

APPLICATION OF MATHEMATICAL SOFTWARE FOR THE IMPROVEMENT OF TEACHING-LEARNING TO THE TEACHERS OF MATHEMATICS OF THE ACCALAUREATE OF THE SCHOOL YEAR 2021-2022, IN THE FISCAL COLLEGE OF THE CANTON CHAMBO

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Summary: In this research work, the objective was to apply the Mathematica software for the improvement of teaching-learning to high school mathematics teachers, in the fiscal college of the Gambo Canton, in the elective year 2021 - 2022. The use of ICT in the area of mathematics is unusual due to the lack of training for teachers for this reason this work helps teaching-learning through the Mathematica software. This research had a qualitative approach, its scope is descriptive and its design is not experimental, but documentary. The population was made up of 2 teachers of the mathematics area of the baccalaureate and 159 students who were duly enrolled officially in the various courses 1 BGU, parallel A, B, C, D and E, 2 BGU, parallel B in the school year 2021 - 2022 in the fiscal college of the Canton Chambo, the technique used was the evaluations and the instrument was the questionnaire, These instruments met the characteristics of validity and reliability for the collection of the information required in the research. The results obtained were through a didactic strategy, after the second evolution the academic performance of the students had a considerable increase with respect to the first evaluation and also increased the number of students who obtained grades greater than 8.99 points in the second evaluation. It is concluded that: with the application of didactic training using Mathematica, the Baccalaureate Teachers improved the teaching-learning of Mathematics and the students with the trainings improved their academic performance in learning Mathematics.

Keywords: <MATHEMATICS>, <TEACHING>, <LEARNING>, <ACADEMIC PERFORMANCE>, <BGU>, <DIDACTIC STRATEGY>, <MATHEMATICA (SOFTWARE)>, <ICT>.

I. INTRODUCTION

When education in general is going through a paradigm shift, oriented towards an active and participatory model. Teachers in the area of mathematics must go according to the new educational models, which is why it is of great importance to apply the Mathematica software, which allows them to efficiently reach the topics and the problem-solving process to their students in an easily meaningful way by properly applying ICT leaving behind the concept of teaching and learning as transmission, Reception and observation. Information and communication technology makes it possible to create a new virtual space, this environment is developing in the area of education as well, enabling new learning processes and transmission of information and knowledge through educational software. Suarez (2002) mentions: "The resources, well used, fulfill the following functions in the teaching process: Interest the group, motivate it, focus its attention, fix



and retain knowledge, vary the stimuli, encourage participation, facilitate the effort of learning and specify the teaching avoiding ramblings and verbalisms". (p. 41). However, the presence of educational software in the area of Mathematics alone does not represent a qualitative leap in the field of education. Thinking in this way is a devaluation of teachers and their interrelation with students; that is, by themselves they do not have to modify contents, methods and processes that allow them to solve the problems presented.

1.1. Background

Throughout the history of mathematics teaching, many pedagogues have tried to decipher the best forms of teaching that allow human beings to acquire the skills that come from mathematics. However, it turns out to be a rather complex task since it is affected by several social and personal factors (Cerdeira, Pérez, Casas, & Ortega, 2017).

This technological revolution occurs within the framework of the knowledge society that is understood as the social space where human capital is put into play, which refers to the competences, skills and abilities that a human being possesses and makes available to the production process; and the structural capital that is related to the technological advances that have been made. Made as: software, hardware, platforms, devices, among others. These two types of capital mark the progress of society. In this sense, it can be understood that knowledge has to do with human capital which, in turn, is dictated by the structural capital that would be information and its forms of dissemination (Terrazas & Silva, 2013).

Now, these two paradigms: knowledge and information, are what dynamize the technological progress of society, which is concerned with generating tools and through that generate new and better production processes. This implies that "Societies that want to be more competitive have entered into the logic of planning, organizing, directing, controlling the means and strategies of knowledge generation, involving education and research with this objective" (Terrazas & Silva, 2013, p. 147).

According to Casado Ortiz (2001) cited in Terrazas and Silva (2013), there are three types of ICT that can be applied to the different phases of educational processes:

- **Transmissive Technologies:** They are instructor-centered and the student is a passive subject.
- **Interactive Technologies:** They are centered on the student, it is he or she who carries out his or her learning process through technologies.
- **Collaborative Technologies:** This type of technology allows collaborative work between students and teacher-students.

These types of technologies have been expanded with the advancement of research that is carried out to validate their applicability in educational processes and depend on the favorable results they generate. Especially in today's society that is characterized by its great technological advance and the complexity that has created the excess of information and disinformation.

Recognizing the type of error allows the teacher to respond assertively to the difficulty presented by the student, Godino (2004) exposes some types of errors that can help not to fix attention on the error in a punitive way, on the contrary, promote interaction environments that collaborate in the resolution of a group.

In addition, it is important to take into account that there may be obstacles that hinder the learning of mathematics. According to Arteaga & Macías (2016) these are classified into:

- **Ontogenetic:** Related to the psychogenetic development of children; that is, for each stage certain learning must be ensured and these are resolved with age.
- **Cultural:** These come from culture (stereotypes).
- **Didactics:** These are directly related to the teaching action within the teaching-learning process. These decisions should be in line with curriculum guidelines.
- **Epistemological:** These are the obstacles inherent in the construction of knowledge that depend mostly on the student.

These types of obstacles are highlighted so that the teaching work takes them into account when generating initiatives that promote a successful learning of Mathematics.



These advantages that can offer the use of ICT in the teaching of Mathematics are overshadowed by the lack of training that teachers present in the face of these technological advances. Thus, the traditional teaching of Mathematics has been perpetuated. It should be noted that those teachers who have knowledge about these platforms for the teaching of mathematical skills and functions strive to use them in their classes since they have come to understand the degree of difficulty that this process has and that is why they look for assistants (Fernández, Riveros, & Montiel, 2017).

For this reason, there are a variety of software that facilitate the teaching and learning of Mathematics, among them are, according to Fernández, Riveros & Montiel (2017):

- **Graphmatica:** It is a program that by myth Make graphical representations, calculate areas, derivatives, solve equations, among others. All this through on-screen graphing all kinds of functions and mathematical calculations. In addition, it has a function analyzer to learn a correct writing of functions, respecting the rules of algebra.
- **Winplot:** Through this software you can generate graphs of linear, quadratic, hyperbolic, exponential, geometric and trigonometric functions, applied to different areas of knowledge: demography, biology, physics, chemistry, among others.
- **Derive:** It is a general-purpose mathematical tool that processes all kinds of natural, integer, rational, real and complex numbers; variables, algebraic expressions, equations, vectors, matrices, functions, among others. The graphics that can be made with this software are 2D and 3D.

There are a variety of programs or software that can collaborate in the process of teaching and learning mathematical skills. For this work we have chosen to work with the Mathematica platform. Below is its description.

1.2. Wolfram Mathematica Platform

The Mathematica platform belongs to *Wolfram Research*, which "is one of the world's most respected computer, web, and cloud software companies, as well as as a powerhouse of scientific and technical innovation" (Wolfram, 2021). Founded by Stephen Wolfram in 1987. This company is considered as a pioneer in computer science and the computational paradigm since it has created and maintained a long-term vision that leads them to develop science, technology and tools to make computing a pillar in the growth of the world, from different fields. It is considered as the leading system of modern technical computing worldwide because it has more than thirty years providing its services worldwide.

First launched in 1988, it is regarded as Wolfram Research's original and durable flagship product. It is a driving force in the technical and educational communities, it has millions of users in all parts of the world. Mathematica was built on a global technology foundation, "representing a unique blend of research advances, exceptional user-oriented design, and world-class software engineering" (Wolfram, 2021).

1.1.1. Mathematica Features

As one of Wolfram Research's flagship and oldest products, Mathematica introduces advanced, easy-to-use features for the math and other learning environment. Below are the ones that are considered most important.

Comprehensive integrated system: It has approximately 5000 built-in functions covering all fields of technical computing, which are carefully integrated to work together and seamlessly. **Extensive, industrial algorithm:** "Mathematica uses unprecedented array of algorithms for all fields, many of which were created at Wolfram using development methodologies and capabilities unique to the Wolfram Language [...] [On the other hand] it provides industrial power capabilities, with some robust and efficient or rhythms for all fields, capable of handling large-scale problems, with parallelism, GPU computing and more."

Efficient organization: Using the Wolfram notebook interface, it lets you organize everything you do into rich notebooks that include text, executable code, dynamic graphics, user interfaces, and more. Thanks to the Wolfram Notebook Interface.

- **Sophisticated aesthetics:** Mathematica presents the results obtained in an elegant and sophisticated way in a graphic way that allows a better interactive visualization so that documents are easily publishable.



- **Cloud integration:** There is a good and seamless integration with the cloud, allowing users to share, perform cloud calculations and more in a single and powerful hybrid environment between cloud and desktop, thanks to Wolfram Cloud.
- **Superior and easy level:** It presents superfunctions, meta algorithms, among others. This allows you to create complex level environments in an automated way so that their use is as easy and efficient as possible. It does this thanks to the Wolfram Algorithmbase.
- **Language with Meaning:** The language Mathematica uses is Wolfram Language, it is exceptionally easy to read, write and learn with its intuitive English function names and consistent design.
- **Connection:** Because of its design, Mathematica can read all kinds of file formats and store them. With the help of Wolfram Knowledgebase also enables access to all kinds of information in real time.

1.1.2. Coverage

Within the Mathematica platform there are several types of languages that are used thanks to Wolfram Language, it is considered important to highlight the following since they help in the process of teaching mathematical competences.

- **Symbolic language :** The language you use Mathematica is quite accessible for quick learning and use. In addition, within the website of the platform se you can find the language manual, which allows easy and quick access. Within the language are: symbolic expressions, associations, functional operations, logic, among others.
- **Numeric values:** As already described, the Mathematica language is quite simple to use since it is integrated with numeric values that are normally used and the autocorrect function of them is added if it presents errors.
- **Algebraic manipulation:** Polynomial algorithms are at the core of classical computer algebra. Mathematica has a database that spans from antiquity to the latest cutting-edge research at Wolfram Research. In addition, it has the largest and most profound integrated network of polynomial algorithms in the world. It even favors the use of optimal algorithms for algebraic functions.
- **Mathematical functions:** This type of coverage is the most important for the present work since this language will be the most used by teachers when teaching. The Wolfram Language has the most extensive collection of mathematical functions ever assembled. Each function supports a full range of symbolic operations, as well as efficient numerical evaluation with arbitrary precision, for all complex parameter values.
- **Visualization:** It presents several functions when visualizing the data such as geographically, by tables or graphs, functions, among others. This allows a wide range of presenting the results of the operations/functions performed.

It is necessary to emphasize that there are other types of coverage languages that Mathematica presents, such as: images; geographical data; video and sound; computerized medical and scientific data; social, cultural and linguistic data; interface language and computational engineering, among many others (Wolfram, 2021).

With all the above, it is affirmed that Mathematica has a wide field of application for the learning of mathematical competences as a result of its evolution of more than thirty years.

1.2. National Curriculum of Compulsory Education in the area of Mathematics for the sublevel Unified General Baccalaureate

In 2016, the Ministry of Education of Ecuador (MINEDUC) has developed an educational reform of the entire curricular framework of education in the country. From this renewal, it is proposed to work from the pragmatic-constructivist pedagogical model that seeks to strengthen the resolution of problems in real life (Educación Ecuador, 2016).

In this way, in the area of Mathematics, the curricular blocks of Basic General Education and Unified General Baccalaureate were integrated. Well, in the 2010 curriculum there were different blocks for each of these levels (Educación Ecuador, 2016). Below is a table showing the integration of these blocks.



real to optimize Processes Perform simplifications and solve exercises of equations and inequalities, applied in real and hypothetical contexts.	
CE. M.5.2. It employs systems of 3x3 equations applying different methods, including Gaussian elimination; It operates with UADRADAS C matrices and MXN order.	Mathematical computing superior
CE. M.5.4. It recognizes patterns present in real, monotonic and recurrence-defined numerical sequences; identifies arithmetic and geometric progressions; and, through its properties and formulas, solves real problems of financial and hypothetical mathematics.	Symbolic and numerical computation Mathematical computing superior
CE. M.5.5. Applies limit algebra as the basis for differential and integral calculus, interprets derivatives in form geometric and physical, and solves exercises of optimization areas and problems.	Symbolic and numerical computation Mathematical computing superior
CE. M.5.6. It employs geometric vectors in the plane and operations in R^2 , with applications in physics and in the equation of the line; it uses graphical, analytical and technological methods.	Symbolic and numerical computation Mathematical computing superior
CE. M.5.7. Performs operations in space (three dimensions) with vectors, lines and planes; identifies whether they are parallel or perpendicular, and	Visualization and graphics

finds their intersections			
CE. M.5.8. Applies the systems of linear inequalities and the set of feasible solutions to find the extreme points and the optimal solution in linear programming problems.		Symbolic and numerical computation Mathematical computing superior Visualization and graphics	
CE. M.5.9. Uses descriptive statistics to summarize, organize, graph, and interpret grouped and non-grouped data		Symbolic and numerical computation Mathematical computing superior Visualization and graphics	
THAT. M.5.10. Employs counting techniques and probability theory to		Symbolic and numerical computation	
Curricular Blocks (Curriculum 2010)		Curricular blocks (Curriculum 2016)	
Education General Basic	Numeric relationships and functions Geometric Measure Statistics and probability	Education General Basic and High school General Unified	Algebra and Functions Geometry and measurement Statistics and probability.
High school Generates Unified	Numbers and functions. Algebra and Geometry Discrete Mathematics Statistics and Probability		
Evaluation criteria		Mathematica Software Resources	
CE. M.5.1. Employs basic concepts of the algebraic properties of numbers		Symbolic and numerical computation Mathematical computing superior	

Table 1-1: Comparison of the curricular blocks of the 2010 and 2016 curricula.
Adapted from: Education Ecuador (2016).



Currently, these curricular blocks are developed through the performance criteria skills (DCD) that teachers must develop in their students so that learning is meaningful and they can put it into practice in the present and future" (Domínguez & Domínguez, 2012, p. 23). The unification of the curricular blocks, the creation of objectives for each sublevel of education, the classification of the DCD for the evaluation criteria and the complement of the evaluation indicators encourage to achieve the quality standards and the profile of the Ecuadorian baccalaureate that consists of being fair, innovative and supportive.

1.2.1. Mathematica Evaluation Criteria

The evaluation criteria provided by the National Education curriculum are considered as reference points to evaluate the learning process of students. For this reason, it is appropriate to relate these to Mathematica resources and thus demonstrate the enrichment that the teaching and learning process can have when using this platform.

The curriculum of the area of Mathematics for the sublevel Unified General Baccalaureate contains eleven evaluation criteria. Of which, the EC evaluation criteria. M.5.3 and EC. M.5.11 request that ICT be used to strengthen the teaching and learning process, so by using Mathematica software, these two criteria are being fully met, thus advancing in compliance with educational quality standards.

Those with more evaluation criteria fit the resources presented by the platform, without exception, as shown in Table 2 for each evaluation criterion there is at least one resource that Mathematica offers for teaching.

Table 2-2: Relationship of evaluation criteria and resources of Mathematica software.

calculate the possibility that a certain event occurs; identifies random variables; solves problems with or without ICT; contrasts processes, and Discuss your results	Mathematical computing superior Data manipulation and analysis
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However, it is necessary to emphasize that the use of the resources presented by the platform is in the hands of the teachers who guide the teaching and learning process. The above is a proposal for the use of resources. However, each teacher can adapt this use from the context in which he finds himself.

1.3. Facilities of Use of Mathematica for the Teaching of Mathematics

As already suggested, the use of this platform is subject to the needs of each educational context where the creative skills of teachers will be put into play to interact with this platform and at the same time motivate students to better learn mathematics.

In that sense, this platform has a guide book for its use, which allows the student to train and learn about the computational language applied to mathematics. In addition, on the Youtube platform there is a series of videos where the use of the Wolfram language is explained step by step and the resources that are at hand to be used in the teaching of mathematics.

An important point to highlight is that the platform must be acquired by the educational institution that wishes to use it because, although it has a free version, the paid version allows access to all resources in an unlimited way providing teachers with the necessary tools to improve their quality of teaching and new students, creative and

Better ways to understand math

Finally, it is emphasized that the use of the software in its great majority has to answer the skills of calculation within the curriculum of education of the area of mathematics since, its resources are quite varied in this field and in that way the teachers will be able to teach more clearly the

processes that these skills entail so that the students can understand them better, assimilate and practice them.

2. METHODOLOGY

2.1. Type and design of the research

Due to the objectives to be achieved, the type of research that will be used in the degree work is a quantitative, cross-sectional and field research.

According to the approach: Quantitative. - Data was collected, processed and analyzed numerically with the help of statistics and the results are presented through graphs and statistical tables.

According to the time: Transversal. - The information that was obtained was made at a certain time

According to the language: Field. - To access the required information, we interacted directly with the Mathematics Teachers of the baccalaureate of the fiscal school of the Gambo Canton, Province of Chimborazo and also with the students of the same.

In the design of the research, due to the nature and complexity of the problem, this research is not experimental because there is no use of the variables, if it is not a documentary research design, this is a process of research, analysis, criticism and interpretation of information or data that were obtained.

2.2. Scope of the investigation

In this research, a teaching-learning methodology was proposed through the application of Mathematica software, which was directed to teachers and replicated to students and then validated through academic performance, so the scope of the research is descriptive.

2.2.1. Population and study sample

Population. - The population for the present research is established by the Mathematics Teachers of the Baccalaureate of the Chambo High School, Province of Chimborazo in the period 2021-2022.

Table 1-2: Baccalaureate Teacher Population

Sections	Frequency	Percentage
Teachers	3	100%

Source: Coordinator of the mathematics area of the Colegio de Bachillerato Cambo

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Table 2-2: Baccalaureate student population

Sections	Frequency	Percentage
Students	378	100%

Source: Coordinator of the mathematics area of the Colegio de Bachillerato Cambo

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Sample. - The research was carried out with the 2 Mathematics Teachers of the 1 BGU and 2 BGU and with 159 students of the 1BGU parallel A, B, C, D and E, in addition to 2 BGU B of the Chambo High School.

Table 3-2: Sample of Baccalaureate Teachers

Parts	Frequency	Percentage
Teachers	2	66.66%

Source: Coordinator of the mathematics area of the Colegio de Bachillerato Cambo

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Table 4-2: Sample of Baccalaureate Students

Sections	Frequency	Percentage
Students	159	42.06%

Source: Coordinator of the mathematics area of the Colegio de Bachillerato Cambo



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2.2.2. Techniques and instruments for the collection of primary and secondary data

Techniques. - The technique that was used in the present work of titulación are the evaluations that allowed me to collect information of the problem to be investigated through the formulation of questions directly to those involved to obtain the results.

Instruments. - The instrument that was used in this research is the questionnaire that allowed me to collect the necessary data through specific questions about the variables indicated, in this way the greatest amount of information was obtained.

2.2.3. Instruments for processing collected data

In the present research, statistics and logic were used for the processing and analysis of the data obtained.

For data processing, Microsoft Office Excel was used, through which statistical tables and graphs were established.

The interpretation of the statistical data was carried out through the induction and analysis of the same.

3. RESULTS AND DISCUSSION

3.1. Concept of evaluation and school performance

Throughout the history of education certain concepts of assessment have been put forward, and it has been said that it is a measure of learning outcomes, or assessment is a measure of the degree to which teachers' objectives have been achieved, and/or worse, the following definition is now presented to clarify this concept, "The evaluation constitutes a critical reflection on all the moments and factors that intervene in the didactic process in order to determine what they can be, are

being or have been, the results of it" (Rosales, 2003)

As you can see from the definition, assessment is all about the time aspect, i.e. what worked in the past, what needs to be corrected, what is happening, and how to modify it so that student learning outcomes are better in the future.

But the results lead us to the definition of "school performance", in this sense, school performance is measured by a number that represents the percentage of success achieved by a student in his learning, but is also defined as "The level reached in the different intended achievements in education" (Blázquez, 1988). In most cases, these learning outcomes do not clearly reflect students' learning outcomes, because many factors prevent students from actually demonstrating what they have learned.

3.2. Results of teacher training

The results obtained during the training are as follows:

The indications that this degree work is about were carried out with the objectives set. The teachers of the baccalaureate in the area of mathematics of the high school Chambo together with their coordinator of area, who were willing to receive training on the use and management of Mathematica software for the improvement of teaching-learning to teachers of mathematics of the baccalaureate, in addition to diagnosing and proposing the use of Mat software hematica, after making the replicas to their students to be able to validate the teaching-learning of the Mathematica software, through the academic performance of what has been learned.

The trainings that were carried out with the teachers are as follows:

- Introduction Mathematica • Applications.
- Real and rational functions.
- 2D and 3D graphics.
- vectors R^2 and R^3 .
- Trigonometric functions.
- Conical.
- Replicate to students.

It was observed that during the training provided to teachers, many concerns came to light about the Mathematica software since it is a program that appeared in 1988 revolutionized technical computing and has not stopped since then, introducing new functions, algorithms and ideas every year, it is a program not so used in our country. The teachers, knowing that it is a very easy and interactive software, and also the indications that were made known to them, executed it on time and in the corresponding order, in such a way they brought out that in the same way they will do it with their students.

At this point a numerical result was not obtained since they are trainings on the use and management of Mathematica software for the improvement of teaching-learning to high school mathematics teachers.

3.3. Results of student training

3.3.1. First evaluation

The first evaluation was carried out at 1BGU parallel A, B, C, D and E, in addition 2BGU B obtaining the following results:

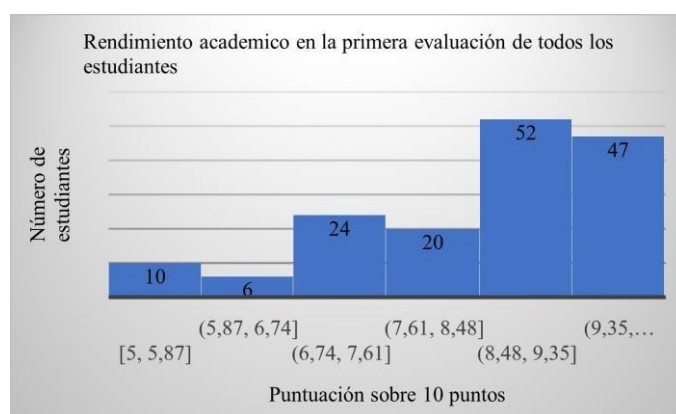


Figure 1-3: Academic performance in the first evaluation Conducted by: Zapata, Cecilia, 2022.

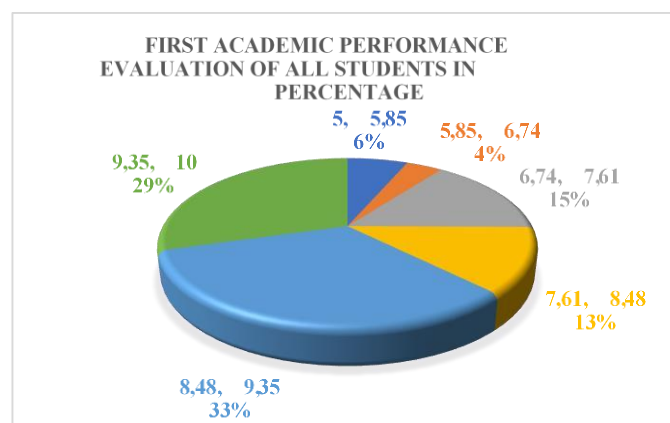


Figure 2-3: Academic performance as a percentage of first assessment Made by: Zapata, Cecilia, 2022

Analysis and interpretation: In the graphs, it can be seen that the academic performance of all the students of the, in the first evaluation we have a 6% that corresponds to 10 students who have a grade of 5 to 5,85 points this allows us to say that we have to pay attention to these students so that they overcome the concerns that were presented to them during the evaluation. It is also observed that we have 4% that corresponds to 6 students, who have difficulties understanding the software that has a grade of 5.85 to 6.74 points. Attention is also paid since 15% corresponds to 24 students, who have a good learning of the software and that their grades are between 6.74 to 7.71 points. Thus also two ranges of grades that reach the learning of Mathematica such as 13% with 20

students with academic performance points of 7.61 to 8.48 and 33% with 52 students with academic performance of 8.48 to 9.35 points. In the same way we can see that we have 29% that corresponds to 47 students, who understand better the Mathematica software since their grades are between 9.35 and 10 points.

As a final interpretation of the first evaluation to the students of the various parallels allows me to say that they have an acceptance of the software since in the academic performance it is noted that it has a slight increase in it. In addition, the students came to mention that by solving the exercises using the Mathematica software, they reduce the resolution time and it is very dynamic and easy to see the graphs that are presented, which is not the same when solving in their notebooks.

3.3.1. Second evaluation

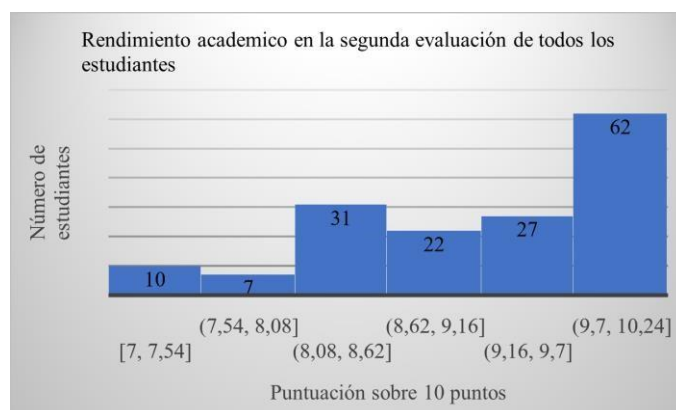


Figure 3-3: Academic performance in the second evaluation Conducted by: Zapata, Cecilia, 2022.

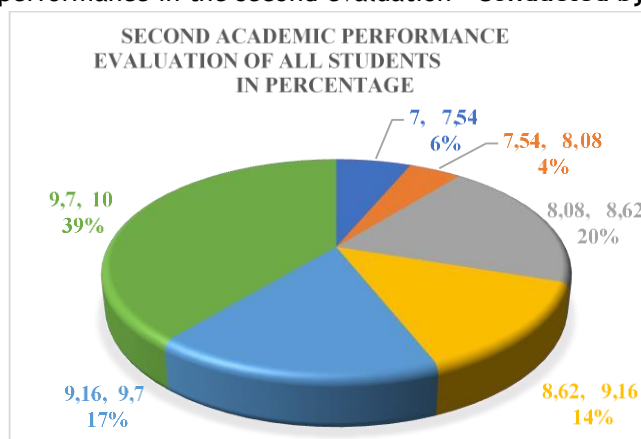


Figure 4-3: Academic performance as a percentage of the second evaluation Made by: Zapata, Cecilia, 2022

Analysis and interpretation: In the graphs, it can be noted that the academic performance of all students of the, in the second evaluation we have a 6% corresponding to 10 students who have a grade of 7 to 7.54 points this allows us to say the students overcame the difficulties they obtained in the first evaluation. So it is also observed that we have a 4% that corresponds to 7 students, who already have less difficulties to understand the software that has a grade of 7.54 to 8.08 points. Also pay attention since 20% that corresponds to 31 students, who has a good learning of the software since their grades are between 8.08 to 8.62 points. Give us also two ranges of grades that reach Mathematica learning such as 14% with 22 students with academic performance points of 8.62 to 9.16 and 17% with 27 students with academic performance of 9.16 to 9.7 points. In the same



way we can see that we have 39% that corresponds to 62 students, who understand better the Mathematics software since their grades are between 9.7 and 10 points.

As a final interpretation of the second evaluation to the students of the different parallels allows me to say that they have a slight increase in academic performance in relation to the first evolution as can be seen in the different graphs. In addition, an assimilation and acceptance of Mathematica software since it is very easy, dynamic and interactive to manipulate, and in turn reduces the time of solving math exercises.

4. PROPOSAL

4.1. Description

The present investigation of the realization in the Colegio de Bachillerato Chambo, I know that it is located in the Canton Chambo, province of Chimborazo. The same that by presenting several documents to the Riobamba-Chambo district and also to the Magister Mirian Bonifaz rector of the school allowed me to carry out the present research in the area of Mathematics.

Once the authorization to occupy the school facilities was obtained, a meeting was held with the coordinator of the mathematics area, Magister Nataly Sigcho to explain what the degree work is about, and allowed me to carry out the training to the teachers and students of the baccalaureate 1 BGU parallel A, B and C, with Eng. María Fernanda Ortiz, and 1

BGU D and E and also of the 2 BGU B cola Lic. Jessica Lindao who teach the chair of mathematics in these courses.

With the mathematics teachers, the trainings were carried out in the computer laboratory and to make the training better, it was decided to do the same with the students and teachers so that it is a more active informative training about the Mathematica software, and that it is a software not known in this school, they told me that if I was doing in some resolutions of exercises with the Geogebra program. The trainings carried out with teachers and students are the following:

- Introduction Mathematica • Applications.
- Real and rational functions.
- 2D and 3D graphics.
- vectors R2 and R3.
- Trigonometric functions.
- Conical.

Which was carried out during the month of May and June of the year 2022 which I was a total of 52 hours face-to-face and autonomous work 104 hours giving us a total of 156 hours of training on the use and interpretation of Mathematica Software.

Two evaluations were carried out to the students on the resolution of exercises to later have their grades.

4.2. Interpretation of the simulation of the mathematical model

Application of the software and Mathematica for the improvement of teaching-learning to the teachers of mathematics of the baccalaureate of the school year 2021-2022, in the fiscal college of the Canton Chambo.

In the first instance it was diagnosed not in the form of questionnaires but in the form of conversation since in this way both teachers and students feel comfortable and not intimidated by answering in a wrong way. As I progressed with the trainings I realized that both teachers and students are interested in improving the teaching and learning of this software, in the same way they were made aware of the time it would take them to solve an exercise in their notebooks and how long it will take them to solve the same exercise in the Mathematica software.

The evaluations made to the students could be noticed that in the first evaluation some students had some difficulties because it was a software not very well known to them, in the second evaluation the students could dissuade the concerns and doubts about some functions of the Software and be able to solve the exercises in a better way.

4.3. Verification and validation of the mathematical model

This research is verified and validated by the academic performance of the students of the following courses, 1 parallel BGU A, B, C, D and E and also of the 2 BGU B.

Table 1-4: Results of evaluations

First evaluation		Second evaluation	
Note range	# of students	Note range	# of students
0 - 4,00	0	0 - 4,00	0
4,01 - 6,99	17	4,01 - 6,99	0
7,00 - 8,99	66	7,00 - 8,99	55
9,00 - 10,00	76	9,00 - 10,00	104

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As can be seen in table 1-4, in the first evaluation the number of students with a score lower than 7 points are 17 students and in the second evaluation students who have less than 7 points there are no students, in this way we can validate and verify the increase in the academic performance of the students of these parallels. In addition, the students who obtained conflicts in the first evaluation were able to correct their difficulties in the second Evaluation.

There is a significant difference between the averages obtained in the first evaluation which is 8.46 points and the second evaluation which is 9.18 points, after applying the didactic trainings using Mathematica software to improve the teaching and learning to the students of the Fiscal College of the Cambo Canton.

Comparison of grades of the two evaluations made to the students after the trainings on the application of Mathematica software to improve the teaching-ap performance of mathematics.

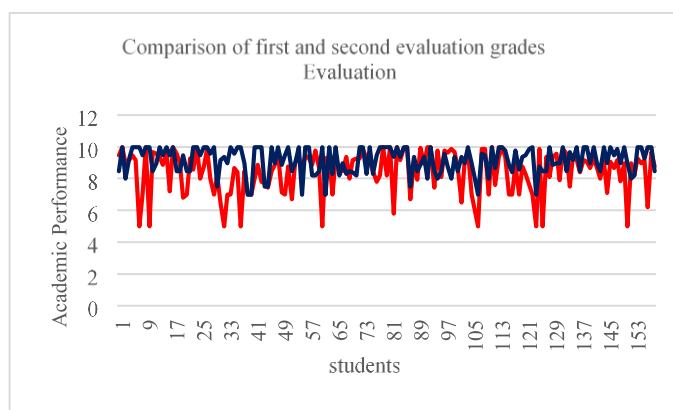


Figure 1-4: Comparison of first and second evaluation grades

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In graph 1-4 you can finally compare the marks of the first evaluation of red color and the second evaluation of blue color to all 159 students, which allows me to say that there is an increase in the academic performance of the students of the 1 BGU parallel A, B, C, D and E and of the 2 BGU B of the academic period 2021-2022.

5. CONCLUSIONS

The use of educational software by teachers in the area of mathematics in their classrooms is rare, since they state that they do not use any educational software in most of the mathematics content,



however in what they consider appropriate, most teachers support their lessons with the free GeoGebra software, since they did not know the Mathematica software since it has an intuitive environment that allows easy handling of their own tools and also addresses algebra, geometry and calculus in a dynamic and interactive way, involving students interested in better learning.

In the experience of the teachers of the establishment, the most accessible contents for the use of some educational software either in the different courses such as 1 BGU A, B, C, D and E and 2 BGU B, but with a good methodology and didactic strategies, any mathematical content can be taught and understood by the educational programs because they provide us with many elements to build the activities, Exercises, simulations and other resources available from the software.

The development of learning activities is achieved through the development of lesson plans that incorporate technology, in this case the use of Mathematica educational software and through learning activities created with resources provided by Mathematica software such as analysis, problem solving, thus incorporating technologies in the expected constructive way, providing a pleasant space to teach mathematical content in a planned and organized way.

It can be concluded that with the union of the national baccalaureate curriculum in the area of mathematics and the Mathematica software, it leads us to verify that teaching-learning improves in a relevant way in the academic performance of students.

In the end, the teaching-learning of the Mathematica software was validated, through the academic performance of the students of the fiscal college of the Chambo Canton, which obtained a considerable increase in it.

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