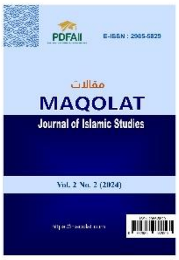

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Research Article

The Mathematical Thinking Among Muslims and Its Impact on the Science of Inheritance

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Abstract. The challenge I faced while teaching the inheritance course to students unfamiliar with this field and its terminology was evident in their difficulty in easily understanding the scientific material, requiring considerable time for explanation. This situation prompted me to seek a way to simplify their understanding of inheritance. Given the mathematical nature of the course and the students' familiarity with this area, so I decided to utilize this aspect to achieve my teaching objectives, eventually developing mathematical rules that clarify the distribution of inheritance among heirs. This approach not only helped me achieve my goals but also led me to connect the efforts of Muslims with mathematics, highlighting their creativity in this domain, which continues to this day. Therefore, in my teaching methodology, I relied on both library research and mathematical approaches. The research highlighted the contributions of Muslims to mathematics and I introduced some of my own rules, applying them specifically to the topic of intersex cases.

Keywords: Mathematics among Muslims; The science of inheritance; Mathematical formulation in inheritance; The issue of Intersex in inheritance.

INTRODUCTION

There is no doubt that teaching in higher education necessitates those responsible to focus on and develop scientific research, both in terms of content, such as issues leading to the advancement of knowledge, and in enhancing the university's level where such innovative and invention-based studies occur, rather than relying on rewriting published material. Researchers have the opportunity to advance knowledge using suitable methodologies.

The topic of inheritance is one of the subjects that requires our study to make it more accessible to students. It is a course heavily linked to mathematics, in which many students do not excel, though they have some familiarity with mathematics and its terminology. My personal experience with my students has shown the importance of relying on mathematical analysis.

The challenge I faced was in enabling students to comprehend the course as I intended to present it, particularly because some of them were weak in mathematics.

Another issue was related to the students' feelings of inferiority compared to those from scientific disciplines. I wondered if this teaching method could boost their morale and make them proud of their Sharia specialization, especially when they learned about the contributions of Muslims to mathematics and their advantages over the West in developing knowledge.

I reflected on all the aforementioned points while preparing my teaching method, ensuring student participation in discussions, gathering their opinions, and monitoring their comprehension of the course. The success of this approach encouraged me to organize training sessions and competitions in this area, which my students welcomed enthusiastically. These sessions were open to all interested individuals from various fields, whether they were students, teachers, lawyers, notaries, or judges.

Over time, I have managed to compile these mathematical rules and chose to present some in this research while studying the contributions of Muslims to mathematics throughout history to the present day. Consequently, my research topic is "**Mathematical Thinking Among Muslims and Its Impact on the Science of Inheritance**".

Muslims studied mathematics as a science during the Abbasid era, through the translation of Greek sciences. However, they went beyond merely acquiring knowledge; they proceeded to explain Greeks texts, correct the errors made by their predecessors, and creatively developed new fields within mathematics. A notable example is Al-Khwarizmi, the author of (Al-Jabr wal-Muqabalah), who excelled in his field. The term 'algebra' has been used extensively for centuries and is derived from his book. Muslims also solved multivariate equations, thus exceeding Western scholars in this and other domains. They applied mathematics in various other sciences as well. Modern mathematics experts recognize the contributions of Muslim mathematicians, who have played a crucial role in advancing Western knowledge.

In discussing inheritance, I employed mathematical analysis and introduced my own rules alongside others, addressing the issue of intersex individuals, explaining how their inheritance is determined, and the method used to ascertain their share in the inheritance. My contribution to this field is expressed through mathematical theorems, the outcome of meticulous research, which, with Allah's assistance, has enabled me to provide researchers with a new approach to research and teaching. This aims to facilitate the understanding of the subjects taught, pioneer new research avenues, and develop a digital program utilizing these formulas to further Muslim scientific research and emphasize its significance.

The study's results showed that students were able to understand the course easily and became proud of their affiliation with Sharia studies because this science is open to all fields, both scientific and others. They became more engaged academically with their peers in the scientific faculties, going to their libraries to complete their assignments. The study also revealed the significant role of Muslims in mathematics and other sciences, and how this influence manifested in their use of mathematics in engineering, chemistry, physics, and other fields.

So, the Research Objectives:

1) **Enhance Higher Education Teaching:** Examine how higher education can improve by integrating advanced mathematical concepts and research methodologies, focusing on inheritance studies.
2) **Make Inheritance Studies Accessible:** Simplify the subject of inheritance for students, particularly linking it to mathematical analysis to facilitate understanding.
3) **Improve Mathematical Competency:** Address the challenge of teaching students with varying levels of mathematical skills, ensuring they comprehend the course fully.
4) **Boost Student Morale:** Explore the impact of teaching methods on students' self-esteem, especially in relation to their appreciation of Islamic contributions to mathematics.
5) **Engage Students in Research:** Reflect on teaching practices that encourage student participation, discussion, and feedback in inheritance and mathematical studies.
6) **Organize Educational Activities:** Evaluate the effectiveness of training sessions and competitions in enhancing students' understanding of mathematical rules in inheritance law.
7) **Study Historical Contributions:** Investigate the historical contributions of Muslims to mathematics, particularly during the Abbasid era, and their impact on modern scientific disciplines.
8) **Develop Mathematical Theorems:** Articulate mathematical theorems that assist in explaining inheritance laws, especially in complex cases like those of intersex individuals.
9) **Introduce New Research and Teaching Approaches:** Offer new methodologies for research and teaching that merge mathematical analysis with Islamic legal studies.
10) **Create Digital Tools for Islamic Sciences:** Develop a digital program that incorporates mathematical formulas to advance research in Islamic sciences and demonstrate its contemporary relevance.

These objectives aim to bridge historical Islamic contributions to mathematics with modern educational needs in Islamic legal studies, particularly in inheritance, fostering a comprehensive understanding and innovative research in the field.

METHOD

In the presented research, I used the following methodology:

1) **Historical Analysis:** Investigate the development of mathematical thinking among Muslims. This would involve examining historical texts, and contributions of Muslim mathematicians.
2) **Case Studies:** Analyze specific examples of inheritance calculation in Islamic law, illustrating how mathematical thinking was applied to solve complex inheritance issues, including those involving intersex individuals.
3) **Theoretical Framework:** Develop a theoretical framework that links mathematical thinking with Islamic legal principles, demonstrating how mathematical logic and reasoning are applied in the context of Islamic inheritance law.
4) **Mathematical Modeling:** Create mathematical models or simulations to demonstrate the application of algebraic and geometric principles in determining inheritance shares according to Islamic law.
5) **Contribution to Knowledge:** Highlight how the research contributes to existing knowledge and understanding of the role of mathematical thinking in Islamic inheritance law and how it can inform current legal practices and educational strategies.

This research methodology would provide a comprehensive understanding of how mathematical thinking among Muslims has influenced and shaped the science of inheritance, offering valuable insights into the integration of mathematical principles in Islamic legal thought and practice.

A. The Role of Mathematics in Serving Society and Knowledge:

The importance of mathematics in serving knowledge, in general, is undeniable, and the Holy Quran contains many verses indicating this, mentioning terms like statistics, ordinary numbers, fractions, arithmetic operations, and others. The Muslim scholars' profound understanding of this was very deep. Hence, they excelled in this field, and their names shone in the world of knowledge, testifying to their towering intellect. The Arabs were the ones who invented the zero, which changed the course of science altogether. We can see that computer programs are based on zero and one, and the discovery of zero facilitated all mathematical operations.

1. The Role of Muslim Mathematicians in Introducing the Foundations of Algebra and Algorithms:

Among the evidence of the effective contribution of Muslim scholars in the field of mathematics is their establishment of the foundations of algebra and algorithms and their early development of these fields. Their works, which history has preserved, some of which remain in manuscript form, testify to this, and Western mathematics researchers have recognized their contributions. There is no need for detailed discussion on this; it suffices to present the evidence through the writings of Muslims and the testimonies of researchers. As an example, we mention the following scholars:

Muhammad ibn Musa al-Khwarizmi (d. 235 AH) (Al-Qifti, 2005, 216, Al-Jua'idi, 2001) laid the foundations of algebra and algorithm in Baghdad, and he authored a book titled (Al-Jabr wal-Muqabalah), which had a significant impact on mathematics. He revolutionized mathematical thinking by inventing solutions to first and second-degree equations with one unknown. The term "algebra" in Latin is translated from Arabic, and it was printed in London in 1831 AD with an English translation by Rosen (Edward, 1896, 236). Also, Abu Kamil Shuja' ibn Aslam, a scholar of the third Hijri century, was extensively engaged in researching the books of mathematicians. He considered the most accurate among them to be the book of al-Khwarizmi, and he wrote books on mathematics, including "Curiosities of Calculation," in which he studied equations with four unknowns. He named the first unknown "thing," the second "dinar," the third "fils," and the fourth "ring," while he referred to the constant number as "dirham" or "number." (Sa'idan, 1963). Arabic numerals spread to Europe through his books. He authored other valuable works such as "The First Treatise" and "The Second Treatise," known as "Al-Sind Hind." (Al-Qifti, 2005, 216).

Ghiath al-Din Jamshid al-Kashi (d. 839 AH), a distinguished mathematician of the Islamic Golden Age, made notable contributions to the field of mathematics, particularly with his work on decimal fractions in his book "Miftah al-Hisab" (The Key to Arithmetic). This text, completed in 829 AH, served as an extensive manual covering various mathematical topics, including arithmetic, algebra, and geometry, intended for educational use in Samarkand. In his book, al-Kashi made significant advancements in the computation of π, calculating it to sixteen decimal places (Al-Kashi, 18-62, Roshdi, 1994, 88-91), an accuracy that was not surpassed until nearly two centuries later.

2) The use of mathematics by Muslim scholars in the field of astronomy and meeting people's needs:

Muslim mathematicians did not confine themselves to theoretical study within their field; rather, they branched out into other scientific disciplines due to their pressing need for mathematics. In doing so, they provided a valuable service to people, facilitating their daily lives, administrative tasks, and business activities through their books. Among these scholars, to name but a few, are the following:

Jacob ibn Ishaq al-Kindi (d. 253 AH), known for his expertise in medicine, philosophy, arithmetic, logic, geometry, and astronomy, authored numerous famous works (Ibn al-'Ibri, 1997).

Abu Abdullah Muhammad ibn Isa ibn Ahmad al-Mahani (d. around 260 AH) was famous for mathematics and astronomy. He was the first to express Archimedean problems in algebraic forms.

Thabit ibn Qurra al-Harrani (d. 288 AH) authored several books in mathematics, including "Computing the Lunar Months," "The Solar Year," "A Treatise on Extracting Geometrical Problems," "A Treatise on Numbers," "The Sector Shape," (Ibn al-Nadim, 1978, 380) and others.

Mohammad ibn Jabir ibn Sinan Al-Harrani Al-Battani (d 317 AH), often called Albategnius in the West, was a renowned Arab mathematician and astronomer whose contributions had a major impact on the advancement of mathematics and astronomy in both the Islamic and Western worlds. The astronomical information and techniques that were carried over from ancient Greek astronomy, particularly Ptolemy's, were greatly improved by Al-Battani's contributions. By introducing the use of sines and tangents for the computation of celestial occurrences, Al-Battani improved the mathematical tools of trigonometry in his work (Ibn al-Nadim, 1978, 389-390, Abdullatif, 2011).

Abū al-Wafāʾ Muhammad ibn Yahya ibn Ismail al-Būzjānī (lived between 328 and 388 AH), author of the oldest extant book on arithmetic: "What the Writers and Workers Need in the Craft of Arithmetic," had outstanding contributions. (Ibn al-Nadim, 1978, 394-395)

Abu al-Hasan Ali ibn Yunus al-Sufi (d. 399 AH), who invented the astrolabe centuries before the Italian scientist Galileo (d. 1642 CE), had significant works such as "The Book of the Astrolabe," "The Book of the Utility," which contained tables on solar azimuth and time measurement of solar altitude from sunrise, and "The Precise Adjustment," which included equations about solar and lunar eclipses (Stevenson, 1991). In his book about The Hakimi Zij, he contributes in the trigonometry and spherical astronomy (King, 1972, 57-316).

Abu Bakr Muhammad al-Karaji (d. between 410 and 420 AH), who shifted algebra from the realm of equations to applications and focused on sequences, was the first to use arithmetic progression. His most well-known work is "Al-Fakhri," in which he established the foundation for algebraic calculus without the need for geometric techniques by defining and supplying rules for monomials and their products. One important step toward contemporary algebra was made possible by his contributions, which assisted in the shift in algebraic problem solution from geometrical to arithmetical methodologies (Hormoz and Gus, 1986, Roshdi, 1994, pp. 22-32).

Thereafter, we have Abu al-Rehan al-Biruni (d. 440 AH), who authored nearly a hundred books covering mathematics, astronomy, and more. He was the first to solve cubic equations algebraically. His contributions to trigonometry were particularly noteworthy. He focused on the applications of spherical trigonometry in astronomy, providing detailed classifications and solutions for spherical triangles. In his treatise on shadows, he expanded upon trigonometric definitions and applied these to practical religious and astronomical problems. Al-Biruni's mathematical prowess was evident in his development of methods for measuring the Earth and calculating distances, which significantly advanced the field of geodesy. He estimated the Earth's radius with remarkable accuracy and compiled extensive geographic coordinates, demonstrating a profound understanding of mathematical and functional relationships (Kennedy and Muruwwa, 1958, Davidian, 1960, Kennedy, 1963).

Omar ibn Ibrahim al-Khayyam (d. 516 AH), the renowned poet, was also a mathematician who solved many problems in trigonometry using algebraic equations. He attempted to classify equations according to their degrees and limits, five centuries before the Dutch mathematician Stevin (d. 1620 CE), who was credited with it (Siadat and Tholen, 2020, Bisom, 2021).

Jabir ibn al-Aflah al-Andalusi (d. 540 AH) derived the equation known as "Jabir's Theory," used to solve right-angled spherical triangles. Some applied this in engineering, statistics, and economi (Lorch, 1976, Bellve, 2011).

3) The Openness of Muslim Mathematicians to Sharia Sciences:

When discussing the involvement of Muslim mathematicians with Sharia sciences, it does not imply that their interest developed only later. There is a profound linkage between the sciences, reflecting the encyclopedic nature of these scholars. Their scientific pursuits were not confined to a single field, contrasting with today's era that categorizes specializations into general and specific.

The nature of research necessitates this segmentation, aiming to underscore aspects that have significantly impacted both the East and the West. While not all researchers who have significantly contributed to the evolution of human knowledge to this day are followed, especially those influencing mathematics-based industries, we will mention a few of these scholars subsequently:

Abu al-Abbas Shihab al-Din Ahmad ibn Mohammad ibn al-Ha'im al-Maqdisi (d 815 AH), was renowned for his significant contributions to mathematics and inheritance law (al-Fara'id). Ibn Hajar remarked that he excelled in these fields, surpassing his contemporaries, leading to people traveling from afar to seek his knowledge (Ibn Hajar, 1994, 2: 525). He completed his influential book "Murshidat al-Talib ila Asna al-Matalib fi Ilm al-Hisab" (Guide for the Seeker to the Highest of Aspirations in the Science of Arithmetic) at the age of twenty-seven or thirty, depending on whether he was born in 753 AH or 756 AH. This is deduced from his statement at the end of his book, where he expressed gratitude to Allah for His blessings and prayers for Prophet Muhammad, his family, and companions, dating the completion to Sunday, the sixth of Rabi' al-Thani in the year 783 AH (Ibn al-Ha'im, 1994, 254).

Ali ibn Muhammad ibn Muhammad ibn Ali al-Qurashi al-Basri, known as Abu al-Hasan al-Qalasadi (d. 891 AH), was a prolific author who made significant contributions to various fields including arithmetic, astronomy, inheritance law, jurisprudence, Hadith, Quranic readings, and grammar. Among his works in arithmetic are "Kashf al-Jilbab 'an 'Ilm al-Hisab" (Unveiling the Cloak from the Science of Arithmetic), "Ghunyat Dhawi al-Albab fi Sharh Kashf al-Jilbab" (Sufficiency of the Intelligent in Explaining Unveiling the Cloak), "Tabsirat al-Mubtadi bi al-Qalam al-Hindi" (Enlightenment for the Beginner with the Indian Pen), "Kashf al-Asrar 'an 'Ilm al-Huruf al-Ghubar" (Unveiling the Secrets from the Science of Dust Letters), "Sharh Arjuzat al-Tilimsani fi al-Fara'id" (Commentary on the Tilimsani's Poem in Inheritance), and "Sharh Talkhis A'mal al-Hisab" (Commentary on the Summary of Arithmetic Operations). In his introduction to "Sharh Talkhis A'mal al-Hisab," he states the purpose is to explain the summarized arithmetic operations by

Sheikh Imam, the exemplar and the righteous saint, Abu al-Abbas Ahmad ibn Muhammad ibn Uthman al-Azdi, who was born in Marrakech in Dhu al-Hijjah in the year 656 AH (Al-Qalasadi,1999, 27).

In recent times, there has been widespread discussion about the scientific miracles in the Holy Quran, and attention has been paid to its mathematical aspects. Scholars have emphasized that human knowledge is limited in grasping the true knowledge, and that since its revelation, the Quran continues to reveal evidence supporting its miraculous nature, as it is from the All-Knowing, Most Subtle. Among those studies completed in this field is what Professor Dr. Idriss Al-Kharshaf presented to obtain his PhD at the University of Paris in the 1980s under the title: "Mathematical Equations in the Holy Quran." He also published a book titled: "The Scientific Method in Studying the Holy Quran," demonstrating his dedication to this field. Additionally, Professor Abdelrazzak Noufel contributed in his book: "Numerical Miracles in the Holy Quran," and Engineer Ahmed Mohammed Ismail in his book: "Mathematical Systems in Programming the Letters of the Holy Quran," among many others.

From all the above, it becomes evident the importance of mathematics in serving society by providing regulation for needs, estimating spaces, and solving issues related to human life in general, and knowledge in particular. The evidence shows the Muslims' attention to this field, their development and significant benefit from it, indicating its significance and necessity in advancing societies and the development of sciences. It also confirms that Muslims have had a noteworthy mathematical mentality throughout history, despite attempts by the West to obscure these facts.

B. The Role of Mathematics in Serving Inheritance:

1. Challenges in teaching inheritance:

It's undeniable that inheritance is fundamentally a mathematical subject. Allah Almighty delineated in the Quran how to distribute the estate among its rightful heirs, and the noble Prophetic Sunnah is also a source of guidance in this matter alongside the Quran. Jurists have authored valuable books focusing on inheritance and wills, explaining how to establish mathematical tables, indicating unequivocally that inheritance is closely associated with mathematics to a significant extent.

Recognizing the importance of incorporating mathematical methods into teaching the science of inheritance, I deemed it beneficial to utilize mathematical approaches to present the material in a structured manner, enabling students to comprehend the course content efficiently. Over the years, I observed difficulties among students in understanding, especially considering their diverse backgrounds.

In 1988, I was assigned to teach the inheritance and wills course at our university. I introduced students to the scientific material using terms and methods commonly employed in dealing with issues related to estate distribution among heirs. While these methods showcased their remarkable ingenuity, many students had not studied inheritance in secondary schools, lacking familiarity with the terminology and table placement methods. Consequently, they struggled to comprehend and apply the concepts, presenting a challenge in effectively conveying the material.

2. *Incorporating Mathematics in Teaching Inheritance:*

Upon deeper examination, I realized that the inheritance operations were indeed mathematical operations, applying mathematical laws in various forms. The complexity of the terminology required extensive explanation for students to grasp its arithmetic implications.

The first aspect that intrigued me was the terminology, which students took considerable time to comprehend before applying its arithmetic implications. For example:

Symmetry, which entails the agreement of fraction positions, such as 2 in the case of a deceased wife leaving behind a husband and a sister. Here, the husband's share in the absence of the wife's branch is half $\frac{1}{2}$, and the sister's share is also half $\frac{1}{2}$, making the estate's base 2.

Interference, indicating the existence of fractions where one interferes with the other, such as 3 and 6 in the scenario of an individual passing away, leaving behind a mother's father and sister. Here, the father's share is one-third $\frac{1}{3}$, and the sister's share for the mother is one-sixth $\frac{1}{6}$. It's apparent that 6 is a multiple of 3, making the estate's base 6, and we multiply the father's share by 2 to make it compatible with the sister's share for the mother, resulting in $\frac{2}{6}$.

Compatibility, meaning two fractions in the least ratio agree, such as $\frac{1}{8}$ and $\frac{1}{6}$. To unify their positions to facilitate arithmetic operations, we multiply half of one by the full value of the other, resulting in $\frac{3}{24}$ and $\frac{4}{24}$.

Contrast, where fractions do not agree on anything, such as $\frac{1}{4}$ and $\frac{1}{3}$. To unify them, we multiply each by the other, resulting in $\frac{3}{12}$ and $\frac{4}{12}$.

I presented exercises demonstrating how to distribute the estate among heirs, observing that those unfamiliar with this field were perplexed in translating the terminology and its implications into the presented exercises. Even when they attempted to do so, they often misapplied the rules, demonstrating a need for significant clarification. Additionally, students majoring in literature and Islamic studies typically have less interest in mathematical courses, requiring considerable effort on my part to elucidate the concepts. It's essential for courses like this to be taught by professors rather than solely from textbooks to ensure proper understanding and application.

I thought about the matter thoroughly, then I found that these operations could be presented to them in a different way they were accustomed to. So, I resorted to my rule of "Greatest Common Divisor" and "Least Common Multiple," which the students have been familiar with since early times, and they have used them in arithmetic operations more than once. I presented them with two examples, and afterward, it became quite easy for them to find the estate's base and overcome the problem of unifying fractions. All praise be to Allah.

Assuming the existence of shares $\frac{1}{6}$ and $\frac{1}{8}$:

First, we search for the Greatest Common Divisor as follows:

6	2	8	2
3	3	4	2
1		2	2
		1	

Then we search for the common divisors with the highest frequency, in order to obtain the least common multiple.

The highest frequency of 2 is 3.

The highest frequency of 3 is 1.

Then, we make each divisor's frequency as its exponent. So, the unified fraction (base of the estate) is:

2^2 x 3^1 = 8 x 3 = 24.

To make the fraction $\frac{1}{6}$ from 24, we multiply both the numerator and the denominator by 4, resulting in: $\frac{4}{24}$.

To make the fraction $\frac{1}{8}$ from 24, we multiply both the numerator and the denominator by 3, resulting in: $\frac{3}{24}$.

After applying this method with my students since 1990, I noticed that, by the grace of Allah, they avoided making mistakes and grasped the method in the shortest possible time.

This work I have undertaken has been the key that opened the door wide for me to search for effective methods in delivering scientific material in a way that students comprehend, register, and return to whenever needed. By the grace of Allah, I was guided to formulate equations to solve some aspects of inheritance and will issues. I will present an example studying how to distribute the estate among the heirs in the presence of an ambiguous Intersex Individual.

3. *Study of the Inheritance Case of an Ambiguous Intersex Individual:*

Al-Jurjani defined Intersex (Khuntha) as a person who has the sexual organs of both men and women, or has neither at all (Al-Jurjani, 1938, 91). Sheikh Bin is mentioned that jurists described such a person as having the male genitalia and the female genitalia, which is the most common understanding. However, it is also said there exists another type who has neither of the two but has an orifice between the thighs for urination, resembling neither gender.

Intersex Individuals are categorized into two types: Ambiguous Intersex (Khuntha Mushkil) and Clear Intersex. The term "Clear Intersex" refers to individuals who exhibit obvious characteristics of either male or female gender. In contrast, "Ambiguous Intersex" applies when the person's characteristics do not clearly align with male or female, making the determination challenging.

The first to judge Intersex cases in the pre-Islamic era was ʻAmir ibn al-Ḍharib al-ʻAdwani. The Arabs would seek his judgment on various matters. When asked about Intersex cases, he spent a night awake, contemplating his decision. His slave girl named Sakheela, who tended his sheep, noticed his restlessness and inquired about it. Upon hearing his dilemma, she suggested him to rely in his judgment on which organ of him urinates the most. He felt relieved by her advice and decided accordingl(Ibn Makula, 1411 AH, 6: 63, Ibn Kathir, 1992, 2: 206). Later, Ali ibn Abi Talib (may Allah be pleased with him) made similar judgments in Islam, becoming the first to do so in the Islamic era.

The scholars have differed regarding the inheritance share of the Intersex Individual. Some of their opinions include (Benis, private manuscript):

1. The popular opinion is that they are entitled to half of the inheritance in each scenario (considering them as male and then as female), with each problematic individual doubling the share for each accompanying problematic individual.
2. Ibn Habib stated that each heir, including the Intersex Individual, should be multiplied by the maximum share they are entitled to. If the Intersex Individual has both a son and a daughter, the son's share is doubled because he is more likely to claim it, while the Intersex Individual's share is halved because they are more likely to claim it.
3. Ibn Habib also mentioned that the Intersex Individual should receive three-quarters of the share or less. If there are other heirs who are not problematic, then the Intersex Individual receives three-quarters of the share, while the remaining quarter goes to the direct heir. If the Intersex Individual has a son, the share is three-quarters of half, and if they have a daughter, it is three-quarters of three-quarters.

All of this applies when there are heirs who inherit alongside both males and females, such as a son, grandson, or paternal nephew. However, if the heirs only inherit their males, such as an uncle, cousin, or brother's son, then the Intersex Individual receives half of the male inheritance. This opinion is supported by Ash-Sha'bi, Ath-Thawri, Ibn Abi Layla, Ash-Sharik, Ahmad ibn Hanbal, his companions, the companions of Malik, Yahya ibn Adam, and An-Nu'aim ibn Hammad (Al-Kalwadhani, 1995, 285-286).

For the calculation of their share, we will rely on the popular opinion, as follows:

Suppose a person dies, leaving behind a son and a problematic Intersex Individual. The distribution of the inheritance would be as follows:

In the first scenario: We consider the Intersex Individual as a male, so the base of the inheritance is 2: for each one 1.

In the second scenario: We consider the Intersex Individual as a female, so the base of the inheritance is 3: the son gets 2 and the Intersex Individual gets 1.

Then we unify the denominator for both scenarios (2 and 3), resulting in 6. The share for the Intersex Individual, assuming they are considered as male, is 3, and for the other son is 3.

In the second scenario, the share for the Intersex Individual is 2, while the share for the son is 4.

Since we are dealing with two cases, we divide what we have allocated to both the son and the intersex Individual by 2 in the first case, and similarly for what we have allocated in the second case, and then sum the results. This sum represents the share of the heirs as follows:

For the son: (1 x 3 = 3) divided by 2 equals 1.5. Then we consider the second scenario, which is (2 x 2 = 4), divided by 2 equals 2. So, the total share for the son is 3.5.

As for the Intersex Individual, in the first scenario: (1 x 3 = 3) divided by 2 equals 1.5. Then we consider the second scenario, which is (1 x 2 = 2), divided by 2 equals 1. So, the total share for the Intersex Individual is 2.5.

Then we correct the inheritance share. Thus, the total shares amount to 12: 7 for the son and 5 for the intersex individual, as shown in the following table:

	3	2	
	2	3	12
Son	1	2	7
Intersex	1	1	5

The issue can be discussed more concisely as follows: After unifying the denominator (the base of inheritance), we multiply it by the number of Intersex individuals to obtain the total denominator, which is 12, as in the problem we have solved.

If the number of Intersex Individuals increases, the issue becomes more complicated for the students. It is needless to mention that the time required for me to explain this method to the students is not easy, along with their tendency to forget the procedure over time and their continuous mistakes. All of this prompted me to establish mathematical rules in the subject, which I call the "Makkiyah Rules" for the students' benefit.

To solve a problem involving Intersex Individuals, we apply a set of rules as follows:

1. **Rule regarding the number of Intersex cases:**

$$I_{(x)} = 2^x \qquad (1)$$

I: Intersex.

x: Number of Intersex

If we assume the presence of three Intersex Individuals with a sibling, then the number of inheritance cases is:

$$I_{(3)} = 2^3 = 8$$

2. **The rule for obtaining the denominator of the last column that consolidates the share of heirs in the Intersex cases:**

If the common denominator for the cases is denoted by the letter y, then:

$$F = 2^x \times y \qquad (2)$$

3. **The rule for obtaining the share of heirs in the last column that consolidates their share in the case of Intersex Individuals:**

If (P) represents the share of heirs in each case, (k) represents each heir, (M) represents the numbers by which these shares are multiplied to unify the denominators (the base of inheritance), and (n) represents the number of heirs, then:

$$f_{(k)} = \frac{\sum_{k=1}^{n} P_{(k)} \times M_{(n)}}{2^x \times y} \qquad (3)$$

Eg. A man died and left behind three Intersex children and a brother.

To solve this case and apply the aforementioned rules, I present the following table. I will explain its contents afterward:

	60	3	20	45	45	45	36	36	36		
	3	3	9	4	4	4	5	5	5	1440	72
$I_{(1)}$	1	2	2	2	1	1	2	2	1	460	23
$I_{(2)}$	1		2	1	2	1	2	1	2	460	23
$I_{(3)}$	1		2	1	1	2	1	2	2	460	23
Brother	0	1	3	0	0	0	0	0	0	60	3

Interpreting the table through the application of the aforementioned rules, it can be noted that we have 3, 9, 4, and 5. Between 3 and 9, there is an overlap, so we keep 9. Between 9 and 4, and between 4 and 5, there is a discrepancy, so they are multiplied together, resulting in a unified denominator of 180.

According to the method proposed earlier, which involves finding common factors and then identifying the smallest common multiple, after determining the highest frequency of each factor as mentioned above, we determine the unified denominator as follows:

$$F = 2^x \times y$$

Therefore, the unified denominator is:

$2^3 \text{ x } 180 = 1440$

Naturally, each share of the heirs (the numerator) is multiplied by the same number used to multiply the denominator to make it equal to 180. This is what we have done, as we multiplied each share by the number at the top of the column.

The share of the Intersex 1:

$$f_{(k)} = \frac{\sum_{k=1}^{n} P_{(k)} \times M_{(n)}}{2^x \times y}$$

$$f_{(1)} = \frac{60 + 40 + 90 + 45 + 45 + 72 + 72 + 36}{1440}$$

$$f_{(1)} = \frac{460}{1440}$$

$$f_{(1)} = \frac{23}{72}$$

The share of the Intersex 2:

$$f_{(2)} = \frac{23}{72}$$

The share of the Intersex 3:

$$f_{(3)} = \frac{23}{72}$$

The share of the brother:

$$f_{(4)} = \frac{3 \times 20}{1440}$$

$$f_{(4)} = \frac{60}{1440}$$

$$f_{(4)} = \frac{3}{72}$$

Note that we added a column after the first one to adjust the inheritance, ensuring it does not include fractions, as 2 cannot be divided by 3. Regarding the last column, it was designated for the simplification of fractions.

CONCLUSION

In conclusion, this research has highlighted significant findings:

1) **Educational Enhancement in Higher Education:** The research validated the integration of advanced mathematical concepts in higher education, particularly in inheritance studies. This integration not only improved the teaching methodology but also deepened students' understanding of complex mathematical and legal principles.
2) **Accessibility of Inheritance Studies:** The findings demonstrated the effectiveness of simplifying inheritance studies through mathematical analysis, making it more accessible to students and enhancing their comprehension of the subject.
3) **Mathematical Competency Improvement:** The study successfully addressed the challenge of teaching students with varying mathematical skills, confirming that tailored mathematical methods could significantly enhance their understanding of inheritance law.
4) **Morale and Appreciation of Islamic Contributions:** The research highlighted the positive impact of specific teaching methods on students' morale and their appreciation of the significant contributions of Islamic scholars to the field of mathematics.
5) **Effectiveness of Educational Activities:** Training sessions and competitions were shown to be highly effective in reinforcing students' understanding of mathematical principles in the context of inheritance law.
6) **Historical and Modern Contributions of Muslim Mathematicians:** The research underscored the lasting contributions of Muslim mathematicians during the Abbasid era and their enduring impact on modern scientific disciplines, bridging historical achievements with contemporary applications.
7) **Development of Mathematical Theorems for Inheritance Laws:** The study articulated mathematical theorems that clarify complex inheritance scenarios, such as those involving intersex individuals, illustrating the practical application of these theorems in modern jurisprudence.

8) **Innovation in Research and Teaching Approaches:** New methodologies combining mathematical analysis with Islamic legal studies were presented, showcasing innovative approaches to research and teaching in the field.
9) **Creation of Digital Tools for Islamic Sciences:** The potential for developing a digital program that integrates mathematical formulas was highlighted, aiming to advance research and demonstrate the contemporary relevance of Islamic sciences.

In essence, this research journey through the realms of mathematics and Islamic inheritance law has illuminated the profound influence of Muslim mathematicians across centuries. Their legacy, marked by a blend of scholarly rigor and creative problem-solving, continues to resonate in today's academic and practical spheres, paving the way for future innovations and applications in both mathematics and Islamic studies.

Finally, I say: The potential for development in the field of Sharia sciences in terms of presenting scientific material is indeed possible, and researchers can excel remarkably in this area. We should not adhere to the saying 'The predecessor left nothing for the successor,' otherwise, we will never move forward.

REFERENCES

1- Arabic Sources and References:

A. Manuscripts:

Al-Qalasadi, Abu al-Hasan Ali ibn Muhammad ibn Muhammad ibn Ali al-Qurashi, Kashf al-Astar ‘an ‘Ilmi Huruf al-Ghubar, manuscript at the British Library, another copy exists at King Saud University in Riyadh, number: 5951 F 1718/5.

Benis, Al-Sheikh, Kitab Bahjato al-Basar fi Sharhi Faraid al-Mukhtasar, private manuscript.

B. Printed Sources (in Arabic):

Al-Jurjani, Al-Sharif. (1938). Al-Ta'rifāt, Egypt: Matba'ah Al-Ittiḥād Al-Masrī.

Al-Jua'idi, Muhammad Abdullah. (2001). “Al-Tarjamah wasīlah binā' wa al-tajdeed fi al-thaqāfah al-'Arabiyyah al-Islāmiyyah, wa tawāsuloha ma'a al-thaqāfah al-Ispāniyyah”, Coloque: Al-Tajdīd fī al-fikr al-Islāmī.

Al-Kalwadhani, Abu al-Khattab Mahfouth ibn Ahmad. (1995). Al-Tahdhīb fī 'Ilmi al-Farā'id wal-Wasāyā, Riyadh: Maktabah al-Obikān.

al-Kashi, Ghiath al-Din Jamshid, Miftāḥ al-Ḥisāb.
https://archive.org/details/KitabMiftahAlHisab

Al-Qifti, al-Wazir Jamal al-Din. (2005). Iẖbār al-'Ulamā' bi-Akhbār al-Ḥukamā', Beirut: Dār al-Kutub al-'Ilmiyyah, ed 1.

Al-Qalasadi, Abu al-Hasan Ali ibn Muhammad ibn Muhammad ibn Ali al-Qurashi. (1999). Šarḥ Talẖīs A'māl al-Ḥisāb, Beirut: Dār Sāder.

Ibn al-'Ibri, Abu al-Faraj Gregorios ibn Aharon al-Malati. (1414 H/1997 CE). Tariẖ Muẖtasar al-Duwal, Beirut: Dār al-Kutub al-'Ilmiyyah, ed 1.

Ibn al-Nadim, Muhammad bin Ishaq. (1398 H/ 1987 CE). Fihrist Ibn al-Nadim, Beirut: Dār al-Ma'rifah.

Ibn al-Ha'im, Abu al-Abbas Shihab al-Din Ahmad ibn Mohammad al-Maqdisi. (1999). Muršidah al-Tālib ilā Asnā al-Matālib fī 'Ilmi al-Ḥisāb, Beirut: Dar al-Gharb al-Islamī.

Ibn Hajar al-Asqalani. (1994). Inbā' al-Ġumr bi-Anbā' al-Ġumr, Cairo.

Ibn Kathir, Abu al-Fida Ismail. (1992). Al-Bidāyah wa al-Nihāyah, Beirut: Maktabah al-Ma'ārif.

Ibn Makula, Abu Nasr Ali ibn Hibah Allah. (1411 H). Al-Ikmāl fi Raf' al-Irtiyāb 'an al-Mutalif wal Mukhtalif fī al-Asmā' wal Kunā wal Anasāb, Beirut, Dar al-Kutub al-Ilmiyyah.

Sa'idan, Ahmad Salim. (May 1963). "Tarā'īf al-Ḥisāb li-Abī Kāmil, Shujā' bin Aslam", Egypt: *Majallah Ma'had al-Makhtūtāt al-'Arabiyyah*, 9: 2, 291-320.

2- Non-Arabic References

Abdullatif, Salah Aldin Mohammad. (2011). "Al-Battānī Contributions in Astronomy and Mathematics", (chapter of: Contributions of Early Muslim Scientists to Engineering Studies and Related Sciences), IIUM, International Islamic University Malysia, 1 first ed.

Bellve, José. Jabir b. Aflah. (2011). "On the limits of solar and lunar eclipses", *SCIAMVS* 12: 3-27.

Bisom, Thomas (2021). "The Works of Omar Khayyam in the History of Mathematics," *The Mathematics*, Enthusiast: 18: 1, 290-305.

DOI: https://doi.org/10.54870/1551-3440.1524

Davidian, Marie-Louise. (Oct.-Dec.1960). "AI-Birünī on the Time of Day from Shadow Lengths", *Journal of the American Oriental Society*. 80, 330-335.

doi.org/10.2307/595882

Edward Van Dyck. (1896). Iktifāa' al-Qanoo' bimā huwa Matboo', Beirut: Dār Sāder,

Hormoz, Pazwash and Gus Mavrigian. (OCTOBER 1986). "The contributions of Karājī: Successor to al-khwārizmī", *The Mathematics Teacher*, 79: 7, 538-541.

Lorch, Richard P. (March 1979). "The Astronomical Instruments of Jābir ibn Aflaḥ and the Torquetum", *Centaurus*, 20: 11–34.

https://doi.org/10.1111/j.1600-0498.1976.tb00214.x

Kennedy, E. S. and Muruwwa, Ahmad. (Apr., 1958). "Bīrūnī on the Solar Equation", *Journal of Near Eastern Studies*, 17: 2, 112-121.

Kennedy, E. S. (DECEMBER 1963). "Al-Bīrūnī on determining the meridian", *The Mathematics Teacher*, National Council of Teachers of Mathematics, 56: 8, 635-637.

King, David Anthony. (1972). The Astronomical Works of ibn Yunus, Yale University PhD thesis, University Microfilms, A XEROX Company, Ann Arbor, Michigan.

Roshdi, Rashed. (1994). "The Development of Arabic Mathematics: Between Arithmetic and Algebra", Translated by: A. F. W. Armstrong, Springer Science+Business Media Dordrecht, 22-32.

Siadat, M. Vali and Tholen, Alana. (2021). "Omar Khayyām: Geometric Algebra and Cubic Equations", *Cubic Equations, Math Horizons*, 28:1, 12-15.

DOI: 10.1080/10724117.2020.1770495
Stevenson, F. R. and S. S. Said, "Precision of Medieval Islamic Eclipse Measurements." *Journal for the History of Astronomy* 22, (1991): 195–207.
DOI : 10.1177/002182869102200301
Struik, D. J. (April 1958). "Omar Khayyām, mathematician", *The Mathematics Teacher*, National Council of Teachers of Mathematics, 51: 4, 280-285.