GESj
Vol. 5, N° 1, 2023

Journal of Global Education Sciences

A publication of
CINCADER
Centre of Research and Training for Regional Development
Online at www.journals.cincader.org

ISSN 2663-3787
DOI: https://doi.org/10.32829/gesj.v5i1.187

The influence of the free software GeoGebra use in the teaching achievement of mathematics course learning in the students at the Educational Institution Gabino Uribe Antúnez "GUA"-UGEL-Aija, 2022

[Influencia del uso del software libre GeoGebra en el logro del aprendizaje del curso de enseñanza matemática en los estudiantes de la Institución Educativa Gabino Uribe Antúnez "GUA"-UGEL-Aija, 2022]

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Received: 29 December 2022; Accepted: 27 January 2023; Published: 06 February 2023

Resumen

El propósito de la investigación es explicar la influencia de uso del Software Libre Geogebra en el logro de aprendizaje del curso de matematica en los estudiantes de la Institución Educativa Gabino Uribe Antúnez “GUA”-UGEL-AIJA. La investigación es tipo experimental transversal, método cuantitativo y diseño preexperimental. Se aplicó dos instrumentos: un examen de entrada y otro de salida, a una muestra poblacional de 19 estudiantes de 4° grado de secundaria de la I.E. Gabino Uribe Antúnez “GUA”-UGEL-AIJA. Se realizo un análisis sobre los resultados, después de haber usado el Software Libre Geogebra al grupo único de estudio (cuarto año de secundaria, grupo experimental). aplicando métodos inductivos, deductivos y de análisis, así como técnicas de observación con su respectivo instrumento. De los resultados obtenidos en el tratamiento estadístico por medio de la estadística descriptiva e inferencial, concluyendo que existe influencia significativa en el logro de aprendizaje del curso de matematica en los estudiantes de la Institución Educativa Gabino Uribe Antúnez “GUA”-UGEL-AIJA

Palabras clave: Software Libre, Software GeoGebra, Interpretación geométrica, aprendizaje, enseñanza.

Abstract

The purpose of the research is to explain the influence of the use of Free Software Geogebra on the learning achievement of the mathematics course in the students at the Educational Institution Gabino Uribe Antúnez "GUA"-UGEL-AIJA. The research is cross-sectional experimental type, quantitative method and pre-experimental design. Two instruments were applied: an entrance exam and an exit exam, to a population sample of 19 students of 4th grade of secondary school of the I.E. Gabino Uribe Antúnez “GUA”-UGEL-AIJA. An analysis of the results was carried out, after having used the Free Software Geogebra to the single study group (fourth year of high school, experimental group). applying inductive, deductive and analysis methods, as well as

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observation techniques with their respective instrument. From the results obtained in the statistical treatment through descriptive and inferential statistics, concluding that there is a significant influence on the learning achievement of the mathematics course in the students at the educational Institution Gabino Uribe Antúnez "GUA"-UGEL-AIJA

Keywords: Free Software, GeoGebra Software, Geometric Interpretation, learning, teaching.

I. Introduction

Given the context of the COVID-19 health emergency, educational institutions have adapted to this Teaching-Learning method and are now supporting the creation and use of active methodologies together with ICTs in the teaching of mathematics in encourage participation and collaboration in the classroom virtually and remotely using the media, the internet, mathematical programs and other tools that help in Teaching - Learning. For its part, the General Education Law No.: 28044, also mentions in chapter V- role of the state: article 21 function of the state, literal c: Promote scientific and technological development in educational institutions throughout the country and the incorporation of new technologies in the educational process, in Article 31, literal c: Develop learning in the fields of science, humanities, technology, culture, art, physical education and sports, as well as those that Allow the educate a good use and usufruct of new technologies and finally in article 74, literal i: Support the development and adaptation of new communication and information technologies to achieve the improvement of the educational system with an intersectoral orientation (Minedu, 2003).

The free software GeoGebra in Mathematics Teaching-Learning has entered in these new times in all areas of knowledge and application, also making contributions to the educational society, its organization and development model has allowed it to position itself today as a real support complementing with the computing and informatics means of the current world. But little is known about the use and application of free software GeoGebra in particular for educational use at all educational levels, and it is necessary to study the evolution and development status of free educational software. It should be mentioned that in this investigation it was identified and documented that in the current educational society, the use of technologies as a means of facilitating the teacher and student's teaching-learning process is far from reality, so that with This research is to be transformed, with evidence for a repository or physical files of digital resources initially designed for simulators that store the results and experiences of this study and publish them on the Internet through a Web site. And subsequently includes all types of educational software.

Once this purpose was defined, the project began the study on the subject and throughout this document the results obtained are exposed, categorizing and analyzing the results under certain variables.

Studies are presented by type of free GeoGebra software identified, by type of language in which they were developed, by type of license with which they are distributed, by the operating system platform in which they are available and in the case of mathematics that is the central topic by area of knowledge within mathematics. These challenges are aimed at training professionals within the framework of scientific and technological progress. For this reason, those who assume the training responsibility have to commit themselves to educational innovations that help guide students in Teaching-Learning, with analytical and critical thinking about the adaptation to the reality where they carry out their teaching work.

We must keep in mind that the Teaching-Learning process at the university level presents, in some cases, serious difficulties for the specialist who assumes the responsibility of conducting it

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without having the necessary pedagogical preparation for it. This forces them to combine methods and strategies to contribute to their professional profile that the Society of the 21st century requires. Students increasingly need to face problem solving and compare them with the use of mathematical software, in particular through the use of Mathematics software (GeoGebra); not only in school and/or higher education, but in their future workplaces, where creativity and innovation will be necessary.

In this research work, a comparative study was carried out between the academic performance achieved in the teaching of mathematics; using for this the traditional Didactic Method in solving Problems and the free software GeoGebra, in addition complemented with the Traditional Method of teaching in the students at the Educational Institution Gabino Uribe Antúnez "GUA"-UGEL-AIJA. GeoGebra is a free software (Free use) of dynamic Mathematics where you can work on geometry, algebra, graphics, spreadsheet, statistics and calculation. It allows the dynamic drawing of geometric constructions, as well as the algebraic treatment, the graphical representation and the calculation of functions.

It was created by Markus Hohenwarter in 2002 as part of his thesis "Education, materials and applications in the teaching of mathematics with GeoGebra" at the University of Salzburg (Austria) and later continued his work at the Florida Atlantic University (USA) and at Florida State University. Hohenwarter is a Master of Mathematics Education, a Master of Applied Computer Science, a teacher for teaching Computer Science in Secondary Schools, and a Doctor of Mathematics Education. From 2002 to the present he works in the Teaching of Mathematics at the University of Salzburg. He did internships and worked as a visiting professor at many universities around the world. Markus had as objective to create a calculator of free use to be able to work with Geometry and Algebra. He wanted to achieve a software where the virtues of symbolic calculation programs were combined with those of dynamic geometry. The idea of creating GeoGebra arose because, in his research, he found that many teachers found it difficult to learn symbolic calculation software due to the rigidity of its syntax. In addition, he observed that teachers found dynamic geometry programs more useful because they were easier to use.

Now with the creation and integration of communities made up of teachers and students on the use and application of free software GeoGebra, at a national and world level, its new contributions have been innovated in the use of augmented reality (ARCore), which is of very useful in Teaching-Learning for these new times. Geogebra free software can run on multiple platforms such as Microsoft Windows, Apple, Linux and Android, Unix, MS-Windows and GNU-GPL. Currently the latest version of this software is GeoGebra Classic ver. 6 (GeoGebra-Windows-Installer-6-0-674-0). The most advantageous thing is that it can be used directly from the Google internet.

In the Educational Institution Gabino Uribe Antúnez “GUA”-UGEL-AIJA, from the 42 teachers of the Professional School of Mathematics, only 18 make use of application mathematical programs, such as the particular case of the free software GeoGebra; In the teaching-learning process, most classes are expository, whether virtual or semi-face-to-face, for reasons beyond our control (there are no updated computer tools or laptops) so they do not innovate in sharing their virtual classes with students, therefore their classes they might not be attractive, let alone be forthcoming with their students. There is an educational justification, due to the use of technological resources in the teaching-learning process, which is nothing new, because it would be difficult to imagine the development of any educational activity without relying on some curricular material and pedagogical medium. We could say that without materials it would not be possible to carry out an educational program or project. In the case of secondary school teachers, the same thing happens in the use of mathematical software to be shared with their students. Reason for which we pose the following problem:

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To what extent does the use of Free Software GeoGebra influence the achievement of Teaching - Learning of the Mathematics course in the students at the Educational Institution Gabino Uribe Antúnez "GUA"-UGEL-AIJA?

We consider the findings found in the research work of Alvarez et al. (2020), work entitled "Geogebra as a strategy for teaching mathematics", whose objective was focused on describing the use of the GeoGebra tool as an alternative in the teaching process. -Mathematics learning, in order to propose a guide for the formulation of a didactic strategy plan aimed at teachers of the mathematics area of the city of Azogues. It was based on the positivist approach and was developed based on the quantitative methodology. The population consisted of 84 teachers from the area of mathematics. The results reveal that 71.8% of the teachers surveyed occasionally, almost never and/or never use some type of educational software to teach their Mathematics class. The ADDIE model proposed for the implementation of the use of GeoGebra in the classroom allows the teacher to identify the positive and negative aspects in each phase of the methodological cycle, to improve and renew their didactic activities and thus obtain better student participation.

In the same way, we consider the research of Lugo de Acosta (2017), entitled: "Effects of the Application of GeoGebra Software for Teaching - Blended Learning of Geometry Analysis at the University Level", reaching the conclusion: A comparison is made with the control group, and in response to the specific objective that is related to these dimensions, an analysis of the activities in Units I, II, IV and VI through the indicators achieved by the students participating in said activities in both groups, obtaining a notable difference between the experimental group and the control group that has resulted in a p - value equal to 0.07; this means that there is no difference between the means of both groups, that is, for the selected sample the first hypothesis is not verified:
H1: The use of GeoGebra software improves the level of understanding of fundamental concepts of Analytical Geometry and Vector Analysis through problem solving. Likewise, we consider a local antecedent of the author Valderrama, (2017), in his research work "Influence of Geogebra Software on the academic performance of students of cycle I of the EAP Tourism in the mathematical complement course-Unasam, 2017-I". It concludes that the Geogebra Software significantly influences the average academic performance of students who take the subject of Mathematical Complement of the EAP of Tourism-Unasam, 2017-I.

GeoGebra is a design and symbolic calculation program to work on Geometry and mathematical functions. The most important thing about GeoGebra is interactivity; once a figure is built, any of the independent objects that form it can be moved and all those that depend on it are automatically modified. Furthermore, once the figure is built, it can be exported as HTML and thus create the corresponding applet automatically.

Regarding learning, there are various definitions of learning, in the dictionary of Educational Sciences, it is conceived as a process through which a subject acquires practical skills or abilities, incorporates information content or adopts new knowledge strategies. Let's see the concepts of some authors about learning:
Ontoria, (1993), points out that learning is a process of development in "insights", of knowing and understanding the meaning, because learning implies not only the capture of content but also an emotional commitment of the learner. (Gallego et al, 1997), define learning as a "process of acquiring a disposition, relatively lasting, to change perception or behavior as a result of an experience".

Zabalza, (1991), indicates that learning is a theoretical construction, key in didactics that allows development at two levels, behavior and thought. In addition, it is a student's task, so it is necessary to identify the conditions of the internal processes that allow learning; He also

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considers that learning is a task of the teacher, who, being a facilitator, must not only teach content but must also try to teach how to learn.

Learning has to make sense not only logically and at the level of the content in particular, but it must have a psychological sense, which is the one that prevails over the logical sense, (Ausubel, 1985). In this way, the new information is incorporated in a substantive and non-arbitrary way into the cognitive structure of the student. The significant approach to a material makes the acquisition easier and faster than in the case of a repetitive approach because it fundamentally implies the use of previously acquired structures and elements that function as anchors for the new material (Ontoria, 1993). However, it must be recognized that not all receptive learning is passive, just as not all discovery learning is meaningful (Ausubel, 1985). Therefore, learning implies a process of construction of cultural knowledge that is typical of the subject who learns and that corresponds to the psychological functioning of each individual, while allowing their personal and social development. This learning allows the subject autonomy and the possibility of facing new situations in an active, critical and creative way (Sanchez, 1999). In each educational action, not only conceptual contents are learned, but also values, norms, attitudes, strategies and procedures that allow them to observe and explore reality in a broader dimension (Sanchez, 1999).

II. Materials and Methods

Type of research

This research is basic. Experimental, cross-sectional, quantitative method and pre-experimental design, the results were analyzed after applying the Geogebra application program to the single study group.

Research design

The research design can be defined as a schematic structure or organization that the researcher adopts to relate and control the study variables. "It serves as an instrument of direction and restriction for the researcher, in this sense, it becomes a set of guidelines under which an experiment or study is going to be carried out" (Hernández et al, 2014).

In order to achieve the proposed objectives and to analyze the accuracy of the formulated hypothesis, the research design is descriptive, specifically pre-experimental, whose scheme is:

Group	Pre-Test	Experiment	Post-Test
EG	O_1	X	O_2

Where:
EG= Experimental group (single group)
O1 = Pre-test at diagnostic level applied to the experimental group
X= Experiment (Geogebra Free Software)
O2 = Post-test applied to the experimental group to find the significant difference

Sample population

In the present research work, the study population is considered to be the students of the 4th grade of secondary school of the I.E. Gabino Uribe Antúnez "GUA"-UGEL-AIJA, made up of a population of 19 students, whose sample is the same as the population.

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Data Collection Techniques

- Survey: To collect information from students or students and standardize its computer processing for statistical analysis.
- Pretest.

At the beginning, a written test was considered with the purpose of knowing, analyzing and diagnosing the previous knowledge that the students bring about the Geogebra application program.

- Post test

At the end of the experiment, the same written test that was taken at the beginning is taken, with the purpose of evaluating the learning progress of the students to measure the achievements of the objectives set. To carry out the data analysis we used descriptive statistics and for the contrasting of hypotheses through the student's t test.

III. Results

In accordance with the objectives set out in this research, the results are shown through the table, which are a reflection of the evaluation carried out by the teacher through a single survey.

Table 1. Influence of the use of the Free GeoGebra software on the achievement of teaching-learning of the Mathematics course in the students at the Educational Institution Gabino Uribe Antúnez "GUA"-UGEL-AIJA.

		Statistics
Pre test	Average	13.26
	Median	13.00
	Standard deviation	0.73
	Minimum	12.00
	Maximum	14.00
Post test	Average	17.65
	Median	18.00
	Standard deviation	0.70
	Minimum	16.00
	Maximum	19.00

Description: Table 1 shows the most important statistical data regarding the results obtained in the pre-test of the Mathematics subject, with the average being 13.26; median of 13 and a range of levels between 12 and 14. In the post-test the average of 17.65, the median of 18 and the range between 16 and 19. The greatest variability that exists in the results is in the pre-test (0.73), however, the results of the descriptive statistics indicate that the use of the Free Geogebra software has influenced the achievement of teaching-learning of the Mathematics course in the students of the Gabino Uribe Antúnez Educational Institution "GUA" -UGEL-AIJA.

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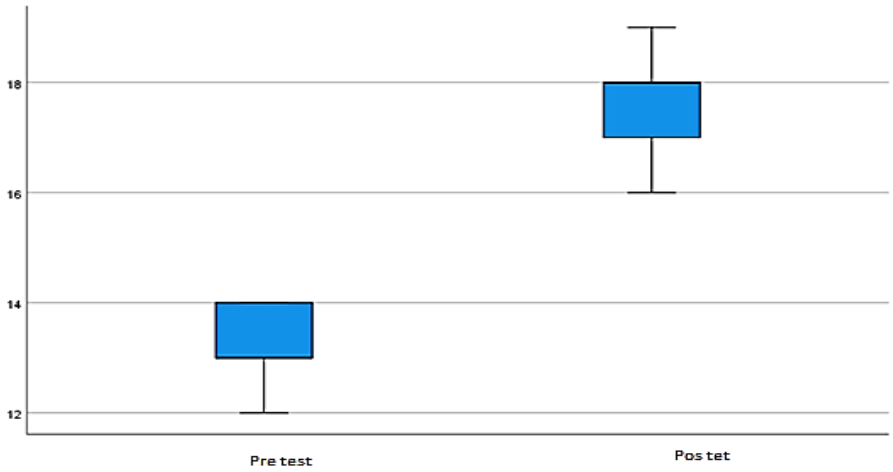

Figure 1: Average scores of the teaching-learning of the Mathematics course in the students at Educational Institution the Gabino Uribe Antúnez "GUA"-UGEL-AIJA.

Table 2: Influence of the use of the Free Geogebra software in the achievement of the ability to Communicate and represent the ideas of the Mathematics course at the Educational Institution Gabino Uribe Antúnez "GUA"-UGEL-AIJA.

	Communicative and representative capacity in ideas			
	Pre-test		Pos-test	
	n	%	n	%
Low	7	41.2	0	0.0
Medium	6	35.3	5	29.4
High	4	23.5	12	70.6
Total	17	100.0	17	100.0

The results of the Pre test show that 41.2% of the students are at a low level, 35.3% are at a medium level and 4% are at a low level, while in the post test 70.6% are at a high level while 29.4% are at a medium level.

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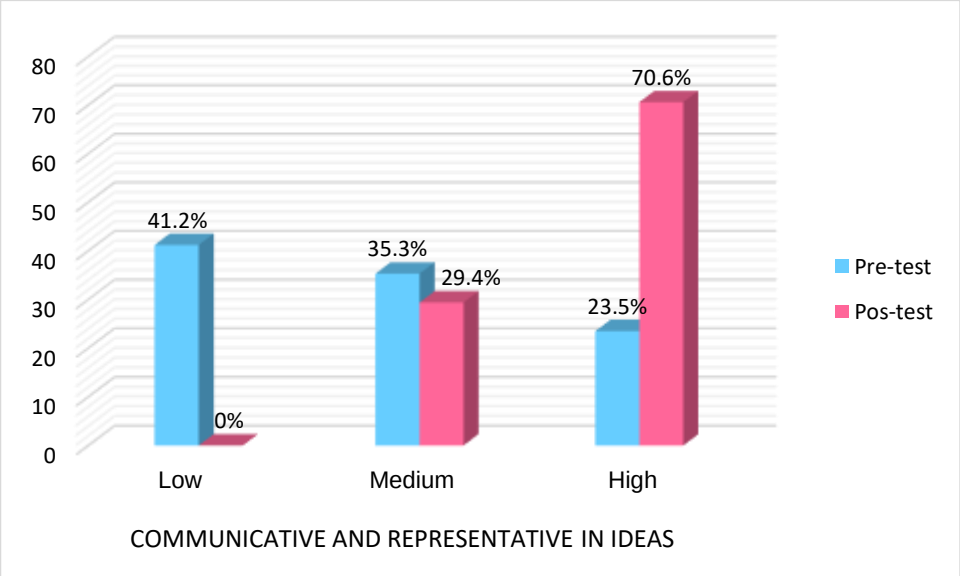

Figure 2: Influence of the use of the Free Geogebra software in the achievement of the ability to Communicate and represent the ideas of the Mathematics course at the Educational Institution Gabino Uribe Antúnez "GUA"-UGEL-AIJA.

Table 3: Influence of the use of the Free Geogebra software, in the achievement of the ability to elaborate and use strategies of the Mathematics course at the Educational Institution Gabino Uribe Antúnez "GUA"-UGEL-AIJA.

	Elaborate and use strategies			
	Pre-test		Pos-test	
	n	%	n	%
Low	2	11.8	1	5.9
Medium	12	70.6	3	17.6
High	3	17.6	13	76.5
Total	17	100.0	17	100.0

Description: The results of the Pretest show that 70.6% of the students are at a medium level, 17.6% are at a high level and 11.8% are at a low level, while in the post test, 76.5% are at a high level, 17.6% are at a medium level, and 5.9% are at a low level.

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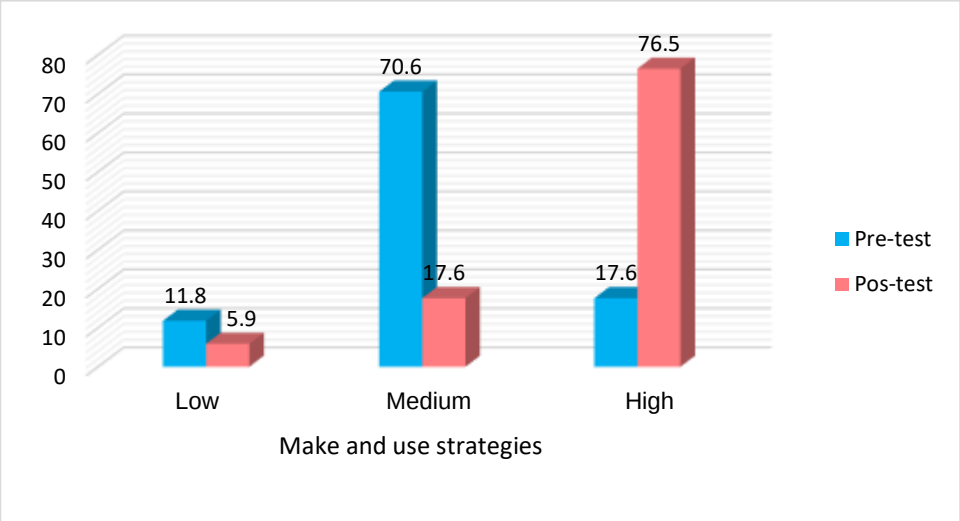

Figure 3: Influence of the use of the Free Geogebra software, in the achievement of the ability to elaborate and use strategies of the Mathematics course at the Educational Institution Gabino Uribe Antúnez "GUA"-UGEL-AIJA.

Table 4: The influence of the use of free software Geogebra in the achievement of the ability to reason and argue generating mathematical ideas in the students of the Mathematics course of the Gabino Uribe Antúnez Educational Institution "GUA"-UGEL-AIJA

	Reason and argue generating mathematical ideas			
	Pre-test		Pos-test	
	n	%	n	%
Low	11	64.7	0	0.0
Medium	5	29.4	5	29.4
High	1	5.9	12	70.6
Total	17	100.0	17	100.0

Description: The results of the Pretest show that 64.7% of the students are at a low level, 29.4% are at a medium level and 5.9% are at a high level, while in the post test, 70.6% are at a high level, while 29.4% are at the medium level.

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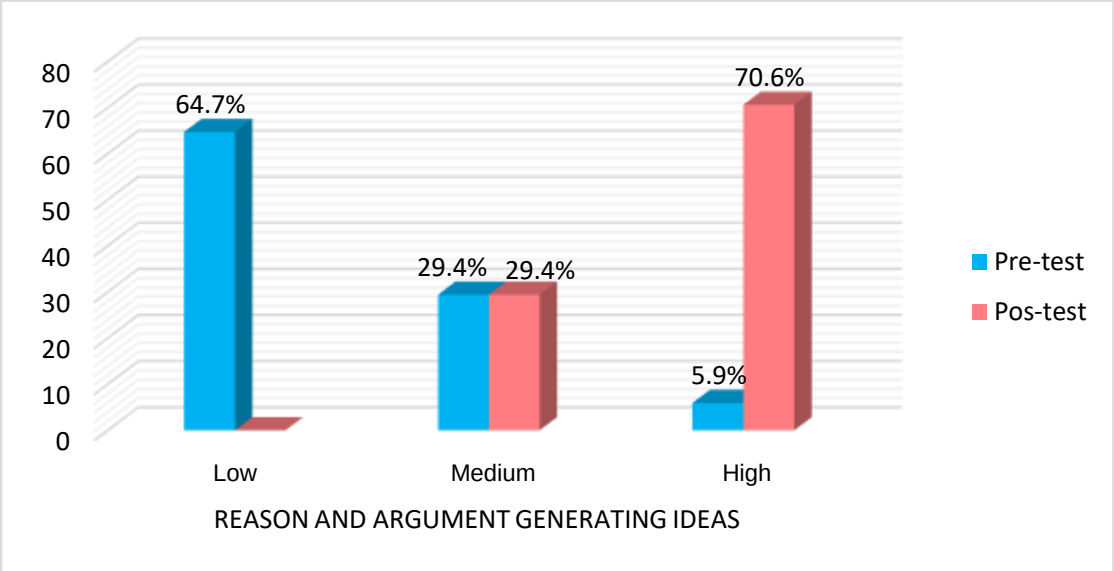

Figure 4: The influence of the use of free software Geogebra in the achievement of the ability to reason and argue generating mathematical ideas in the students of the Mathematics course at the Educational Institution Gabino Uribe Antúnez "GUA"-UGEL-AIJA.

IV. Conclusions

- According to the results obtained in the pre-test of the Mathematics subject, the average being 13.26; median of 13 and a range of levels between 12 and 14. In the post test the average of 17.65, the median of 18 and the range between 16 and 19, the results of the descriptive statistics indicate that the use of Free software Geogebra has influenced the achievement of the teaching-learning of the Mathematics course in the students of the Gabino Uribe Antúnez Educational Institution "GUA"-UGEL-AIJA.
- The results of the Pre test show that 41.2% of the students are at a low level, 35.3% are at a medium level and 4% are at a low level, while in the post test 70.6% are at a high level while 29.4% are at a medium level. This means that there is a positive influence of the use of the Geogebra software in the Communicate and representative dimension in the learning achievement of the Mathematics course.
- The results of the Pretest show that 70.6% of the students are at a medium level, 17.6% are at a high level and 11.8% are at a low level, while in the post test, 76.5% are at a high level, 17.6% are at a medium level, and 5.9% are at a low level. All this means that there is a positive influence of the use of the free software Geogebra in the dimension elaborates and uses strategies in the learning achievement of the Mathematics course.
- The results of the Pretest show that 64.7% of the students are at a low level, 29.4% are at a medium level and 5.9% are at a high level, while in the post test 70.6% are at a high level, while 29.4% are at the medium level. This means that there is a positive influence of the use of the Geogebra software in the reason and argument dimension in the learning achievement of the Mathematics course.

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V. Acknowledge

A special thanks to the authorities at the Educational Institution Gabino Uribe Antúnez "GUA"-UGEL-AIJA, for giving us the facility to implement our research work, likewise to the authorities of the Faculty of Sciences of our National University Santiago Antúnez de Mayolo, for the collaboration of the logistics and unconditional support for the completion of this research work.

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