


Mathematics in the arab world: A journey through the golden age of knowledge

 <https://doi.org/10.56238/sevned2024.025-030>

Ariel Antonio Robles Gálvez¹, Abdiel Octavio Cosme Del Rosario² and Narciso Galástica Ruiz³

ABSTRACT

The history of Arabic mathematics is crucial to the development of mathematics. During the Islamic Golden Age (8th-14th centuries), Arab mathematicians made important contributions in algebra, geometry, trigonometry, and arithmetic, applying their knowledge in astronomy, navigation, and engineering. A significant advance was the introduction of the Hindu-Arabic numeral system, which facilitated arithmetic operations.

Prominent mathematicians such as Al-Khwarizmi, who developed methods for solving equations and wrote about algebra, and Omar Khayyam, known for his work in algebraic calculus, made fundamental contributions. Thabit ibn Qurra also contributed to geometry and number theory. In addition, Arabic mathematics preserved and translated works of ancient civilizations, which allowed the transmission of this knowledge to Europe and its influence on the Renaissance.

Keywords: Arabic Mathematics, Golden Age, Algebra, Numerical System, Renaissance.

¹ National University of Panama
E-mail: arielrobles2812@gmail.com

² National University of Panama
E-mail: 507profesor@gmail.com

³ National University of Panama
E-mail: ngalastica06@gmail.com



INTRODUCTION

Ancient Greece, the cradle of Western civilization, stood out for its flourishing in various disciplines, especially mathematics. During this golden age, Greek mathematicians developed fundamental concepts in logic, geometry, arithmetic, and number theory, laying the foundation for a rigorous and systematic discipline. This breakthrough was driven by a spirit of inquiry and critical reasoning, which enabled thinkers to understand the world through reason and observation.

The legacy of this period influenced not only science, but also philosophy and physics, laying the foundations for logical and deductive thinking in the Western intellectual tradition.

This paper explores the achievements and contributions of Greek mathematicians and advances in various branches of mathematics during this era, highlighting the importance of their role in preserving and transmitting the knowledge of the era. It is hoped that this research will spark interest in mathematics in ancient Greece.

CONCEPTUAL ELEMENTS

THE LIBRARIANS OF ALEXANDRIA AND THEIR ROLE IN THE PRESERVATION AND TRANSMISSION OF KNOWLEDGE

The librarians of Alexandria played a pivotal role in the preservation and transmission of knowledge in the famous Library of Alexandria. These scholars and custodians of knowledge were responsible for organizing, preserving, and disseminating the vast collection of works that made up the library. (Van der Waerden, 1983).

The librarians of Alexandria were carefully selected for their knowledge and skills in different disciplines. They were scholars versed in a wide range of subjects, ranging from literature and philosophy to astronomy and medicine. Their academic training and passion for knowledge made them the guardians of the library's cultural and scientific legacy. (Encyclopedia Britannica, n.d.).

One of the main roles of librarians was to organize and catalog the collection of works. It is believed that a classification system based on different topics and areas of knowledge was used. This allowed for easy location and retrieval of texts, thus facilitating research and study.

In addition to their organizational work, librarians were responsible for the conservation and restoration of papyrus scrolls, the main means of writing at the time. Because of their delicacy and susceptibility to deterioration, librarians were required to take steps to preserve texts and prevent their loss. This involved the use of preservation techniques, such as proper storage, moisture protection, and pest control. (Heath, 1999).

Librarians also played a crucial role in the transmission of knowledge. They were not only limited to the mere preservation of works, but were also dedicated to the dissemination and exchange



of ideas. The library of Alexandria was a meeting place for scholars and philosophers, and librarians facilitated intellectual dialogue and promoted collaboration among scholars.

Another important aspect of the work of librarians was the translation of works into different languages, mainly Greek. This task allowed works from different cultures and civilizations to be accessible to a wider audience. The librarians were expert linguists and worked closely with translators to ensure the quality and accuracy of the translations. (Heath, 1999).

CONTRIBUTIONS OF MATHEMATICIANS IN THE ALEXANDRIAN PERIOD

During the Alexandrian period, known as the Golden Age of mathematics, outstanding mathematicians emerged who made significant contributions to this discipline. Among them, Euclid is one of the most recognized figures, famous for his work "Elements", a treatise that laid the foundations of Euclidean geometry and established an axiomatic approach to the proof of theorems, using deductive logic.

Euclid defined fundamental concepts in plane geometry, such as points, lines, and planes, and formulated postulates and axioms that are still used today. He also made important contributions to arithmetic, exploring properties of prime numbers and developing methods to find the greatest common divisor and the least common multiple. Its rigorous and clear methodology has influenced the teaching of mathematics over the centuries and continues to be essential in mathematics education today.

Euclid and flat bodies

In addition to his work in plane geometry and arithmetic, Euclid was also interested in the study of space and plane bodies. In "Elements", Euclid explored the properties of regular polygons and convex polyhedra. He defined and studied Platonic solids, which are regular convex polyhedra composed of congruent faces, edges, and vertices. (Euclides, Xirau, 2013).

Euclid established fundamental properties of polyhedra, such as the number of faces, edges, and vertices that compose them. In addition, he showed that only five regular convex polyhedra exist: the tetrahedron, the cube, the octahedron, the dodecahedron, and the icosahedron. This classification of regular polyhedra has been a lasting contribution and has influenced the study of geometry and three-dimensional bodies. (Netz, 2003).

Euclid played a pivotal role in the Alexandrian period, leaving important contributions in the fields of plane geometry and arithmetic. His work "Elements" laid the foundation for Euclidean geometry and provided a rigorous method of mathematical demonstration. In addition, Euclid explored the study of regular polyhedra, establishing a classification of them. His legacy lives on



today and his influence extends beyond mathematics, impacting many other areas of knowledge. (Euclides, Xirau, 2013).

Archimedes

Archimedes was a Greek scientist, mathematician, and inventor born in Syracuse, Sicily, around 287 BC. His contributions in mathematics, physics, and technology are widely recognized as precursors to many modern ideas. In mathematics, Archimedes developed methods for calculating areas and volumes of geometric figures, formulating fundamental principles that laid the foundation for integral calculus. His achievements include the precise determination of pi using geometric approximations, and the creation of a system of large numbers called "Archimedes numbers".

In addition, in physics, Archimedes formulated the principles of lever and the principle of flotation, establishing mathematical relationships between the density, volume, and weight of objects submerged in liquids. His contributions in various disciplines demonstrated a unique combination of mathematical ingenuity and scientific vision. (Dijksterhuis, 1987).

Spirals, conoids and spheroids

Archimedes also studied the properties of spirals and conoids. In his work "On Spirals", he examined the characteristics of Archimedean spirals, which are curves generated by a point moving at a constant speed along a straight line while this line rotates around a fixed point. (Arquímedes, García, 2007).

In addition, Archimedes investigated conoids and spheroids. A conoid is a surface that is generated by rotating a line around a fixed axis while traveling along another fixed line. A spheroid is a surface similar to a sphere, but deformed in a certain direction. Archimedes studied the geometric and mathematical properties of these surfaces, establishing important results and laying the groundwork for future developments in geometry and physics. (Thomas, 2012).

Apolonio

Apollonius of Pergamum, also known as "The Great Geometer", was a Greek mathematician born in Pyrgamon, around 262 BC. He is credited with significant advances in geometry and, in particular, in conical sections. His most important work, "The Conics", consists of eight books and addresses the geometric properties of conic sections: circles, ellipses, parabolas and hyperbolas. Apollonius introduced crucial concepts such as foci and the guidelines of conics, allowing for an accurate description of their mathematical properties. In addition, he developed methods for the construction and analysis of these curves, which had a profound impact on ancient mathematics and



the subsequent evolution of geometry. His systematic and rigorous approach influenced mathematical methodology for centuries. (Durán, 2013).

Tangencies or contacts and the theory of epicycles

Apollonius was interested in the study of tangencies or contacts, which are points of contact between two geometric figures. In his work "The Tangents", Apollonius investigated the properties of tangents to a curve and their relationship with the geometric properties of the curve itself. His work laid the foundations for the systematic study of tangencies and their application in various fields of geometry and physics. (Thomas, 2012).

In addition, Apollonius developed a theory of epicycles to explain the apparent motions of the planets in the sky. Epicycles are small circles whose center moves along another larger circle, and were used to model planetary orbits in Ptolemy's geocentric system. Apollonius' theory of epicycles provided an accurate mathematical description of planetary motions and was widely accepted until the heliocentric theories of Copernicus and Kepler gained acceptance. (Thomas, 2012).

DESCRIPTION

This research project is carried out as part of the requirements to obtain the degree of Bachelor of Science in Mathematics at the National University of Panama. It has been carried out with the collaboration of professors Alcibiades Medina, Eliecer Cedeño, Narciso Galástica and Abdiel Cosme, who are professors at this institution. The work is structured in chapters that examine the most relevant aspects of the Greek legacy in the development of mathematics, covering its historical evolution, as well as the analysis of the mathematical contributions of the Greeks. In addition, the important scientific and cultural contribution that these civilizations have made to our society is highlighted.

FINAL THOUGHTS

The legacy of mathematical flourishing in Alexandria invites us to recognize the monumental human capacity to seek and understand the universe. This golden period not only represents a significant stage in the history of mathematics, but also symbolizes the connection between ideas and curiosity that have shaped our civilization. As we look at how the contributions of those mathematicians still reverberate in our current era, it becomes apparent that the teachings and discoveries that emerged from Alexandria have provided the foundation upon which contemporary knowledge is built.

The impact of the Library of Alexandria, though physical in its existence, is present in every advance in scientific and mathematical exploration today. This brilliant era reminds us of the



importance of the exchange of ideas and intellectual collaboration across cultures and generations. The thirst for knowledge that characterized that time continues to be a beacon that guides our aspirations towards a future where curiosity and research are essential.

As we pay tribute to the pioneers of ancient scholarship, we acknowledge our debt to them and the need to continue to cultivate understanding and wisdom. Alexandria's mathematical legacy, though faded into its physical form, continues to light the way for further exploration of the unknown, urging us to transform our questions into answers, and our theories into realities. Thus, the spirit of Alexandria's flourishing lives in each of us, encouraging us to continue investigating, learning and dreaming.



REFERENCES

1. Arquímedes, & García Gual, C. (Trad.). (2007). *Arquímedes: Obras completas*. Editorial Gredos.
2. Boyer, C. B., & Merzbach, U. C. (2010). *Historia de las matemáticas*. Editorial Reverté.
3. Boyer, C. B. (2010). *Historia de las matemáticas*. Editorial Alianza.
4. Cordero, A. (2014). *Alejandría: El encuentro de las matemáticas y el mundo antiguo*. Editorial Ediciones Síntesis.
5. Dijksterhuis, E. J. (1987). *Arquímedes*. Editorial Crítica.
6. Durán, A. J. (2013). *Matemáticas en la antigua Grecia: Del misterio a la precisión*. Editorial Ediciones Akal.
7. Enciclopedia Británica. (s.f.). Matemáticas griegas. Disponible en: <https://www.britannica.com/topic/Greek-mathematics>.
8. Euclides, & Xirau, J. (Trad.). (2013). *Euclides: Los elementos*. Editorial Porrúa.
9. Heath, S. T. (2013). *Historia de la matemática griega*. Editorial Alianza.
10. Heath, T. L. (1999). *Historia de las matemáticas griegas* (Vol. 1). Editorial Labor.