the Normal Superior of Pitalito about the technological tools used in the last two years.
2. Questionnaire open to teachers and students on the management of technological tools inside and outside the classroom.
3. Evaluation of personal experiences on the liking for the area of mathematics and the use of technological tools in the classroom.
4. Application of a diagnostic evaluation on the resolution of mathematical problems according to the curriculum of secondary education of the Normal Superior.
5. Open questionnaire to teachers in the area of mathematics and secondary education students about the most used and recommended technological tools in the area of mathematics.
6. Use of technological tools in math classes.
7. Use of software and platforms inside and outside the classroom.
8. Observation of math classes when using technological tools.
9. Application of a final test on mathematical problem-solving.
10. Group discussion about the liking of mathematics with the use of technological tools.

11. Analysis of the results obtained after the intervention.

5.3. Variables

A variable is a property that can fluctuate and whose variation is capable of being measured or observed (Hernández, Fernández & Baptista, 2013). Thus, the variables to be treated in this research are the independent and the dependent. In the independent, interactive games that motivate the student will be worked, improving the learning process and liking the subject to develop the cognitive, conductive, and affective dimensions.

The dependant variable will work on the development of logical thinking that allows improving skills for solving problem situations in immediate, scientific, and area contexts. We want to develop the capacities that favor learning for a better apprehension of knowledge and utility in the various areas of their life.

5.4. Population and Sample

5.4.1. Population

The project will be carried out in Colombia at the Normal Higher Educational Institution located in the Municipality of Pitalito in the department of Huila at the headquarters. The school is public, calendar A, morning and afternoon shifts; It has approximately 4,500 students including all its venues. The analysis will be carried out with 36 seventh-grade students of the morning shift, 22 female and 14 male whose ages range from 11 to 13 years old, whose socio-economic stratum is between 1 and 2 since their families are low-income; The main economic activity of their parents is informal vendors, with serious social problems since the vast majority come from the Porvenir slum, which has a high degree of crime and low economic factors. They have family problems, with divorced or in-prison parents, or siblings with legal problems, so the situation with the group, in general, is a bit difficult.

5.4.2. Sample

The sample for the project is equivalent to the total population, that is, 36 students, 14 men and 22 women, from the Pitalito Municipal Normal Superior Educational Institution of grade 701 of the morning shift whose ages range between 11 and 13 years old.

The type of sample that was taken is that of simple random selection, which is the best-known modality and reaches the highest scientific rigor (General Comptroller of the Republic, 2012. Pp.9).

5.5. Results Analysis

The Educational Institutions are governed by the Ministry of Education, which in turn presents decrees and regulations for the proper functioning of the area plans and curricular networks of the Institutions at the National level. The area of mathematics has basic standards and basic learning rights which serve as a guide for the

orientation of the area. The basic seventh-grade math standards that influence the teaching of fractional numbers and the development of logical thinking are:

"I solve and formulate problems in contexts of relative measurements and variations in measurements."

"I use rational numbers, in their different expressions (fractions, ratios, decimals, or percentages) to solve problems in measurement contexts"

"I justify arithmetic procedures using the relationships and properties of operations."

"I formulate and solve problems in additive and multiplicative situations, in different contexts and numerical domains."

The basic learning rights regarding this topic are:

"Solve problems in which you must divide an integer by a fraction or a fraction by a fraction."

"Solve problems involving positive rational numbers."

Based on the above, it was observed that the Ministry of National Education is asking for the child to develop logical thinking that helps him in solving problem situations in various contexts, which was achieved with the application of interactive games through software available on the network and with the execution of the said project.

The use of Thatquiz was of great help in deepening the subject since its platform was very easy to use and various operations were found so that the subject was well understood.

The sallita.net software led the student to pose situations of their daily life with the various subjects internalized with the previous software and the motivation to win, record, and make slides, among others, led them to compete and relate theory to practice.

The pedazzitos1.2 software, as it deals with games and competitions, attracted students to the achievement of an objective applied to the required subject matter, which made the work easier because in a playful and fun way it demonstrated what they had learned and applied it through games.

Regarding the objectives set out in the project, the analysis is as follows:
- Students are not motivated in class because technology tools are not used in class.
- Most students have access to technology.
- Children use technology in much of their time when they are not within the Institution.
- In the process of learning mathematics, the application to problem situations is not being taught, which leads to little development of logical thinking because it only remains in theory and not in practice or daily use.

- The use of online games is motivating for children today and the vast majority have used and know how to use them, including interactive game software.
- Problem solving is difficult for students because they do not understand problems and do not know how to make comparisons using graphs or various situations.
- The low development of logical thinking is being affected because what is learned in the classroom is not being practiced and the usefulness of different subjects is not seen.
- The problems that children have at home affect their concentration in the classroom and, furthermore, being monotonous, without any manipulation, they do not catch their attention.
- Lack of use of technological tools in the learning process.
- Students paid more attention to explanations to play in the classroom.
- They finished the activities quickly and what they did not understand they asked with the desire to win the indicated game.
- Working in pairs encouraged them to solve the various exercises.
- The use of stopwatches, tape recorders, screenshots, PowerPoint, computers, and other technological elements pleased them in the development of the classes.
- The use of rules in the games made it easier for them to use the software
- With the use of the graphs, it was easier for them to solve the established problems.
- The diversity of games helped them to relate the theoretical with the practical.
- They were faster doing the exercises.
- They created problems regarding software exercises more easily.
- The responses to the initial survey and the final one changed since it was evidenced in the last survey that the attitude towards the area and problem solving improved.
- It was evidenced that the results of the diagnostic test and the final test changed in the last one since they were able to develop the exercises more logically, mainly through graphs.
- It was determined that problem solving with fraction numbers improved with the use of technological tools and interactive games.
- The worked subject lasted in the students and how they graphically carried out all the operations.
- Problem solving was facilitated, which implies that logical thinking improved because they were able to correctly solve various situations that arise in everyday life.

5.6. Social Impact

Initially, the project presented difficulties in its production since the Institution, due to serving such a large population of students, presents few spaces where technological tools are found, just as the tools are limited; teachers and parents at first did not believe in proper development. With the help of teachers in the IT area and spaces that have computers, tablets, and an internet connection, the project was implemented, which was able to demonstrate to the entire educational community that, although there are limitations of all kinds such as spaces, technological tools,

and lack of an internet connection, Mathematics classes can be done playfully, leading to a lasting apprehension and application in daily life, real examples that will help them in solving real situations.

The students were more attentive and understood that technological tools are important in the classes to be able to understand why what they learn will serve them for life and they do not think that the subject does not serve them.

Academic performance improved in the last academic period, which made parents understand that the project was profitable and that it was worth applying, leaving an example for the continued implementation of this methodology in the following years.

6. CONCLUSIONS

Regarding the subject, it is vitally important to try to integrate more constantly and directly the use of information and communication technologies, especially educational software available on the Internet, as in this work, which highlighted the development of logical-mathematical thinking through games and in a didactic way for lasting and applicable knowledge.

It is noteworthy how the other professors in the Institution area do not use this type of tools and methodologies for teaching the topics in their classes as a method of interactive strengthening in the development of logical thinking, being a great flaw because there are various animated activities on the internet for all areas and the software are free and accessible to anyone, making students feel encouraged and the classes more fun and applied to their real environment. With a quite conclusive result according to the survey carried out to the students of the seventh grade of the Institution, which shows how 92% of them responded to their satisfaction with the implementation and use of this type of educational innovations, especially games made through software since they are simple and easy to use tools.

Thanks to the knowledge obtained throughout the development of this project, it is possible to highlight how, through the integration of the existing technology in the Institution, what the internet network currently allows, tablets, computers, and specialized software in education offer; regarding the development of the topics of the area, it is possible to create meaningful learning spaces that go from being monotonous, such as the well-known master classes, moving to more interactive ones that generate enthusiasm, curiosity, and interest in those involved and, thus, create spaces called virtual learning environments.

It was possible to determine how students are not alien to the monotony of teachers and their classes, which are not very understandable and, in many cases, the boring of the various topics that are covered in the seventh grade is highlighted, with what corresponds to mathematics, according to the results evidenced in the surveys where the vast majority of them responded that the current classes are not very motivating and to a large extent they do not understand the topics discussed.

A great shortcoming is noted, which arises from the need for the Institution to specifically incorporate technological tools and software such as sallita.net, that quiz,

and pedazzitos1.2 in the classes of the area, which greatly favor the obtaining of knowledge in terms of the various subjects, so that they perform the role of reinforcing and consolidating what is given in class, encouraging logical thinking with different activities that are directed towards logic to train analytical and critical people about their knowledge. According to all this, it could be concluded that:

- The development of logical thinking improves when we articulate technological tools, educational software, and games in the application of theory with practice.
- Interactive games attract the attention of the students in the proposed subject.
- Technological tools are a motivator for obtaining new learning.
- Information and communication technologies are part of our daily lives and should not be alien to education.
- Educational software offers various options to strengthen the subjects.
- Access to technology must be increasing taking into account the large amount of information it provides.
- The use of educational software attracted the attention and motivation of the students and left a seed in the teachers to continue making use of these implements in the various areas to contribute to improving education and raising the results obtained within and outside the Institution.
- Proposing the use of educational software for the development of logical thinking was a good idea since the relationship between theory and practice was observed and created a better environment for students in the area of mathematics, who at first said they were afraid of and was boring.

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