Remittances Review
June, 2023
Volume: 8, No: 4, pp. 114-135
ISSN: 2059-6588 (Print) | ISSN 2059-6596 (Online)
remittancesreview.com

Received: 28 November 2022 Accepted: 28 March, 2023
DOI: https://doi.org/10.33182/rr.v8i4.9

The use of geogebra in the achievements of mathematical skills in students of a private entity

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Abstract

GeoGebra is free software of interest for teaching and learning mathematics, since it offers the possibility of associating geometric and algebraic objects to solve complex problems; It also allows the approach of various mathematical problems in a creative and original way. For this reason, this research had the objective "to identify the effect of the use of GeoGebra on the achievement of the competences of the area of mathematics in the students of the 4th grade of secondary school of the private educational institution Bertolt Brecht of Lima, 2022". Its main theoretical foundation is the focus on problem solving. It was a quantitative study, positivist paradigm, hypothetical deductive method; quasi-experimental design, longitudinal cut, with a population of 70 students, control and experimental group of 35 members each. For data collection, the survey was used by technique and the knowledge test by instrument. The main result was that in the pretest the average range of achievement of mathematical skills was similar for both the control group and the experimental group, while in the posttest the U-Mann Whitney test exhibited significant differences (11,500 and z= -7 .09), with a ρ= .000. It is concluded that the use of GeoGebra influences the achievement of mathematical skills in the studied sample.

Keywords: *Life skills, Mathematical logic, Reasoning, Problem solving, Didactic software (source: Unesco Thesaurus)*

Introduction

The achievement of mathematical skills is one of the most outstanding facts of basic training, given that mathematics has a utility and applicability that transcends the borders of an educational center. To facilitate this process, fortunately there are various materials and didactic resources such as the free GeoGebra software. He is known for his contribution to the development of mathematical skills, including in university and non-university higher education.

Mathematical competence is defined as the individual ability to use and interpret mathematics in diverse contexts and includes mathematical reasoning and the use of mathematical concepts, procedures and tools for the description, explanation and prediction of phenomena (Organization for Economic Cooperation and Development, 2017). It is constantly used in everyday life and is a fundamental tool of scientific knowledge, but due to its abstract nature and the persistence of non-

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relevant didactics, it has become one of the areas that most affects school failure (Ramos et al., 2021). It is in mathematics where a student gets the lowest grades, due to the lack of knowledge of mathematical language and its erroneous use in educational contexts.

The Organization of Ibero-American States (2021) points out that the use of didactic resources makes education meet the diversity of students' learning, considering their interests and needs. The use of various tools allows them to take advantage of the diversity of students and to assume their own leadership in relation to their learning, in what allows them to address the resolution of problems, challenges or projects in real situations of their lives contributing to their community. Accordingly, the use of GeoGebra in the region has had an impact on academic performance, as demonstrated by research conducted in Ecuador with a 70% increase in the assimilation of symbolic knowledge and graphics (Barahona et al., 2017), likewise in Mexico it was evidenced that the use of the Geogebra tool impacted student satisfaction by 97% and 20% in terms of improving academic performance; All this managed to improve skills such as abstraction, analysis, synthesis and the ability to pose, solve and identify problems (Ortiz & Mejía, 2020).

Regarding the mathematical competence evaluated in PISA 2018, most Latin American countries were located at level 1, being meritorious what Chile and Uruguay achieved since they obtained the best results in the region (Ministry of Education, 2018, p. 77). In addition, the average performance of Peruvian students in mathematics is similar to that obtained by students in Colombia, Costa Rica, Mexico, Bosnia and Herzegovina, Jordan, Georgia, North Macedonia and Lebanon. It should be noted that 60.3% of Peruvian students evaluated are located at level 2 (Minedu, 2018), which should be cause for reflection, since those in that PISA group are only able to answer questions related to known contexts where they have all the necessary data to infer an answer. So to solve a problem they are only able to carry out routine procedures in explicit situations.

For the Ministry of Education of Peru (2021) The use of didactic resources in the classroom facilitates the teaching and learning process, since it allows to complement, use and strengthen the practice of the teachers, improving the implementation of the curriculum within an approach that seeks to give prominence to the student in his formative process, also highlights the importance of generating learning opportunities that deepen knowledge and improve the pedagogical function. This is shown by a study conducted by Quispe (2018) who in his research obtained a level of confidence of 95% in teachers who used GeoGebra as a didactic strategy that helped improve the manipulation, sketching and approach of solutions on quadratic equations. Another study found an increased level of achievement of problem-solving competence with an average of 14.78 compared to the normal group that scored 11.89 (Apaza, 2020). Likewise, in another study carried out in Lima it was shown that the application of GeoGebra significantly improves the ability of demonstration and reasoning of mathematical functions in students, along with the ability to communicate. (Allcca, 2018)

The use of technological tools as didactic resources helps to explore potential mechanisms of

teacher support, where teachers are equipped with content, knowledge and skills to effectively apply technologies and pedagogies that facilitate the teaching and learning process towards student achievement. It is necessary, since it improves the creativity and visualization of the concept on different forms, increases the performance; encourages curiosity and creativity; clarifies the meaning of concepts and encourages students' overall learning in mathematics (Sagesse et al., 2020; Silfanus & Sariyasa, 2018).

At the national level, the issue has been addressed from various research perspectives. Apaza (2020) in his research he aimed to determine the influence of GeoGebra on the achievement of mathematical competence. It was a study ascribed to the quantitative approach and quasi-experimental design. It was observed that the experimental group obtained better grade point average than those of the control group. Consequently, it was concluded that GeoGebra significantly influences the competence solves problems of shape, location and movement ($p = 0.05$), where the difference was p-value = 0.00, in the means of the pretest and posttest.

Diaz et al. (2018) were interested in evaluating the effects of GeoGebra on the teaching of geometry. It was a quasi-experimental study involving 48 students. The results showed that in the intervention group important effects were found on their reasoning ability, mathematical communication, demonstration and problem solving. It was concluded that the application of the software allowed to reach high ($r>0.50$) and moderate ($r>0.30$) levels in the study capacities of the intervention group.

In the same way, at the international level Adelabu et al. (2019) raised their research with the aim of examining the importance of GeoGebra software in the performance of students in geometry. The study had a quasi-experimental design. The results showed that the use of GeoGebra was important in the experimental group, since it improved the performance of the students and their performance in the mathematical field. It was concluded that there is great potential in using GeoGebra to teach mathematics in secondary schools.

Zulnaidi et al. (2019) proposed an investigation with the objective of determining the effects of the use of GeoGebra software on the performance of students in a secondary school. A quasi-experimental research was carried out with a sample of 80 students, 40 formed the treatment group and 40 formed the control group. The results of the research showed that teachers and students approved the use of GeoGebra in teaching and learning mathematics, it helped to illustrate mathematical concepts and procedures well through images and graphs, which considerably helps students to master and understand concepts and procedures related to functions and limit functions.

It was presented as an easy-to-use teaching material and can ease the burden on teachers by explaining the functions, allowing an active interaction between teachers and students. This study provides suggestions as interventions to increase student achievement.

Methods and Materials

The research has been of the applied type, since what is sought is the application of cooking immediately (Carhuancho et al., 2019). Thus, the quasi-experimental experimental design was used, which allowed measuring the influence of an independent variable (use of GeoGebra educational software) on the dependent variable (teaching and learning in the area of Mathematics), all based on pretest and posttest measurements (Cohen and Gómez, 2019). Population is the total universe of elements that share some characteristics such as place of residence, age or sex (Carrasco, 2019). In this case, the population was made up of 70 students of the 4th year of secondary school of a private educational institution in East Lima. Specifically, 35 students from classroom A, 35 more in classroom B. Because it is a relatively small population, the researcher worked with all these elements.

Consequently, this is a census population. The sample consists of a representative subgroup of the population, whose number should support the extrapolation of the conclusions from the part to the whole (Cohen and Gómez, 2019). As it is a census population, the sample has a size equivalent to that of the population. The sample consisted of 70 4th grade students, 35 of them were part of the control group and the remaining 35 were part of the experimental group. The sample was a consequence of convenience sampling. That is, probabilistic criteria have not intervened, but only the criterion of the researcher (Delgado-Santa Gadea, 2018). The technique was the survey and the instrument has been a test of knowledge. The survey is one of the most used techniques for data collection. Likewise, the questionnaire as a systematic series of questions must be articulated with the objectives of the research work. In this case, a pretest and posttest knowledge test was used (Delgado-Santa Gadea et al., 2018). The instrument had a certificate of validity of content by expert judgment, determined by five expert teachers, resulting in the instrument being applicable. This instrument was developed by Reyes-Tucto (2020). On the other hand, its reliability had a coefficient of 0.88 with Cronbach's alpha statistic for dichotomous item instruments. Quantitative data were processed using descriptive and inferential statistical techniques. In the first case, with the descriptive statistics, the frequency distribution was obtained, that is, the descriptive results (Hernández and Mendoza, 2018). In the second case, with inferential statistics, the hypothesis test was performed during the pretest and posttest to establish if there are significant differences after the application of the program (Hernández et al., 2014). The statistical method used will be the Mann-Whitney U, this allowed to verify if two random and independent samples come from the same population, although the normality of the populations of origin cannot be assumed a priori (Ramírez and Pollack, 2020). To this end, a series of tests called nonparametric statistics was carried out, being the most distinctive of them, since it contrasts the medians of two independent groups of free distribution (Porras, 2019).

Results

For the testing of the hypotheses, the characteristics of normality of the population studied had to

be known.

Normality test

Shapiro-wilk normality test (n<50)

Group		Variable	Statistical	Gl	Gis.
Pretest	Experimental	Mathematics	0.966	35	0.335
		Solve quantity problems	0.847	35	0.000
		Solves problems of regularity, equivalence and changes	0.907	35	0.006
		Solves problems of shape, movement and location	0.908	35	0.007
		Solves data management and uncertainty issues	0.912	35	0.008
	Control	Mathematics	0.940	35	0.057
		Solve quantity problems	0.826	35	0.000
		Solves problems of regularity, equivalence and changes	0.859	35	0.000
		Solves problems of shape, movement and location	0.906	35	0.006
		Solves data management and uncertainty issues	0.899	35	0.004
Posttest	Experimental	Mathematics	0.959	35	0.215
		Solve quantity problems	0.820	35	0.000
		Solves problems of regularity, equivalence and changes	0.741	35	0.000
		Solves problems of shape, movement and location	0.789	35	0.000
		Solves data management and uncertainty issues	0.806	35	0.000
	Control	Mathematics	0.953	35	0.135
		Solve quantity problems	0.884	35	0.002
		Solves problems of regularity, equivalence and changes	0.852	35	0.000
		Solves problems of shape, movement and location	0.901	35	0.004
		Solves data management and uncertainty issues	0.867	35	0.001

Table 1: Result of the test statisticians and their math skills

Group		Area and competences	N	Minimal	Maximum	Stocking	OF
Pretest	Experimental	Math test	35	7	14	10.54	1.669
		Solve quantity problems	35	0	4	2.34	0.838
		Solves problems of regularity, equivalence and changes	35	1	5	2.63	0.973
		Solves problems of shape, movement and location	35	1	5	2.86	0.974
		Solves data management and uncertainty issues	35	1	5	2.71	1.017
	Control	Math test	35	7	13	10.20	1.471
		Solve quantity problems	35	0	4	2.40	0.812
		Solves problems of regularity, equivalence and changes	35	1	4	2.40	0.812
		Solves problems of shape, movement and location	35	1	5	2.83	0.954
		Solves data management and uncertainty issues	35	0	4	2.57	1.065
Posttest	Experimental	Math test	35	13	20	16.63	1.784
		Solve quantity problems	35	2	5	4.00	1.029
		Solves problems of regularity, equivalence and changes	35	3	5	4.31	0.583
		Solves problems of shape, movement and location	35	2	5	4.20	0.901
		Solves data management and uncertainty issues	35	3	5	4.11	0.758
	Control	Math test	35	8	15	10.86	1.593
		Solve quantity problems	35	0	5	2.63	0.942
		Solves problems of regularity, equivalence and changes	35	1	4	2.66	0.802
		Solves problems of shape, movement and location	35	1	5	2.86	0.944
		Solves data management and uncertainty issues	35	1	4	2.71	0.860

Note. SD: standard deviation (Source: Authors)

The descriptive statistics of the test and their math competencies are shown; the mean of the mathematics test of the pretest of the control group was 10.20 similar to the mean of the experimental group which was 10.54. On the other hand, in the posttest of the control group it was 10.86 and of the experimental group it was 16.63, evidencing improvement in the posttest of the experimental group in the achievement of mathematics skills.

Table 2: Result of the Pretest and posttest of the achievement of the area of mathematics

Group		Level of achievement								Total
		In the beginning		In Process		Expected achievement		Outstanding achievement		
		n	%	n	%	n	%	n	%	
Pretest	Experimental	18	51.4%	16	45.7%	1	2.9%	0	0.0%	35
	Control	19	54.3%	16	45.7%	0	0.0%	0	0.0%	35
Posttest	Experimental	0	0.0%	2	5.7%	22	62.9%	11	31.4%	35
	Control	16	45.7%	17	48.6%	2	5.7%	0	0.0%	35

Note f: frequencies, %: percentage; $\bar{X}$: mean, CG: control group; GE, experimental group; $\bar{X}$GC-pretest=10.20; $\bar{X}$GE-pretest=10.54; $\bar{X}$GC-postest=10.86; $\bar{X}$GE-postest=16.63.

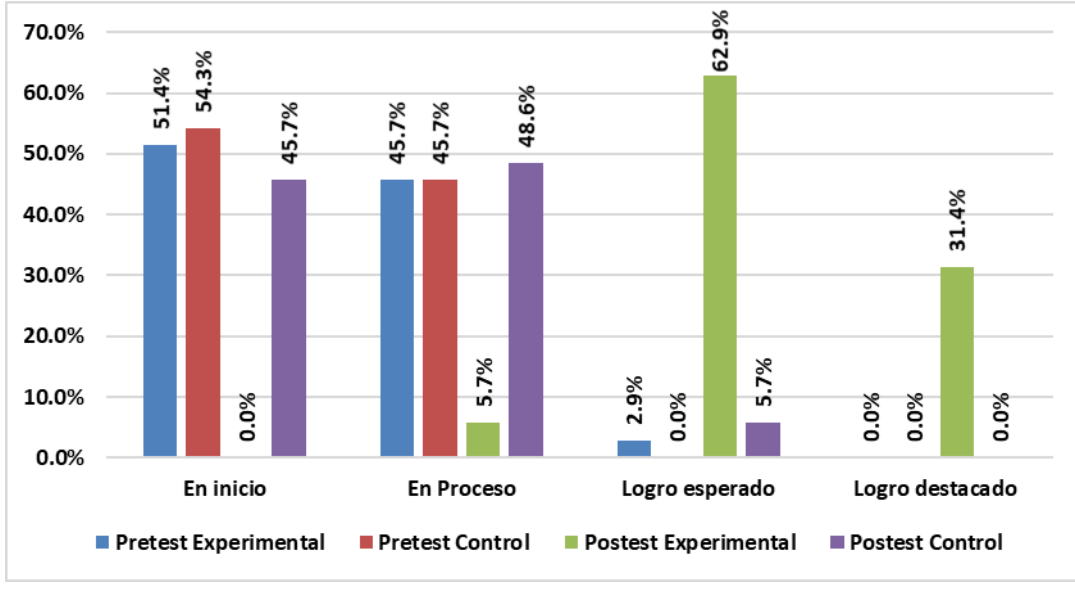

Figure 1: Result of the Pretest and posttest of the achievement of the area of mathematics

(Source: Authors)

Table 2 and Figure 1 show the frequencies and percentages obtained at each level of achievement of the mathematics test according to each group, both control and experimental groups. In this

context, in the pretest, there is a similarity in the frequencies of the levels of achievement for both groups at the beginning (with 51% in the experimental group and 54% in the control group), while for the posttest the frequencies in each level of achievement obtained by the experimental group is greater than that of the control group (with 63% in the expected achievement and 31% in the outstanding achievement of the experimental group and 48% in the achievement in process and 46% in the achievement at the beginning of the control group), in students of the private educational institution Bertolt Brecht of Lima, 2022.

Table 3: Pretest and posttest result of proficiency achievement solves quantity problems

Group		Level of achievement								Total
		In the beginning		In Process		Expected achievement		Outstanding achievement		
		n	%	n	%	n	%	n	%	
Pretest	Experimental	3	8.6%	19	54.3%	13	37.1%	0	0.0%	35
	Control	2	5.7%	19	54.3%	14	40.0%	0	0.0%	35
Posttest	Experimental	0	0.0%	3	8.6%	17	48.6%	15	42.9%	35
	Control	2	5.7%	14	40.0%	18	51.4%	1	2.9%	35

Note. $\bar{X}$: mean, CG: control group; GE, experimental group; $\bar{X}$GC-pretest=2.40; $\bar{X}$GE-pretest=2.34; $\bar{X}$GC-postest=2.63; $\bar{X}$GE-postest=4.0.

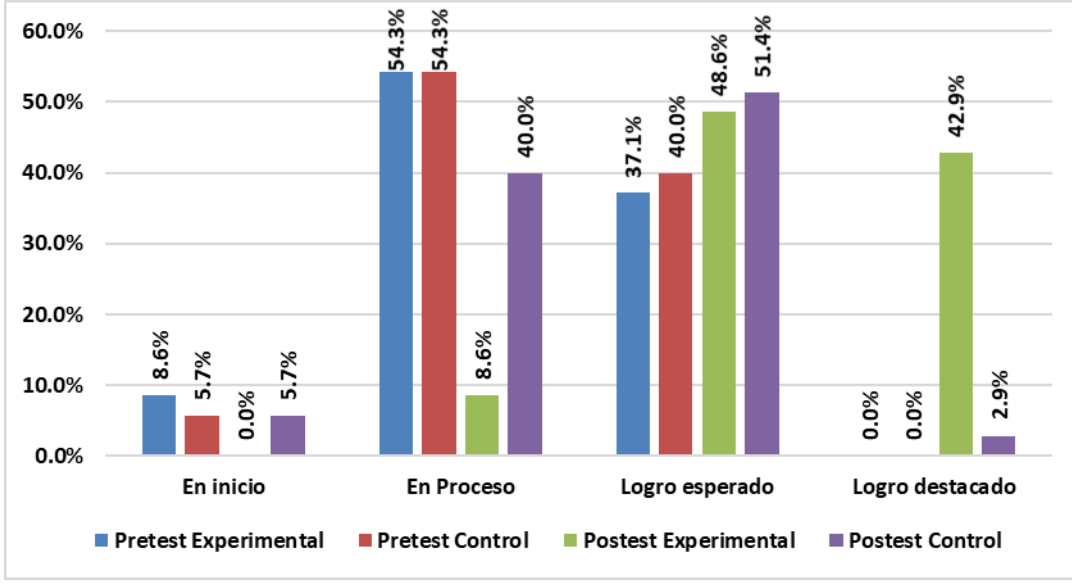

Figure 2: Pretest and posttest result of proficiency achievement solves quantity problems (Source: Authors)

Table 3 and Figure 2 found that in the pretest the control group predominated the level in process

(54.3%), followed by the expected achievement level (40.0%), and at baseline (5.7%); In the pretest, the experimental group predominated the level in process (54.3%), followed by the expected achievement level (37.1%, and at the beginning (8.6%), finding similar results. On the other hand, in the posttest of the control group it was found that the expected achievement level predominated (51.4%), followed by the level in process (40.0%), in initiation (5.7%) and outstanding achievement (2.9%). In the posttest of the experimental group, the expected achievement level predominated (48.6%), followed by the outstanding achievement level (42.9%), in process (40.0%) and at the beginning (5.7%), evidencing improvement in the posttest of the experimental group in the achievement of the competence solves quantity problems, in students of the private educational institution Bertolt Brecht of Lima, 2022.

Table 4: Result of the pretest and posttest of the achievement of competence solves problems of regularity, equivalence and change

Group		Level of achievement								Total
		In the beginning		In Process		Expected achievement		Outstanding achievement		
		n	%	n	%	n	%	n	%	
Pretest	Experimental	4	11.4%	12	34.3%	18	51.4%	1	2.9%	35
	Control	5	14.3%	13	37.1%	17	48.6%	0	0.0%	35
Posttest	Experimental	0	0.0%	0	0.0%	22	62.9%	13	37.1%	35
	Control	3	8.6%	10	28.6%	22	62.9%	0	0.0%	35

Note. $\bar{X}$: mean, CG: control group; GE, experimental group; $\bar{X}$GC-pretest=2.40; $\bar{X}$GE-pretest=2.63; $\bar{X}$GC-postest=2.66; $\bar{X}$GE-postest=4.31.

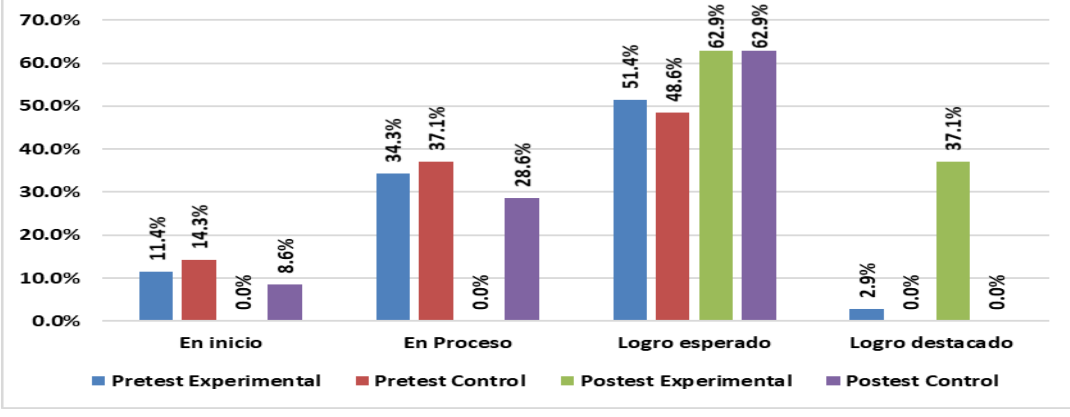

Figure 3: Result of the pretest and posttest of the achievement of competence solves problems of regularity, equivalence and change **(**Source: Authors)

Table 4 and Figure 3 found that in the pretest the control group predominated the expected achievement level (48.6%), followed by the process level (37.1%), and at the beginning (14.3%); in

the pretest the experimental group predominated the expected achievement level (51.4%), followed by the level in process (34.3%), at the beginning (11.4%) and outstanding achievement (2.9%), similar results were found. On the other hand, in the posttest of the control group it was found that the expected achievement level predominated (62.9%), followed by the level in process (28.6%), and in the beginning (8.6%). In the posttest of the experimental group, the expected achievement level (62.9%), and outstanding achievement level (37.1%) predominated, evidencing improvement in the posttest of the experimental group in the achievement of competence solves problems of regularity, equivalence and change, in students of the private educational institution Bertolt Brecht of Lima, 2022.

Table 5*:* Pretest and posttest result of proficiency achievement solves shape, movement and localization problems

Group		Level of achievement								Total
		In the beginning		In Process		Expected achievement		Outstanding achievement		
		n	%	n	%	n	%	n	%	
Pretest	Experimental	3	8.6%	9	25.7%	22	62.9%	1	2.9%	35
	Control	3	8.6%	9	25.7%	22	62.9%	1	2.9%	35
Posttest	Experimental	0	0.0%	1	2.9%	17	48.6%	17	48.6%	35
	Control	3	8.6%	8	22.9%	23	65.7%	1	2.9%	35

Note. $\bar{X}$: mean, CG: control group; GE, experimental group; $\bar{X}$ GC-pretest=2.83; $\bar{X}$ GE-pretest=2.86; $\bar{X}$ GC-postest=2.86; $\bar{X}$ GE-postest=4.20.

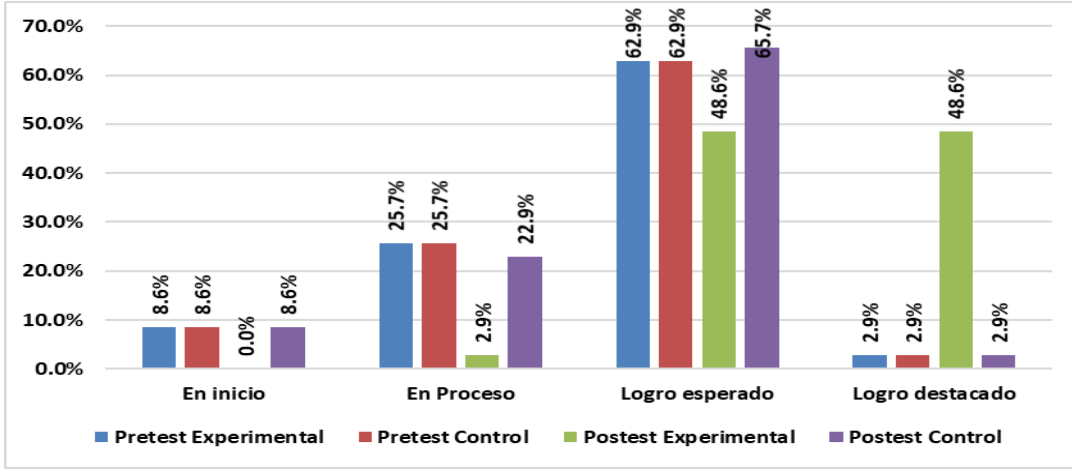

Figure 4: Pretest and posttest result of proficiency achievement solves shape, movement and localization problems (Source: Authors)

Remittances Review
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Volume: 8, No: 4, pp. 114-135
ISSN: 2059-6588 (Print) | ISSN 2059-6596 (Online)

Table 5 and Figure 4 found that in the pretest the control group predominated the expected achievement level (62.9%), followed by the level in process (25.7%), at baseline (8.6%) and outstanding achievement (2.9%); In the pretest, the experimental group predominated the expected achievement level (62.9%), followed by the level in process (25.7%), at the beginning (8.6%) and outstanding achievement (2.9%), finding similar results. On the other hand, in the posttest of the control group it was found that the expected achievement level predominated (65.7%), followed by the level in process (22.9%), in initiation (8.6%) and outstanding achievement (2.9%). In the posttest of the experimental group, the expected achievement and outstanding achievement level (48.6% each) predominated, and the level in process (2.9%), evidencing improvement in the posttest of the experimental group in the achievement of the competence solves problems of form, movement and location, in students of the private educational institution Bertolt Brecht of Lima, 2022.

Table 6: Pretest and posttest result of proficiency achievement solves data management problems and uncertainty

Group		Level of achievement								Total
		In the beginning		In Process		Expected achievement		Outstanding achievement		
		n	%	n	%	n	%	n	%	
Pretest	Experimental	4	11.4%	11	31.4%	19	54.3%	1	2.9%	35
	Control	5	14.3%	12	34.3%	18	51.4%	0	0.0%	35
Posttest	Experimental	0	0.0%	0	0.0%	23	65.7%	12	34.3%	35
	Control	2	5.7%	13	37.1%	20	57.1%	0	0.0%	35

Note. $\bar{X}$: mean, CG: control group; GE, experimental group; $\bar{X}$ GC-pretest=2.57; $\bar{X}$ GE-pretest=2.71; $\bar{X}$ GC-postest=2.71; $\bar{X}$ GE-postest=4.11.

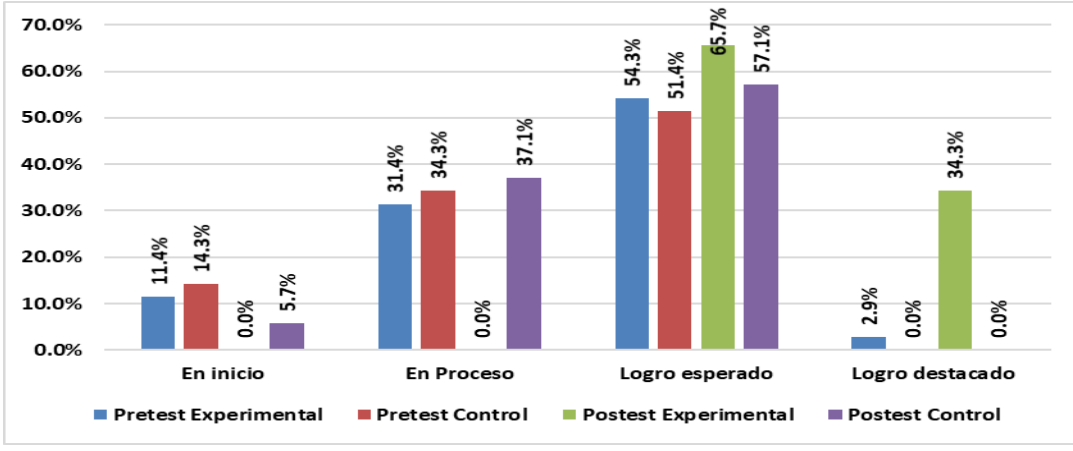

Figure 5: Pretest and posttest result of proficiency achievement solves data management problems and uncertainty (Source: Authors)

Table 6 and Figure 5 found that in the pretest the control group predominated the expected achievement level (51.4%), followed by the level in process (34.3%), and at baseline (14.3%); In the pretest, the experimental group predominated the level of expected achievement (54.3%), followed by the level in process (31.4%), at the beginning (11.4%) and outstanding achievement (2.9%), finding similar results. On the other hand, in the posttest of the control group it was found that the expected achievement level predominated (57.1%), followed by the level in process (37.1%), and in the beginning (5.7%). In the posttest of the experimental group, the expected achievement level (65.7%), and outstanding achievement (34.3%) predominated, evidencing improvement in the posttest of the experimental group in the achievement of the competence solves problems of data management and uncertainty, in students of the private educational institution Bertolt Brecht of Lima, 2022.

DISCUSSION

In reference to the general hypothesis raised, it is indicated that this has had its support in the statistics and results of previous works such as Castillo (2019) and Apaza (2020), finding significant differences in favor of the experimental group when the resource is GeoGebra and the subject of mathematics is plane geometry. We must consider that GeoGebra is part of a didactic strategy for the improvement of competences, integrating technology for a friendlier approach to mathematical content, reaching a greater attractiveness for this subject and the acquisition of knowledge, skills and attitudes for it (Zeballos, 2020). This becomes more relevant in the framework of the approach focused on problem solving, especially since the pioneering publications of George Polya in the second half of the twentieth century (García et al., 2023). The approach in question stands out for considering mathematics as a dynamic cultural product in continuous readjustment, whose scenario is to solve problems based on situations conceived as significant events in various contexts (Minedu, 2016). One of its conceptual bases is the theory of didactic situations described in Brousseau (1986), as a form of modeling the teaching and learning process, so that this process is visualized as a game where the educator and the learner have configured implicit rules and actions.

Regarding specific hypothesis 2, Allca (2018) found means or averages that were always favorable for the experimental group after applying the free GeoGebra software, to the point that it contributes to learning and the progress of mathematical skills. Similarly, Mollena and Fuentes (2019) showed that GeoGebra achieved a significant influence on the development of mathematical competences. In this way we can affirm that the average range of problem solving in the pretest was similar in the control group and the experimental group, which means that there is significant influence of the use of GeoGebra in the dependent variable, which coincides with the authors referred to above.

In reference to the second specific hypothesis, the result has shown that average range of problem solving in the pretest was similar in the control group and the experimental group, which means that there is significant influence of the use of GeoGebra in the dependent variable. These results

coincide with those found by Díaz et al. (2018) who verified the development in reasoning, mathematical communication and problem solving. Likewise, Udofia and Uko (2018) showed that the scores between the control group and the experimental group were resolved in favor of the second after applying the Geogebra. In this regard, Bressan et al. (2016) is the disseminator of an attractive proposal called realistic mathematical education, which emerged in the sixties of the last century as a response to the mechanistic approach of teaching arithmetic. The founder is the German mathematician and pedagogue H. Freudenthal (1973). Its central idea is that teaching and learning mathematics are not activities that achieve their goals separated from reality. On the contrary, permanent contact with reality must be sought, remaining close to the needs and expectations of students, without neglecting their projection to the community (Freudenthal, 1991). Therefore, mathematical work is a structuring activity available to anyone.

With respect to the third specific hypothesis, the previous works of Adelabu (2019) and Bayaga (2019), have been some of the antecedents, where it has been found similitu of, in terms of the theme, theoretical bases and findings. When investigating the theoretical-conceptual bases of the problem-solving approach, it is found that Minedu (2016) cites Schoenfeld (1985). This is no coincidence, since he was an American mathematician enthusiastic about the work of Polya (1990), although some testimonies from instructors who were in charge of preparing people who were going to compete in mathematical Olympiads said that they did not use those ideas, because apparently they did not work. The answer of Schoenfeld (1985) came with one of his books: if you want to work with problem solving as a didactic strategy, you must take into account certain situations beyond the exclusively heuristic. Otherwise, it would not work, not because heuristics are worthless, but because they are not sufficient to fully address the problem of learning mathematics for life.

Regarding the fourth hypothesis The result has supported the premise, because the average range of problem solving in the pretest was similar in the control group and the experimental group, which means that there is significant influence of the use of GeoGebra on the dependent variable. This coincides with what Zulnaldi et a. (2019) found that the use of GeoGebra also improves school performance in mathematics.

Another source cited by Minedu (2016) is the contribution of the Spanish Society for Research in Mathematics Education. This contribution has been synthesized by Trigo (2008). Precisely, he emphasizes that problem solving is a way of thinking where a learning community (teachers and teachers) explore new alternatives to solve a certain problematic situation, recognizing the importance of justifying the answers with various types of arguments. In other words, the goal does not end in informing about an answer obtained, but fundamentally in identifying and contrasting other forms of representation, exploration and resolution of the problem. Obviously, this goes beyond sketching out activities that allow extending the initial problem and formulating guesses and other problems.

Conclusion

Through the present work we can conclude by mentioning that the general objective, the use of GeoGebra influences the achievement of mathematical skills of students of the 4th grade of secondary school, Lima 2022, according to the results of the Mann Whitney test: 11,500; z = -7.09; ρ= ,000. There are also significant differences between pretest and posttest measurements after use. If we refer to the specific objectives set, we can affirm that the use of GeoGebra influences the achievement of the competition solves problems of quantity of the students of the 4th grade of secondary school, Lima 2022, with significant differences between the pretest and posttest measurements after its use. On the influence of GeoGebra in the achievement of the competition, it is resolved that I there is influence, with the existence of significant differences taking the pretest measurements after use. Similarly in the third and fourth specific objective, always showing the significant difference between the measurements of the pretest and posttest. In this sense, through the various measurements and evidence, we show the great influence of GeoGebra in everything related to the Development of competences in the area of mathematics.

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