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Virtual Playful Tools and Mathematical Logical Thinking in EGB Students

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Abstract

The research had the purpose of demonstrating that the use of virtual playful tools and mathematical logical thinking in EGB students of the "Bachillero" Educational Unit. In this sense, a quantitative approach was proposed in order to generate statistics through the results obtained with respect to the declared variables. At the level of results, it is evident that there is significant learning when using the PhET simulator because the student can visualize the exercise three-dimensionally. The opposite occurs when the teacher explains the same exercise on the blackboard. Finally, it is proposed as conclusions that, contrary to the control group, these students achieved significant learning, since the images provided by the PhTE simulator allowed them to visualize the proposed fractional numbers in a three-dimensional way. It is worth mentioning that, with the use of this type of simulator, students also show greater motivation and interest in learning.

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1 Introduction

The profound changes that the educational system is undergoing are transforming the way in which teachers share their knowledge with their students. Currently, it is no longer enough for the teacher to develop a class based on theory and carrying out traditional exercises. Today's students are totally involved in the management of computer technologies, therefore, the teacher must update or learn. From the point of view of Álvarez et al. (2020), the incorporation of computational techniques, namely: a serious game for collaborative learning, allows the incorporation of context sensitivity functionalities, that is, using the logic of the student and the environment in which it develops. On the other hand, Cassinelli Doig et al. (2022), playful-pedagogical tools respond to the need of basic education teachers to have more resources that facilitate the development of teamwork, promoting assertive communication and interaction. above all commitment (Párraga et al., 2018; Pinargote Zambrano, 2020; Ramos et al., 2018; Wilson, 1990).

In response to new educational trends, it is necessary to develop logical mathematical thinking based on virtual tools of a playful nature for students at the Basic General Education (EGB) level. In other words, the teacher must incorporate virtual environments to motivate learning, in this case of mathematics at a basic level. In this sense, the use of these technologies does not exempt the teacher from working on mathematical logic and the development of children's skills, complementing the teaching-learning process with playful activities. Starting from the premise that the current teaching-learning process must follow the trend in relation to the incorporation of the so-called virtual recreational tools, it is also true that this type of technology by itself does not guarantee significant learning in students. It is necessary for the teacher to assume a didactic / playful character where his students manage to assimilate the knowledge with relative ease and without harming the teacher / student relationship. According to Ambriz (2021), the introduction of new technologies has accelerated the paradigm shift in the classroom, which in turn has led to a review of pedagogical strategies, one of which is the approach of learning through play and the development of the collaborative/cooperative work (Bayram & Comek, 2009; Çığrık & Ergül, 2010).

Considering the constructive relationship that there should be between interactive playful tools and mathematical logical thinking in EGB students, it is necessary to remark that it should also involve what is called learning styles. That is, not all students have the same form or not all learn under the same methodology. In this sense, even when these tools motivate the student, they must consider the child's way of learning. According to Tuñoque Gálvez (2019), he identifies that when it comes to didactics in the teaching-learning process, the systemic approach is clearly necessary; since in addition to the teaching system in all areas of knowledge as a whole, the development of logical thinking must be considered as a fundamental and integral part of learning. The objective of the investigation, in light of the current knowledge related to it, was to demonstrate that virtual playful tools have contributed to the development of mathematical logical thinking in EGB students of the "Bachillero" Fiscal Educational Unit. As well as looking for answers to fundamental questions such as: What kind of virtual play tools should be implemented to improve mathematical logical thinking? How to include virtual play tools in the mathematics teaching-learning process?

Based on the aforementioned, it is considered that the research related to virtual playful tools and mathematical logical thinking in EGB students emphasizes that, fundamentally, the center of teaching activity is to share their knowledge with their students in a way that that is productive for students and less stressful for the teacher. Within the research, it is also considered that the teacher must plan and implement strategies so that their students build their own knowledge from their relationship with virtual playful environments (Maloney & Beilock, 2012;Mavrotas, 2009).

2 Materials and Methods

The research adopted a quantitative approach in order to generate statistics through the results obtained based on the implementation of the collection instruments designed with respect to the virtual playful tools used to develop mathematical logical thinking in seventh-year EGB students from the Fiscal Educational Unit "Bachillero". The population consisted of 16 students from the control group and 16 students from the experimental group. The design also contemplated the definition of the methodology used, thus, for example, the use of the Inductive / Deductive Method, begins with the observation of particular phenomena with the purpose of reaching conclusions based on the general premises. The deduction contributes to the elaboration of hypotheses (Balluerka et al., 2005). While the Method of analysis / synthesis: The analysis manages judgments, it is a knowledge process that begins with the

identification of each one of the parts that characterize a reality, it will be able to establish the cause-effect relationship between the elements that make up the object of analysis. investigation. The synthesis considers the objects as a whole, the interrelation of the elements that identify the object (Balluerka et al., 2005).

Regarding the collection of information, the research was based on the objective of demonstrating that virtual playful tools in the development of mathematical logical thinking in EGB students of the "Bachillero" Fiscal Educational Unit. The methodological design used determined a Correlational and Causiexperimental level. At first, a demonstrative class was held for the control group, without the help of the PhET virtual simulators, that is, using only the mathematics school textbook provided by the Ministry of Education and where the didactic material was only the traditional exercises. that are contained therein. In a second moment, a demonstrative class was given to the experimental group, using the PhTE simulator. PhET (2023) It is a virtual simulator through which the student can access PhET graphical environments to explain the mathematical fundamentals. According to Duarte et al. (2022) The implementation of a didactic strategy based on simulators contributes positively to the learning of concepts related to mathematical logic (Proyer et al., 2019; Boysen et al., 2022).

On the other hand, the computer tools used for tabulation and statistical development, according to the nature of the research instruments defined, are detailed in this section. Based on what was pointed out by Pinargote (2020) "The word processor, spreadsheets, survey managers, among others, contribute daily to the work of millions of people who carry out their activities through a computer." In this sense, the Microsoft Excel program is a very efficient computer tool for obtaining meaningful information from large amounts of data. It also works very well for simple calculations and for keeping track of almost any type of information. According to Microsoft (2023) “Excel organizes the data so that the user saves time. Easily create spreadsheets from templates and perform calculations with formulas. The graphic designer helps to present the information in a clear and compelling way”.

3 Results and Discussions

Given the results of the traditionalist demonstrative class, the control group was made up of 16 EGB students from the "Bachillero" Fiscal Educational Unit. The traditional teaching method was used, the teacher's explanation / use of the school textbook, to the students of the participating group. The purpose of the proposed exercise was to teach the fundamental operations of fractional numbers in a classical way to students, having as didactic elements only the school textbook and the teacher's explanation. That is, develop a traditionalist teaching style. In this sense, a series of exercises (A.1) were planned through which the aforementioned fundamentals were explained theoretically. In the first exercise, students were asked to determine whether the answers provided were true or false. Thus, the student was asked to use his mathematical logic and mentally calculate the sum of 5/4+3/4, the correct answer being 2. However, figure 1 shows that 69% of the students they were wrong and 31% were right.

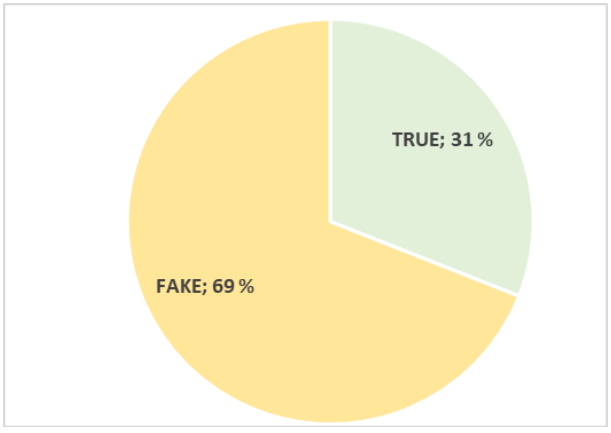

Figure 1. Results of the diagnostic test using the traditional method

In the second exercise, they were asked to use their mathematical logic and mentally multiply 3/5 x 6/8, the correct answer being 18/40. However, Figure 2 shows that 56% of the students were wrong and 44% were correct in their answers.

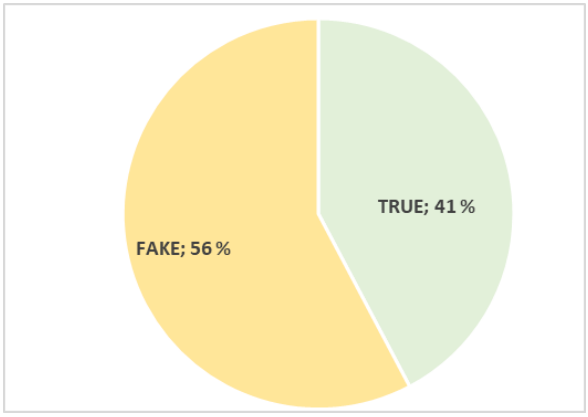

Figure 2. Results of diagnostic test by means of traditional method

In the third exercise they were asked to use their mathematical logic and subtract 12/5 – 7/5, the correct answer being 19/5. Without. However, Figure 3 shows that 38% of the students were wrong and 67% were correct in their answers.

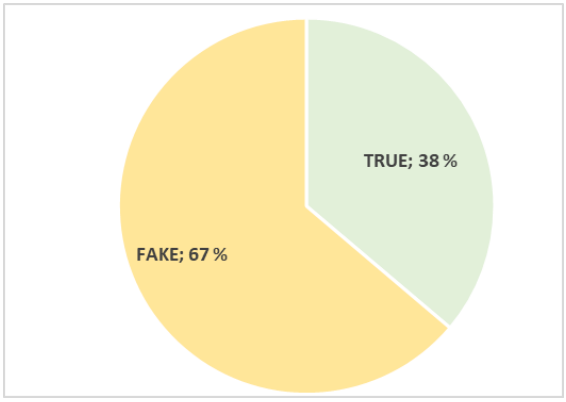

Figure 3. Results of diagnostic test by means of traditional method.

In the fourth exercise they were asked to use their mathematical logic and multiply 4/7 x 6/7, the correct answer being 24/49. However, Figure 3 shows that 56% of the students were wrong and 44% were correct in their answers.

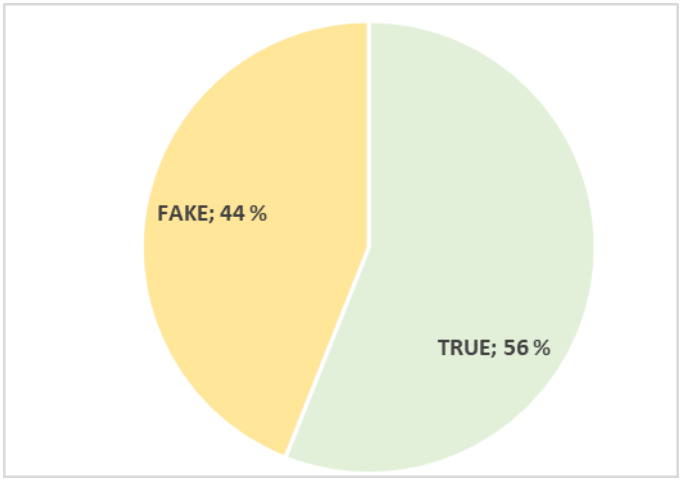

Figure 4. Results of diagnostic test by means of traditional method

In the fourth exercise, they were asked to use their mathematical logic and multiply 6/6 x 3/3, the correct answer being 1. However, figure 5 shows that 100% of the students got it right. Given the results of the demonstrative class using the PhTE simulator. The experimental group consisted of 16 EGB students from the "Bachillero" Fiscal Educational Unit. The teaching method using virtual environments and the respective explanation of the teacher to the students of the participating group was used. The purpose of the proposed exercise was to teach the fundamental operations of fractional numbers in a dynamic way to the students, having as didactic elements the PhTE simulator and the teacher's explanation. In this sense, a series of exercises was planned through which the fundamentals were explained in a playful way (A.2.). In the exercises that applied mathematical logic, the students were 100% correct.

The most palpable difficulties presented by the Ecuadorian educational model is the low level of learning of the subject of mathematics, historically speaking there are students who never learned the basic knowledge and where the development of this knowledge was done in a traditional way, due to the Lack of dynamic methodologies. In this regard, in this regard Noro (2018) “To educate it is essential to define what is human and how it should be human. Education is impoverished and betrayed if it categorically circumscribes and limits the vision of man and his possibilities of development. In this sense, the author establishes a fundamental contradiction regarding the fact that many of the educational institutions, despite having computer laboratories, do not make them available to students, in contravention of educational policies which privilege the use of technology (Zaitseva & Levashenko, 2013; Buchberger et al., 2006).

The research focuses on investigating the Impact of virtual playful tools on mathematical logical thinking in EGB students of the "Bachillero" Fiscal Educational Unit. Where, the information presented allows to determine two different approaches. The first of them corresponds to teachers who develop their educational activity using traditionalist strategies for teaching mathematics. The second approach corresponds to the impact of virtual tools for learning this subject, which is always difficult for students to understand and, therefore, to learn. The results obtained in this first approach show that a majority of the participating EGB students from the Fiscal Educational Unit "Bachillero (Control group) did not clearly understand the resolution of fractional number exercises because they did not have the elements additional didactic materials that would allow them to visualize and assimilate the knowledge shared by the teacher. It should be noted that currently there are various factors that discourage the learning of the subject, the lack of interest in learning mathematics on the part of students is often subject to the didactic strategies adopted by teachers. On the other hand, there is the lack of training regarding the use of educational computer platforms and the lack of technology, this situation generates negative conditions that do not contribute to improving the learning of mathematics. This is evidenced by a majority segment of students from the Control Group, who could not adequately answer the diagnostic test of knowledge of mathematical logic (A. 1.) because, fundamentally, these students cannot visualize the representations of fractional numbers and, therefore, Therefore, they cannot develop a logic to solve them. From the point of view of Lugo et al. (2019), it is indicated that logical-mathematical concepts constitute a fundamental and useful instrument, because through these children express their knowledge every day in each of the educational training experiences (Mujber et al., 2004; Ripphausen et al., 2011).

Diagnostic test results using the PhTE simulator

The results obtained in this second approach show that a majority segment of EGB students from the Fiscal Educational Unit "Bachillero (Experimental Group) was able to solve the proposed exercises related to fractional numbers (A. 2.). With the simulation in real time, the student had at his disposal the different elements for the calculation, it should be noted that the information was presented by the simulator in a graphic way, which contributed to improve his perception regarding the subject studied and to clearly identify the logic of the fractional numbers, that is, it was possible to visualize aspects such as, for example: the form of representation of exercises with mixed numbers. In the same way, the student can check graphically what happens when basic operations are performed with fractional numbers. From the point of view of Cedeño Romero & Murillo Moreira (2019) it is indicated that virtual learning environments have an increasing preponderance in the teaching process. The technological incursion has become a challenge for pedagogical models. That is why there is an urgent need to apply innovative strategies that promote the development of skills that can foster in students their critical and reflective capacity for basic knowledge in different fields (McDonough & Shaw, 2012; Párraga et al., 2018).

As part of the analysis, a performance comparison is also made with respect to the assessment obtained by the pre- and post-test students of the control and experimentation groups. In order to clearly determine the statistical difference based on the results obtained. The information obtained reveals that the experimental group, based on the use of the PhET simulator, had a greater understanding of the concepts of operations with fractional numbers than the control group that received the traditional teaching method (Guo, 2018; Hussein & Dawood, 2018; Kpohoue, 2018).

4 Conclusion

The results obtained through the implementation of the diagnostic test, using traditional methods to develop a mathematical logic class, show that when asking the control group made up of 16 EGB students from the "Bachillero" Fiscal Educational Unit to solve exercises using the mathematical logic for the calculation of fractional numbers, the results indicated that a majority segment of the students could not respond adequately. Probably, the lack of didactic elements does not allow students to visualize fractional numbers in three dimensions and, therefore, this is the cause for them having difficulty mentally calculating this type of exercise. The results obtained through the use of the PhTE simulator to solve exercises with fractional numbers, show that, when asking the experimental group made up of 16 EGB students from the "Bachillero" Fiscal Educational Unit to solve exercises using mathematical logic For the calculation of fractional numbers, the results indicated that, contrary to the control group, these students achieved significant learning, since the images provided by the PhTE simulator allowed them to visualize the proposed fractional numbers in a three-dimensional way. It is worth mentioning that, with the use of this type of simulator, students also show greater motivation and interest in learning.

Conflict of interest statement
The authors declared that they have no competing interest.

Statement of authorship
The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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