THE ROLE OF MATHEMATICAL SCIENCES IN THE DEVELOPMENT OF MUSICAL INSTRUMENTS IN THE ABBASID ERA

BY

HASSIMAH BINTI ABD HAMID

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Kulliyyah of Islamic Revealed Knowledge and Human Sciences (KIRKHS)
International Islamic University Malaysia

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ABSTRACT

The relationship between mathematical sciences and music was first established by the Greek philosophers. The Abbasids unveiled this divine secret and helped to preserve it through their aggressive translation of Greek science into Arabic. They adopted the Greek scientific discovery on musical science, integrating it with Islamic thoughts and produced many monumental musical treatises. The Greeks invented a laboratory tool called monochord to prove their scientific musical theories and acoustic hypotheses. However, the monochord's functionality was very limited thus, the Abbasids decided to use real musical instruments as their experimental apparatus. Musical instruments initially perceived as entertainment tools to accompany singers and poets, were then utilized as laboratory apparatuses to prove mathematical and scientific hypotheses in their study of mathematical sciences. Their vast interests in mathematical sciences had elevated the status of musical instruments and music not only in the musical world, but most importantly in the Islamic world. Their contributions supported by their elite societies, their caliphs, their rational government, political influences and their great inspiration in the study of mathematical sciences intensified the prosperity towards the development of musical instruments. This research presents a historical analysis confirming the Abbasids' contributions toward the paradigm change on the status of musical instruments to be an important scientific tool in their study of mathematical sciences, and subsequently their responsibility towards the development of musical instruments.

ملخص البحث

إن أول من أنشأ العلاقة بين علوم الرياضيات والموسيقى هم الفلاسفة اليونانيون. وقد كشف العباسيون النقاب عن هذا السر الإلهي وساعدوا في المحافظة عليه من خلال قيامهم بالترجمة الواسعة للعلوم اليونانية إلى اللغة العربية. حيث تبنى العباسيون الاكتشافات العلمية اليونانية في مجال العلوم الموسيقية ودمجوها بالفكر الإسلامي وكذلك أنتجوا العديد من المقطوعات الموسيقية الضخمة. اخترع اليونانيون أداة مخبرية تسمى مونوكورد (أي أحادية الوتر) لإثبات النظريات الموسيقية العلمية والفرضيات الصوتية، ولكن وظيفة المونوكورد كانت محدودة جداً، مما دفع العباسيون لاستخدام آلات موسيقية حقيقية كجهاز تجريبي. كان يُنظر للآلات الموسيقية في البداية كأدوات للترفيه ترافق المطربين والشعراء، ولكنها أصبحت تستخدم كأجهزة مخبرية لإثبات الفرضيات الرياضية والعلمية في دراسة علوم الرياضيات. وكان اهتمام العباسيين في علوم الرياضيات سببا في ارتقاء مستوى الآلات الموسيقية والموسيقى، ليس فقط في عالم الموسيقى بل الأهم من ذلك في جميع العالم الإسلامي. كانت إسهامات أصحاب الموسيقى تتلقى الدعم من نخبة المجتمع، ومن الخلفاء، وحكومتهم الرشيدة، وأصحاب النفوذ السياسي، كما كان إلهامهم الكبير في دراسة علوم الرياضيات سببا في توفير الدعم لتطوير الآلات الموسيقية. يمثل هذا البحث تحليل تاريخي لتأكيد إسهامات العباسيين في تغيير نموذج ومستوى الآلات الموسيقية لتصبح أداة علمية مهمة في دراستهم للعلوم الرياضية، وكنتيجة لذلكدورهم تجاه تطوير الآلات الموسيقية.

APPROVAL PAGE

The thesis of Hassimah Binti Abd Hamid has been approved by the following:

Sayyid Mohamed Ajmal bin Abdul Razak Al-Aidrus
Supervisor

Dato' Mohd Zambri Zainuddin
Internal Examiner

Mulyadhi Kartanegara
External Examiner

Ihsan Fazlioğlu
External Examiner

Ismaiel Hassanein Ahmed Mohamed
Chairman

DECLARATION

I hereby declare that this dissertation is the result of my own investigation, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degree at IIUM or other institutions.

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This thesis is especially dedicated to my precious children, Nuqman Alif,

Sarah Liyana, Naqib Adam and Nadiy Amin.

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In the name of Allah, the Most Gracious and the Most Merciful.

> Today, like every other day, we wake up empty and frightened.
> Don't open the door to the study and begin reading.
> Take down a musical instrument.
> Let the beauty we love be what we do.
> There are hundreds of ways to kneel and kiss the ground.
>
> Jalaluddin Rumi

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CHAPTER 1: INTRODUCTION

Music is banned at my little mosque,
Because it is played on the devil's stringed instruments,
Although a little music softens the soul,
And lo, a hardened soul is the devil's taut drum skin.

Little Mosque Poems[1]

1.1 INTRODUCTION

The controversial issue of music among the Muslims has a detrimental effect on the development of musical instruments within the Muslim community. Since the introduction of Islam in 610A.D, the Muslims began to question on the status music and playing of musical instruments in the practices of Islam. However, as the Islamic civilization flourished during the Abbasid era, music had not only continued to be part of their daily entertainment but the study of musical tradition had advanced to the highest degree. Adopting the Greek's ideologies in the study of mathematical sciences, the Abbasid philosophers integrated their Islamic thought with their musical aspiration using musical instruments as their experimental tools. They were the first group of philosophers who used real musical instruments in the study of mathematical sciences. Their brilliant works have influenced many musicians and musical theorists to further develop many new concepts in music. Following the Islamic principles, the Abbasid government promoted a conducive environment that allowed the practices of musical performance and musical studies. Consequently, an invisible bridge was built between the musicians, scientists and religious practitioners that had influenced

[1] Kahf, Mohja, "Little Mosque Poems," in *The Journal of Pan African Studies (Online)*, Vol. 4, Issue.2 (December 2010), 106, via QUESTIA, <http://www.questia.com/library/journal/1P3-2249012611/little-mosque-poems.>, (accessed 12 June 2013).

towards the improvement of many ancient musical instruments as well as the invention of many new-sophisticated instruments. Thus, based on the idea of unity, manifested by the Islamic revelation, the Abbasid era had unified the arts and science in the Islamic civilization by using music as their divine bridge.

The 'prince of ecstasy' (*amīr al-tarab*) is a trademark bestowed to the *'ūd* by Arab musicians for its affective sound quality.[2] The stringed instruments such as the '*ūd,* the *sanj,* the *rabāb* and the *barbat,* produced pleasurable sounds that will normally lead to uncontrollable emotional longing.[3] These musical instruments are among many musical instruments that stimulated unlawful ecstasy and were prohibited by the Muslim orthodox.[4] During the rise of Islam, musical instruments were declared to be one of the most powerful mediums for the devil to seduce mankind; the 'devil's *mu'adhdhin'* or 'caller for mankind to worship the devil' was the label given to musical instruments.[5] Pleasurable music was perceived as the main cause of delusion and could divert one's thoughts away from God. A great theologian and jurist, Ibn Abī'l Dunyā violently condemned musical instruments in his treatise *Dhamm al-malāhī* (The Book of Censure of Instruments of Diversion) feared that mankind will deviate from the law that would bring them nearer to God.[6] Since then the status of music and musical instruments have been disputed in which the religious

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[2] Racy, A. J., *Making Music in the Arab World: The Culture and Artistry of Tarab*, (UK: Cambridge University Press, 2003), 77.

[3] Al-Ghazali, *Music and Singing*, translated by Duncan Black MacDonald, (Petaling Jaya: Islamic Book Trust. 2009), 10-12. According to Al- Ghazali, ecstasy can be summarized as: "And everything that is experienced (*yūjadu*) as a consequence of Hearing, because of Hearing in the soul, is ecstasy (*wajd*)"; "So dread and humility are ecstasy"; "Ecstasy sometimes causes revelations and admonitions"; "Ecstasy is truth. It is what grows up out of the abundance of the love of God Most High and out of sincerity in desiring Him..." 90.

[4] Farmer, Henry George, *A History of Arabian Music to the XIIIth Century*, (London: Luzac & co., 1929), 29.

[5] Ibid, 25.

[6] Amnon Shiloah, M*usic in the World of Islam: A Socio-cultural study,* (USA,Michigan: Wayne State University Press,1995), 34.

leaders were worried that their followers may deviate away due to the ecstasy produced by these pleasurable sounds.

The *nāy*, a reed-flute that can sustain sound is able to promote a special emotional power.[7] The sound of this musical pipe manifested a sense of pleasure and may lead mankind into unlawful ecstasy. "The pipe of the Devil (*mizmār al-shaiṭān*) in the presence of the Apostle of Allah!" was what claimed by 'Abu Bakar, the companion of Prophet Muhammad s.a.w.[8] His statement had been interpreted by many Muslim orthodox that concluded with the condemnation of the *nāy*. The *riqq* or *duff* is known as *tarab* percussion *par excellence* with relatively heavy tambourine with five sets of brass cymbals and produced a variety of timbre effect to form the melodic beat pattern called *īqā'āt*.[9] The ecstasy steering by the *riqq* had worried the religious leaders that they have declared the *riqq* and some other percussion instruments as forbidden. Other than *kūbah,* a long-shaped drum with slender in the middle and broad at both ends,[10] which was prohibited, the rest of drum-like instruments such as *tabl*, *shāhin* and *qādīb* are not considered *mukhannaths* (brought upon ecstasy) in the conventional Islamic views.[11]

As the Islamic teaching become advanced, the religious group, the Sufis started to inquire knowledge in the science of the soul. Musical instruments such as the *nāy, 'ūd, tunbūr*, the bowed instrument *kemençe* and the percussion such as the small kettledrum *kudum, duff, bendir,* and *daire* were widely played in their religious assemblies.[12] These musical instruments were played to help them in reaching

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[7] Racy, 77.
[8] Farmer, 26.
[9] Racy, 78.
[10] Al-Ghazali, 13.
[11] Ibid., 40.
[12] Hammarlund, Anders, "Introduction: An Annotated Glossary", in *Sufism, Music and Society in*

spiritual revelation. The musical activities of the Sufis during their religious gathering attested the ambiguity on the status of music and musical instruments in the Muslim community. Even some of the philosophers such as Ibn Sīnā, Al-Fārābī and Al-Ghazzālī were interested in understanding the Sufis' thoughts in music that they had wrote many treatises on the effect of music on the soul.[13] Their studies on musical science of the soul had caused debates of many intellectuals of various doctrines on the status of music and musical instruments in Islam. These debates concerning all components of music and musical instruments participated by theologians, philosophers, religious leaders, *literati*, and even the Sufi leaders elicited a wide range of views from an extreme condemnation to an absolute liberal attitude. Some interpreted musical instruments must be banned completely while others permitted certain kinds of instruments depending on the level of ecstasy simulated by those instruments. The acceptance or rejection towards music and its instruments had continued to remain uncertain within the Muslim society until the present time. There is not a word of direct censure against music in the Quran, thus, there is hardly any supreme reason for the Muslims to totally ignore the beauty of music crafted for mankind. As Fadlou commented that "…the controversy over music is a controversy over whether this or that kind of music leads in the one direction or the other direction."[14] The Islamic teaching required the Muslims to utilize their intellect and reasoning in inquiring knowledge so that they will be able to justify and balance the cause-and-effect before rejecting or accepting anything. Noted by S.H Nasr that the intellect is the principle of reason in which reason can bring mankind to the gateway

Turkey and the Middle East, edited by Anders Hammarlund, Tord Olsson and Elisabeth Özdalga, (Richmond, England: Curzon, 1999), 4-5.

[13] Seyyed Hossein Nasr, *Science and Civilization in Islam,* (USA, Chicago: ABC International Group, 2001), 147.

[14] Fadlou Shehadi, *Philosophies of Music in Medieval Islam*, (Leiden: E.J. Brill, 1995), 5.

of the intelligible world and the rational knowledge be integrated into gnosis.[15]

Despite all the negative thoughts and controversial ideologies about the musical instruments and music, the Abbasids had taken a different approach and avenue in exploiting the benefits of musical instruments and music in general. They were very fortunate to be bestowed with many rational caliphs that were very generous and passionate about music. Their caliphs were always eager to patron and support the development of music that talented virtuosi and musicians were normally rewarded generously by them.[16] They had openly facilitated and strengthened the position of musical activities in their royal courts as well as within their community. The rational attitude towards music established and encouraged by the caliphs was very well accepted by the Abbasid society. This liberal lifestyle had attracted many talented singers, musicians, and music philosophers from the neighboring country who were excited to earn a fortune and popularity, surged into the Abbasid territories. In addition to the conducive way of living, the Abbasid also offered a diverse governmental institution with a stable political status. The new government built by Abbasid caliphs had encouraged a vigorous economic expansion and promoted international trade in every avenue of trading.[17] The new-sophisticated government had given opportunities to everyone in developing and contributing to the community regardless of their ethnic and social background. The Arab racial supremacy was gradually terminated by the new constitution in order to foster cultural diversity and provide substantial support to the galaxy of *literati*, scholars, philosophers, and

[15] Seyyed Hossein Nasr, 26.
[16] Wright. O, *The modal system of Arab and Persian music A.D. 1250–1300*, Vol. 28, (Oxford: Oxford University Press, 1978), 16.
[17] Hammarlund, 22.

talented artists.[18] Consequently, the Abbasid territory was flooded with extraordinarily gifted philosophers, scholars, traders, and intellectuals including musicians, poets, singers, and musical theorists from every corner of the world.

The Greek translation movement that was aggressively promoted by the Abbasid rulers was one of the main catalysts in shaping their cosmopolitan and intellectual lifestyle. The Greek scientific knowledge was exposed to the Arab world when volumes of their works were translated into the Arabic language. The translation activities had called upon scholars from different backgrounds to earn a fortune by doing the translation works. Thus, the Abbasid regime had synthesized and built the intellectual tradition of scientific knowledge and philosophy by creating the elite culture.[19] The Muslims and non-Muslims were working together in seeking ancient sciences, made them accessible in Arabic, elaborated and circulated the knowledge across the Islamic world.[20] The Greek knowledge was revealed and integrated with the teaching of Islam that allowed the Abbasids to produce many monumental works in every branch of science and philosophy. With the advent of Islam, the Quran became the central work of study and recitation of the Muslim world.[21] The Abbasids then established the fundamental of civilization in accordance with the Quran and *Sunnah,* building the link between cultural phenomena and integrating the Arab culture to the ancient intellectuals.[22]

During the Abbasid era, the perception towards musical instruments evolved with an extraordinary natural bend. The Abbasids constructed an intellectual rational

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[18] Ibid.
[19] Bennison, Amira K, *The Great Caliphs: The Golden Age of the 'Abbasid Empire*, (London: I.B Tauris &Co. Ltd, 2009), 175.
[20] Ibid.
[21] *The Columbia Encyclopedia*, 6th edition, **"**Arabic literature".
[22] McCants, William F, Founding Gods, Inventing Nations: Conquest and Culture Myths from Antiquity to Islam, (Princeton, NJ: Princeton University Press, 2012), 77.

society that accepted music as part of the scientific knowledge. Musical instruments became the important scientific apparatuses to the philosophers, scientists, mathematicians and musical theorists. The knowledge transferred from Greek sciences granted an additional role of musical instruments that they were not only acting as a supplement to musical excellence but as a network of astrology, cosmology, and therapeutic correspondences.[23] The arithmetical speculations and manifestations displayed by musical instruments were used to explain the harmony of all celestial and earthly phenomena as well as manipulating the compositions of melodies and rhythms in the study of sounds.[24] These phenomena and school of thought were very prevalent among the philosophers, scientists and mathematicians. However, to the musician and singers, they have to be talented and skillful players of musical instruments in order to be the 'boon companion' to the caliphs and gained a higher social status within the community. Musical instruments were then perfected, developed, constructed and studied by the musicians, scientists as well as the philosophers for the purposes that suited their intentions. Musical instruments such as the '*ūd*, the single-stringed *rabāb*, the *qanūn* (zither), the three-stringed *kamānchah*, as well as percussion instruments such as the standing drum (*duff*) had gained popularity among the musicians and also from the philosophers.[25] The philosophers studied musical instruments in order to understand the mystery of the universe while the musicians desired for their practical perfections. Most of these philosophers were also excellent musicians who normally collaborated with many other brilliant

[23] Hammarlund, 64.
[24] Amnon Shiloah, "Musical Modes and the Medical Dimension: The Arabic sources (c.900-c.1600)" in *The Dimension of Music in Islamic and Jewish Culture,* (Vermont, U.S.A: The Variorum Collected Studies Series,1993), 148.
[25] Michon, Jean-Louis, "Sacred Music and Dance in Islam", in *Islamic Spirituality:Manifestations,* edited by Seyyed Hossein Nasr, (New York: Crossroad Herder, 1997), 495.

musicians in enhancing and inventing many new musical instruments. Hence, the Abbasid was responsible for collaborating the scientific and artistic studies of music and musical instruments. Their scientists and mathematicians utilized musical instruments as scientific tools and their musicians invested the scientific knowledge to produce excellent ecstatic sounds. The *'ūd* was their favorite instrumental tool. The *'ūd* became the king of all instruments in which poets admired its merits; theorist and philosophers utilized it as a pivot for their theories and cosmological hypothesis; historian and litterateurs considered it as an inauguration of intellectual musical studies.[26] As the secret of the '*ūd* was revealed, the interest to explore other type musical instruments became more predominant. Thus, the Abbasids studied various types of musical instruments and their musicians became excellent players of multiple types of instruments.

Music is known as an audible manifestation that can be measured by precise arithmetical ratios and proportions. Musical instruments are constructed for the purpose of displaying and illustrating the mathematical hypothesis and to prove and develop musical theories and musical sounds. The Abbasid philosophers constructed and enhanced musical instruments as their experimental tools in their scientific studies. They regarded musical instruments as their scientific apparatuses to prove mathematical and acoustical speculations in musical theories and to demonstrate the concepts in the law of harmony in the universe phenomena. Influenced by the Greek scientific tradition, they studied, improved and developed new musical elements including the musical tones, modes, rhythms, and melodies by analyzing and constructing different types of musical instruments. They were interested in the

[26] Ibid., 395.

functional roles of musical instruments and manipulated the numerical relationships to produce harmonized musical sounds. Although these philosophers adopted the scientific musical knowledge from the Greek intellectuals, it was them who were the first group of philosophers utilizing the real musical instruments in their scientific studies of music. The Abbasid philosophers such as al-Fārābī, Ibn Sīnā, and Safi al-Dīn utilized the empirical and factual approach to musical instruments.[27] The musical scales applied on these instruments are based on mathematical absolutes, in which they had further refined the musical theory as well as the practical aspect of music.[28] Hence, their new approaches in the study of musical theories, by using real musical instruments instead of a specific laboratory instrument had benefited many musicians and singers who are desperate for musical performance excellence.

1.2 RESEARCH OBJECTIVE

This main objective of this research is to analyze historical and contemporary literature on mathematical sciences to support the proposition on the contributing factors to the vast improvement and constructions of musical instruments during the Abbasid era. Embracing the Greek's thoughts, the Abbasid philosophers studied music as a branch of mathematical science. The Greeks had invented a laboratory tool called *'Monochord'* as their experimental apparatus for proving the mathematical and acoustic hypothesis in their study of music. However, monochord has limited functionally and some of the musical theories developed using this tool are not applicable on the physical musical instruments. Thus, the Abbasid philosophers had decided to use the real musical instruments as experimental tools in their study of

[27] Wright, 18-19.
[28] Ibid.

mathematical sciences for a more intensive and conclusive analysis. Subsequently, their sophisticated musical theories were applicable in the practical performances. As a result of this realization, many primitive musical instruments had been improved and many new ones were constructed. They had therefore inaugurated the usage of real musical instruments in their intellectual study of mathematical sciences.

The political and intellectual contacts of the Abbasids were two main reasons that had a significant influence towards the development of musical instruments, both artistically and scientifically. The Abbasid caliphs, who have successfully built an era of a rational government with constant economic stability espoused by their cosmopolitan society, had supported the development of the music and musical instruments generously. Consequently, the role of musical instruments had undergone a paradigm change from primarily only as poets and singers' companions to be as an important apparatus for the philosophers in proving mathematical and acoustical speculation in musical theories, and in demonstrating the concept of the law of harmony of the nature. Thus, the Abbasid had successfully built an intellectual bond between the arts of music with its scientific scheme. The musicians, poets, singers, artists, scientists, mathematicians and philosophers were working together in developing and enhancing musical sounds and musical instruments. Their orthodox theologians who had later adopted the rational attitude towards music allowed the developments of musical doctrines without any destructive obstruction. This attitude was clearly acknowledged by a number of different types of musical instruments played in their religious gathering. The religious group, the Sufi perceived that the ecstatic sound produced by musical instruments could enhance their ritual enchanting towards reaching a divine revelation. The Abbasid era had therefore successfully cultivated the arts and scientific knowledge of music in the Islamic civilization.

In order to support the paradigm change hypothesis, this research will demonstrate some of the mathematical principles used by the Abbasid philosophers in their studies of musical instruments. Pythagoras and Greek philosophers investigated the mathematical relationships in music, noting that musical notes differ in pitches according to specific ratios, which can be measured in the relative tension of vibrating strings, and differentiated by the length of the reed pipes; they are convinced that music expresses the mathematical natural order and proportional harmony.[29] Adopting these philosophies, the Abbasid philosophers especially Al-Kindī, Ibn Sīnā, Ikhwān al-Safā, and al-Fārābī had enhanced and developed many more sophisticated mathematical formulations in musical studies using musical instruments as their experimental tools.[30] With these scientific studies in musical instruments, musical elements such as musical tone, scale, melodies, rhythm, and compositions were improved. Musicians who were normally developed their music by their gifted-hearing, then able to produce harmonious melodies using mathematical and scientific analyzes. Musical instruments that customarily invented or perfected by trial-and-error were then designed and constructed with precise scientific calculations. Thus, the extensive knowledge in mathematical sciences studied by the Abbasid is another vital factor towards the development of musical instruments that had benefited many future philosophers, scientists, and musicologists.

In conclusion, the love-hate relationship between musical instruments and Islamic thought has been an ambiguity issue since the manifestation of Islam in 610A.D. The early orthodox theologians prohibited musical instruments such as the *nāy*, some stringed and percussion instruments feared the ecstatic melodies might

[29] Turner, Howard R., *Science in Medieval Islam: An Illustrated Introduction,* (USA,Texas: University of Texas Press, 1995), 55.
[30] Ibid.