UNIDAD EDUCATIVA PARTICULAR JAVIER

BACHILLERATO EN CIENCIAS

MONOGRAPH

"THE HISTORY OF MATHEMATICS"

STUDENT:

MARCO SANTANA

ADVISER: LCDA. CAROLA VILLAFUERTE

AND LCDA. PATRICIA SANCHEZ

THIRD OF BACCALAUREATE - COURSE A

2019 – 2020

Gratitude

Mainly I thank God for giving me the life I have and the wonderful family that has given me and supported me in this long journey from school to now in the last year of high school. Also to my teachers who have taught me a lot about life and how one should behave in order to be able to get ahead in the life that awaits me when I leave school. I am grateful for all of them because they have been my support and support throughout my education process.

Summary

This monographic research presents the importance, value and consideration that we should give to the field of mathematics. It is impressive how young people nowadays decide to avoid numbers, equations and theories as much as possible because they are headaches but do not reflect on the influence they have on the world. Mathematics helps human development and develop its ability to reason and solve exercises that are complicated but are not, thus expanding the knowledge of oneself society as well. Likewise, the field of mathematics was related to other fields such as art, engineering, and accounting, astronomy, in everyday life and even in nature, demonstrating that mathematics is more than numbers. In addition, this work tries to manifest the importance of mathematics in all the history of man because mathematics has been with the human being since its existence, therefore it is necessary to begin from where it began and how it has been developed, the implements and technique that have been used in the mathematics, theories and fundamental characters that contributed in this wonderful and important field. That's why we have to explain to young people why the world is based on mathematics and that you can't survive without it.

Index

Introduction

Mathematics is the science that studies the properties and relationships between abstract entities such as numbers, symbols, geometry and is considered the most important field of all for the human being because from these has been built everything we know today. For this reason, the purpose of this monographic work on ***The History of Mathematics*** is to make known its importance in the past, present and for the future, relating it to usefulness in life and in other fields.

The purpose of this research is to encourage people not to leave aside mathematics just because they are complex and to demonstrate the benefits they provide for oneself. Because nowadays there are several people who try to avoid mathematics at all costs because of the headache they cause but do not realize the influence it has in the world and that they are present in absolutely all sides as in gastronomy, astrology even in art and in everyday life. Several institutions have dealt with this subject, such as the University of La Rioja, which has carried out studies on the importance of mathematics for society. An example, Miguel Vivaz Cortez (university of ESPOL) in his research ***"Mathematics, some applications and their importance"***, ***"Mathematics in Everyday Life and Science".***

The existence of mathematics resides since man was created and has been developed by the hand of the human being. From ancient civilizations such as Egypt and Mesopotamia that used mathematical systems to keep count of what they produced, then arriving in Greece where universities were developed and philosophers such as Sophocles and Platón arose

that delved deeper into the application of these and opened endless opportunities to develop laws and theories such as the law of gravity and the theory of relativity.

The monograph consists of three chapters where the first deals with the evolution that had, the beginnings of mathematics, and the achievements that allowed the development of mathematics, the characters that influenced its development and the various branches of mathematics. The second on current mathematics, the tools that allow its development and the multiple uses in today's world. Finally, the third chapter deals with games that improve and stimulate the mind and on examples that we will always need from them and will never be forgotten in history.

Chapter I

The history of mathematics

1.1 Evolution of mathematics

Mathematics has evolved enormously in the last two centuries, as has the way of teaching the discipline and the material used in the classes.

"The german mathematician Hermann Hankel said that "in most sciences one generation demolishes what another has built and what one has done another undoes it. Only in mathematics each generation adds a new floor to the old structure" (Mendez, 2018, p.1).

To begin with, we can distinguish several stages in the teaching of mathematics:

- Mathematics in the nineteenth century
- Mathematics in the first half of the 20th century

In the 19th century, the blackboard and the abacus were mainly used to teach mathematics. Children from lower social classes could go to school for free, although it was usually middle-class children who had the most access to education. On the other hand, the higher social classes had the services of the governesses, private teachers who taught the children in their homes.

With the approval of the Public Instruction Act of 1857 (Moyano Law), the structure and content of mathematics in primary and secondary education was established. This law divided primary education into the elementary and higher cycles, and the secondary into two periods of three courses each.

As for the first half of the 20th century, let's situate ourselves between 1901 and 1903, when the Count of Romanones drew up two Royal Decrees regulating the exams and contents of the baccalaureate until the Dictatorship of Primo de Rivera. At that time, there was only mathematics the first four years of the six that included the baccalaureate. The contents are limited to Arithmetic, Geometry, Algebra and Trigonometry.

> The fundamental principles of Mathematics were developed in Classical Greece. The "Elements" of Euclid weren't improved until the nineteenth century. The applications made by Archimedes were remarkable and practical applications in agriculture and economics were the fundamental occupation of mathematicians from then until the seventeenth century. (Mendez, 2018, p.2)

1.1.1 Beginnings of mathematics.

"Mathematics is the oldest science. It would be necessary to go back to the dawn of humanity to find the first vestiges of number and geometric shapes" (Mendez, 2018, p.1). It is believed that the Egyptian people were the first to use mathematics. In Mesopotamia, during excavations in the 19th century, some Sumerian clay tablets containing cuneiform writing were recovered, either from the first Babylonian dynasty, or from ancient Greece. In these blocks appear numbers and function as a witness of the capacity that already existed then to solve equations of the second degree.

We also find commercial exchange accounts, where we speak of grain sacks or slaves (Crespo, 2016). Greek philosophers such as Pythagoras, Thales or Plato were the ones who began to theorize and put into practice arithmetic, called the science of numbers. At that time, mathematics began to travel throughout the Empire to reach Alexandria and its

famous school. In the 4th century BC C., Diophantus of Alexandria begins to approach the algebra; from it we keep the decomposition of a number into two identical squares.

1.2 Mathematical achievements

Mathematics has evolved from its origins in a very fluid and constant way, with hundreds of mathematicians contributing new ideas, new concepts and demonstrations, maintaining communication between them and exchanging opinions.

Among the most important we can highlight the following:

1. Pythagorean Theorem

It establishes that in every right triangle, the square of the hypotenuse is equal to the sum of the squares of the legs. This theorem, represent the basis of trigonometry, of great application today in modern measures and technological equipment.

2. Fundamental Theorem of Calculation

The theorem consists in the affirmation that the derivation and integration of a function are inverse operations. This means that every integral continuous function verifies that the derivative of its integral is equal to itself.

3. Probability

Thanks to Probability, conclusions can be drawn about the discrete probability of potential events and the discrete underlying mechanics of complex systems in areas such as statistics, physics, mathematics, and philosophy.

4. Mean value theorem

This theorem is a property of the derivable functions in an interval. Some mathematicians consider that this theorem is the most important one of calculation and is normally used to prove other theorems.

5. Fundamental Theorem of Arithmetic

Affirms that all positive integers can be represented uniquely as a product of prime factors.

6. Fundamental theorem of the Algebra

It establishes that every non-constant polynomial of a variable with complex coefficients has a complex root.

7. Concept of vector space

From the concept of vector space and its implications, a part of the algebra of important applications was developed in other branches of mathematics, science and engineering, such as the modern routines of compression of images and sound.

1.2.1 Important mathematics of this era.

1. Pythagoras of Samos

He lived between the sixth and fifth centuries BC. In addition to the theorem that bears his name, he is considered the father of Trigonometry. Mendez (2018): "Pitágoras conocía la relación existente entre las longitudes de las cuerdas de la lira y los acordes de sus sonidos" (p.5).

2. Euclid

He is considered the father of Geometry from which he established the first axioms. His most famous work "Elements". He lived between the III and II B.C. Mendez (2018): “Euclides was awarded a dozen works, but it went down in history and in what way, by only one of them, the Elements” (p.7).

3. Leonardo of Pisa (Fibonacci)

He published the number series known by that name, as well as various works on the golden ratio. He lived between the 12th and 13th centuries.

4. Rene Descartes

He lived in France in the seventeenth century. He is the father of analytical geometry and representations in axis systems, which in his honor are called Cartesian.

5. Johan Carl Friedrich Gauss

German lived between the seventeenth and nineteenth centuries. He made great advances in fields such as Number Theory, Mathematical Analysis, Differential Geometry, Statistics or Algebra.

6. Isaac Newton and Gottfried Leibniz

English and German lived between the seventeenth and eighteenth centuries. They discovered almost simultaneously but by very different paths and methodologies, differential calculus

1.2.1.1 *Diverse studies in mathematics.*

Fashion, media, median and standard deviation of discrete and continuous variables.

Straight regression. Binomial distribution, normal distribution. Sampling and estimation.

Probability and combinatorial.

Chapter II

The development of mathematics

2.1 The mathematics of today

In our time, mathematics is a fundamental tool, since it is applied in diverse fields such as natural sciences, engineering, medicine, social sciences, music, control of mechanisms, etc. In this way, the application of mathematics plays an important role in the planning of the economy, management of production, diagnosis and treatment of diseases, study of athletes' performance, thus invading all fields of knowledge of humanity.

For this reason, mathematics has become a fundamental and indispensable pillar for the development of new discoveries and new disciplines. For this reason it is a fundamental piece in the development and application of modern technology. “Carl Friedrich Gauss considers mathematics to be the queen of science” (Rodríguez, 2010, p.14).

2.2 Tools and new techniques that help the development of mathematics

The learning of Mathematics can especially benefit from new technologies because they present the concepts in a more visual and interactive way, so that they allow to relate Mathematics with other aspects of life in order to make them more accessible at any age and make them much more attractive.

For this reason it should not sound strange that technology has helped a great deal to facilitate the calculations and development of mathematical problems that facilitate both mathematical and educational learning.

> The appearance of technological tools has influenced the education of mathematics, to carry out a process of self-evaluation and experimentation on the part of the students since more

> precise and agile calculations are made. This means that we cannot continue teaching mathematics as we have been doing. (Leon, 2015, p.2)

One of the most basic and well-known tools for the development of mathematics is the calculator. There are different types of calculators, from basic calculators to scientific calculators and graphics. Solving algebraic expressions, calculations of trigonometric ratios, logarithms, powers, radicals for this reason have stopped using trigonometric tables, ratios and logarithmic. In addition there are some with specialization to be used in accounting, statistics, etc.

Another tool that has revolutionized and helped mathematics is the computer.

The world of the computer changes little by little the daily life of the citizen: the banking transactions, the electronic mail, the reservation of tickets. On the one hand, the new branches of theoretical Computational Mathematics appear. But all the branches of mathematics are infected with the sudden capacity to calculate what was previously only imaginable, satellite orbits or trajectories of dynamic systems, numerical distributions or time series of real processes, etc.

2.3 Multiple uses of mathematics in today's world

There is a debate among young people about the applications of mathematics and their need to learn them or not, even doubting whether studying mathematics is essential in everyday life. This is why we are going to mention the use of mathematics today. Mathematics is an indispensable instrument in human society and in scientific society, when it seeks to analyze phenomena an analysis is made from the most basic to the most complex starting from numbers, formulas, data and equations (Monroy, 2017).

Mathematics is an essential tool in many fields of different sciences without it we would not be able to enjoy current technology. For example:

1. **Mathematics and Engineering**

Engineering uses the knowledge of science, mathematics and appropriate experience to find the best solutions to concrete problems. Applying theories of linear differential equations or algebraic equations. Without mathematics engineering would not exist and thanks to mathematics engineering has had a great development and has been able to be implemented.

2. **Mathematics and Chemistry**

Mathematics helps to establish fundamental concepts in chemistry and, above all, mathematics helps to explain the experimental results in a better way and you will have a greater capacity to predict the properties of the molecules and the materials they are made with.

3. **Mathematics and Astronomy**

In astronomy mathematics is presented to calculate the distance and size of the planets, discover the location of new stars and even developed a whole theory to predict the positions of dwarf planets through astronomical measurements.

4. **Mathematics and Music**

Pythagoras was the one who discovered the importance of numbers in music and their relationship. He discovered that the octave had a mathematical ratio of 2/1 and while developing his research in music he achieved the first and last note of the musical scale. In

this way we can confirm the influence of mathematics for the creation of new rhythms and musical genres.

5. **Mathematics and Finance**

Finance naturally appears as one of the disciplines that make use of mathematics. From the basic problems of percentages to the complex models of prediction of investment portfolios, behavior of the stock exchange, etc. Probability, Brownian movement, analysis, are part of this area of study.

6. **Mathematics and Social Networks**

Social networks on the Internet have taken on the role of one of the main means of communication with new features and these can be analyzed from mathematics. Graph theory appears as basic in this field.

7. **Mathematics and Google**

Google has had the feature of providing people with a simple and efficient way to find information. The procedure to find information is the use of an algorithm that assigns the importance of a Web site related to the search word, this algorithm is called PageRank and uses mathematics in its procedure, although naturally the algorithm is improved day by day, linear algebra, and probability are basic to this technology.

8. **Mathematics and the Rubik's Cube**

One of the most popular toys in the world is the Rubick Cube. Today there are new versions of the cube, but in general the fundamental idea has prevailed. The mathematics of the Rubick cube belong to the group theory, mainly the finite group of permutations,

different proposals for its modeling and solution have been given, even in different groups like the linear group GL (2, F_5).

In this way we can realize that mathematics is found anywhere, it would be impossible to avoid them in the daily life of any person, simply to pay for breakfast, to see a plane, to pay for gasoline, to appear on television at all times, in games of chance, and so on. Hence the importance of learning mathematics, with them we can continue to develop new tools and technologies that help us develop in our lives.

Chapter III

The footprints of mathematics

3.1 Games and math strategies for exercising the mind

Mind games are the maximum playful and thrilling way of stimulating the mind's functionalities, making the brain's abilities increase and therefore improving a human being's intellectual capacities. These games consist of finding the solution to an enigma only through intuition and reasoning. The difference with riddles is that they pose the enigma in the form of a rhyme and are generally aimed at children. As with all logic games, a logical puzzle should have a mathematical or logical basis.

The development of this thought is key to the development of mathematical intelligence since this type of intelligence goes far beyond numerical capabilities, providing important benefits such as the ability to understand concepts and establish relationships based on logic in a schematic and technical way. It also allows understanding abstract concepts, reasoning and understanding relationships. All these skills go far beyond mathematics understood as such, the benefits of this type of thinking contribute to a healthy development in many aspects and achievement of personal goals and achievements, and thus to personal success.

Mathematical logical intelligence contributes to:

- Development of thought and intelligence.
- Ability to solve problems in different areas of life, formulating hypotheses and establishing predictions.
- Promotes the ability to reason about goals and how to plan to achieve them.

- It allows to establish relations between different concepts and to arrive at a deeper understanding.

- Provides order and meaning to actions and/or decisions.

For these reasons there are several mathematical games that improve the development of these mental capabilities. A mathematical reasoning game for a child is the following:

- **Square of numbers**

Place the numbers 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22 and 24 in the empty boxes so that the sum of each column, row and diagonal is 65.

- **Sudoku**

It consists of filling a grid of 9 × 9 cells (81 cells) divided into subgrids of 3 × 3 (also called "boxes" or "regions") with figures from 1 to 9 starting from some numbers already arranged in some of the cells.

This world-renowned mathematical game not only helps to maintain, but also to increase the ability to reason, the speed of mental processes and memory.

However, nowadays, thanks to technology, apps and board games have been developed that also encourage the development of mental skills, games that were created specifically to entertain and better mental calculation, such as Monopoly or Candy Crush, thus showing the importance of mathematics and the relationship of numbers with the human being. They are not only used to learn multiplication tables and recite from memory, but also to acquire a reasoning that allows to solve a complicated problem.

It should also be borne in mind that not all children are equal but can develop the same skills, to achieve this creativity is needed. It has been demonstrated that creative activities allow the development of personal and logical reasoning since they are children.

That is why games are ideal for learning mathematics and improving on topics such as symmetry, logic, calculation, memory, problem solving, mathematical puzzles, etc., in this way children ensure a life with fewer difficulties, with greater agility and security in the decisions they make.

3.2 Mathematical examples that will never die because of their importance and significance in history

The Baldor, the successions of Fibonacci and the Pi number had a great impact on history and will continue to be important until the end of humanity because these mathematical examples revolutionized the way people think and allowed us to understand the world around us, explaining both normal and extraordinary events.

- **Baldor**

Baldor's Algebra is one of the texts that have intervened in the educational process of several generations of Latin American students. It contains a total of 5,790 exercises. It is considered by many people a headache for the simple fact that it is a book of practice, full of exercises that not only provides for the algebra subject, but also contributes to the development of other branches of studies and for human knowledge. Billini (2014) states: "By being able to handle algebra in our lives, we will be able to save a lot of work time and ensure more reliable results" (p.1).

- **Pi Number**

The Pi number, represented by the Greek letter π, is the most famous mathematical constant in history. It is an irrational number, which means that it is neither exact nor periodic, since it has an infinite number of decimals. Pi demonstrates the relationship of the length of a circumference with its diameter.

The Pi number, represented by the Greek letter π, is the most famous mathematical constant in history. It is an irrational number, which means that it is neither exact nor periodic, since it has an infinite number of decimals. Pi demonstrates the relationship of the length of a circumference with its diameter.

The Pi number is present both in antiquity and today, being an important constant in the field of mathematics and especially in the calculations of Einstein's theory of general relativity. Without a doubt, one of the irrational numbers that most attract the attention of mathematics enthusiasts. It is also the ratio between the perimeter of a circumference and its diameter (Flores, 2019).

It is used especially for geometry and trigonometry. This is due to the calculation one can make with this number of the radius of any circle if its circumference is known. It is also used as part of the Gauss Integral and other formulas in calculus, probability, mathematical analysis and geometry.

On the other hand, in physics it is also used in some equations that describe the fundamental principles of the Universe. This is due to the close relationship that exists with the spherical coordinate system and the very nature of the circle.

- **Succession of Fibonacci**

It is an infinite succession of natural numbers where each one of its terms is the sum of the two previous ones:

1, 1, 2, 3, 5, 8, 13, 21, 34…

Now, it is surprising that such a mathematical construction appears in nature and in practically everything in the universe. For example, in the distribution of leaves around the stem, the reproduction of rabbits, even in entire galaxies, where we get the idea of Fibonacci's spiral.

> Each of Fibonacci's numbers comes very close to the so-called golden ratio, golden ratio or gold number (approximately 1.618034). The larger the pair of Fibonacci numbers, the closer to the golden ratio we are. Naturally, this figure is more beautiful and more pleasing to our perception and whether consciously or unconsciously, artists have used it throughout human history. (Pino, 2009, p.3)

Conclusions

At the end of this monographic work it is concluded that:

- Ancient civilizations are known as the first to employ mathematical concepts. For example, in Egypt their mathematical knowledge was advanced, thanks to their knowledge in geometry to build their temples, pyramids, in addition they knew how to solve problems like the annual flood of the Nile. What the Egyptians emphasize is that their calculations were practical and they were not interested in theoretical reflection unlike the Greeks.
- In Greece Hellenic mathematics stood out, the Greeks used deductive reasoning and its logic to deduce theorems. In this way, great mathematical Greeks emerged, such as Pythagoras, who created Pythagoras' theorem, Euclid with his Euclidean geometry, and academies such as Plato's Academy, where almost all the mathematical work of his time was developed.
- Important mathematicians who contributed in the field of mathematics and promoted new theories and foundations such as: Carl Gauss who contributed to consolidate the theory of numbers. Fibonacci who created the succession of Fibonacci which are applied in various fields such as computer science, game theory and even in nature as in sunflowers or branches of trees.
- The world of mathematics has opened up countless branches of study such as arithmetic, algebra and geometry, which are indispensable for its development.

- Today's mathematics relates to everything in the world. For example, in the control of mechanisms, in medicine, in music, in chemistry, in finance and even in nature itself. These have been developed thanks to the tools used for their development such as books, calculators and mathematical games that facilitated their teachings.
- One of the mathematical examples that will last forever in history is the Pi number which is an irrational number that relates the length of a circumference to its diameter. The Baldor, a mythical book of algebraic practice that consists of more than 5790 exercises to train the logical and mathematical development. The succession of Fibonacci that as already mentioned is the sum of a succession of numbers where it is possible to calculate a term of the succession with the terms that precede it.

Recommendations

People, and especially young people, have to understand that mathematics are fundamental to life, for that here are some recommendations so that they do not lose interest in mathematics are:

- You have to have patience in mathematics, there is a saying that says "who has patience, will get everything", and this is fundamental not to be stressed with the problems or theories offered by mathematics.
- Do not focus on how complicated it is, the best thing is to think that if you understand the subject you will get more knowledge and knowledge is power. It is true that they are difficult but fundamental for every human being.
- The best way to understand mathematics is with practice or get a better visualization of how to put mathematics into practice, this way one will feel more attracted and impressive of the skills and knowledge provided by mathematics.

References

Artacho, A. (2015). *¿Sabías que...? sobre la sucesión de Fibonacci*. Retrieved from MatemáticasCercanas: https://matematicascercanas.com/2015/04/18/sabias-que-sobre-la-sucesion-de-fibonacci/18

Díaz, R. (2018). *Superprof*. Retrieved from Superprof: https://www.superprof.es/blog/jugar-con-las-cifras/

Donoso, E. (2017). *Muy breves reflexiones sobre las matemáticas y sus aplicaciones*. Retrieved from MathCon: http://www.math.com.mx/aplicaciones_matematicas.html

Gómez, D. (2018). *Importancia de la Matemática*. Retrieved from Importancia: https://www.importancia.org/matematica.php

Granada, H. (2010). *SIAM Student Chapter Manizales*. Retrieved from SIAM Student Chapter Manizales: https://siamun.weebly.com/mateblog/aplicacin-de-la-matemtica-en-la-actualidad

León, C. (2015). *SlideShare*. Retrieved from SlideShare: https://es.slideshare.net/ca_ri4/la-tecnologia-en-las-matematicas

López, A. (2015). *Las matemáticas en otras ciencias*. Retrieved from Prezi: https://prezi.com/dellbg37gp5p/las-matematicas-en-otras-ciencias/

Rendón, P. (2018). *El número π tiene fin. ¿Quieres saber en qué termina?* Retrieved from Medium: https://medium.com/atodogauss/el-n%C3%BAmero-%CF%80-tiene-fin-termina-en-3-3a285b9d783d

Rodríguez, F. (2016). *BlogElInsignia*. Retrieved from BlogElInsignia: https://blog.elinsignia.com/2016/11/08/origen-actualidad-las-matematicas/

Vázquez, J. (2013). *Las matemáticas y sus aplicaciones, ayer y hoy, retos del futuro*. Retrieved from Encuentros Multidisciplinares : http://www.encuentros-multidisciplinares.org/Revistanº45/Juan%20Luis%20Vázquez.pdf

Zita, A. (2019). *TodaMateria*. Retrieved from TodaMateria: https://www.todamateria.com/que-son-las-matematicas/