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Jurnal Studi Keislaman



Indonesia's Foreign Policy in Promoting a Moderate Islamic Identity after the Reform

Sidrotun Naim, Sabil Mokodenseho

The Role of Al-Qur'an Learning Center for Children in Increasing of Religious Moderation Values in Kenagarian Air Bangis, Pasaman Barat

Musda Asmara, Rahadian Kurniawan, Sarweni Sarweni, Fian Wijayanti

The Influence of Islamic Product Quality and Design on Muslim Consumer Interest in Arung Meubel Products in Sorong City

Rokhimah, Andi Hasrun, Bambang Sunatar, Karfin, Susetyowati Sofia

Revitalization of Moderation Messages in the Madinah Charter: Religious Development Communication Studies

Nazil Mumtaz al-Mujtahid, Hasan Sazali

Zakat Literacy Level of Residents and Muhammadiyah Sympathists in Krajan Village

Lukmanul Hakim, Ikhwan Adriansyah

The Convergence of Maqasid Shari'a and Pancasila in Strengthening the Spirit of Nationalism in Indonesia

Moh Nur Fauzi

Criminal Liability of Children from the Perspective of Islamic Law and Positive Law in Indonesia

Akhmad Sukris Sarmadi, Arne Huzaimah, Jalaluddin, Lahmudinur, Agus Bambang Nugraha, Karimuddin Abdullah Lawang

Science Teaching in Islamic Civilization: an Analysis of Ibn Khaldun's Muqaddimah

Bahrum Subagiya, Endin Mujahidin

Lembaga Penerbitan, Penelitian, dan
Pengabdian kepada Masyarakat (LP3M)

at - t u r a s

Jurnal Studi Keislaman

Volume 10, Nomor 1, Januari-Juni 2023

P-ISSN: 2355-567X

E-ISSN: 2460-1063

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Jurnal Studi Keislaman

Vol. 10, No. 1, Januari-Juni 2023

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at-turas: Jurnal Studi Keislaman (P-ISSN: 2355-567X, E-ISSN: 2460-1063) is a peer-reviewed journal in the field of Islamic studies across disciplines, such as history, geography, political science, economics, anthropology, sociology, law, literature, religion, philosophy, international relations, environmental and developmental issues related to scientific research.

at-turas: Jurnal Studi Keislaman is published twice a year (January-June and July-December) by Lembaga Penerbitan, Penelitian, dan Pengabdian kepada Masyarakat (LP3M), Gedung Rektorat Lt. 2 Universitas Nurul Jadid, Paiton, Probolinggo, Jawa Timur. Email: atturas.unuja@gmail.com

Editorial Office:

at-turas: Jurnal Studi Keislaman

Lembaga Penerbitan, Penelitian, dan Pengabdian kepada Masyarakat (LP3M) Universitas Nurul Jadid, Paiton, Probolinggo, Jawa Timur, Indonesia 67291.

Phone: 0888 30 77077, Hp: 082318007953

Email: atturas.unuja@gmail.com

Website: <https://ejournal.unuja.ac.id/index.php/at-turas/index>

Tables of Content

1-22

INDONESIA'S FOREIGN POLICY IN PROMOTING A MODERATE ISLAMIC IDENTITY AFTER THE REFORM

Sidrotun Naim, Sabil Mokodenseho

23-41

THE ROLE OF AL-QUR'AN LEARNING CENTER FOR CHILDREN IN INCREASING OF RELIGIOUS MODERATION VALUES IN KENAGARIAN AIR BANGIS, PASAMAN BARAT

Musda Asmara, Rahadian Kurniawan, Sarweni, Fian Wijayanti

42-58

THE INFLUENCE OF ISLAMIC PRODUCT QUALITY AND DESIGN ON MUSLIM CONSUMER INTEREST IN ARUNG MEUBEL PRODUCTS IN SORONG CITY

Rokhimah, Andi Hasrun, Bambang Sunatar, Karfin, Susetyowati Sofia

59-79

REVITALIZATION OF MODERATION MESSAGES IN THE MADINAH CHARTER: RELIGIOUS DEVELOPMENT COMMUNICATION STUDIES

Nazil Mumtaz al-Mujtahid, Hasan Sazali

80-97

ZAKAT LITERACY LEVEL OF RESIDENTS AND MUHAMMADIYAH SYMPATHISTS IN KRAJAN VILLAGE

Lukmanul Hakim, Ikhwan Adriansyah

98-115

THE CONVERGENCE OF MAQASID SHARI'A AND PANCASILA IN STRENGTHENING THE SPIRIT OF NATIONALISM IN INDONESIA

Moh Nur Fauzi

116-127

CRIMINAL LIABILITY OF CHILDREN FROM THE PERSPECTIVE OF ISLAMIC LAW AND POSITIVE LAW IN INDONESIA

Akhmad Sukris Sarmadi, Arne Huzaimah, Jalaluddin, Lahmudinur, Agus Bambang Nugraha, Karimuddin Abdullah Lawang

128-143

SCIENCE TEACHING IN ISLAMIC CIVILIZATION: AN ANALYSIS OF IBN KHALDUN'S MUQADDIMAH

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Editorial Office:

at-turas: Jurnal Studi Keislaman

P-ISSN: 2355-567X, E-ISSN: 2460-1063

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SCIENCE TEACHING IN ISLAMIC CIVILIZATION: AN ANALYSIS OF IBN KHALDUN'S MUQADDIMAH

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Received:

2022-12-01

Received in revised

form:

2023-05-29

Accepted in:

2023-06-08

Published in:

2023-06-30

Available online in:

2023-06-30

Citation:

Subagiya, Bahrum.,
Mujahidin, Endin. (2023),
*Science Teaching in Islamic
Civilization: an Analysis of
Ibn Khaldun's Muqaddimah*,
10(1), 128-143.

Abstract: *Islamic civilization has contributed significantly to the advancement of world science. This statement is revealed from the many Muslim scientists who contributed significantly to various scientific discoveries in every field, which inspired European scientists. In addition, the science developed also has its uniqueness and Islamic characteristics. The number of Muslim scientists and the development of science in the Islamic world raises a question of how science teaching is done in the Islamic world and what kind of science is taught. This research aims to reveal the uniqueness of science teaching applied in the history of Islamic civilization by analyzing the book Muqaddimah by Ibn Khaldun. This research is descriptive qualitative research with a literature review approach. The results found that the uniqueness of science teaching in Islamic civilization is centered on faith in Allah, not denying and involving the role of God in science teaching. The method applied in teaching science is done in stages (at-tadrij), repeating lessons (at-takrir) and developing them with experience and experimentation (at-tajribi). The science teaching strategy applied is establishing an authoritative teacher, understanding the learner's thinking and readiness, emphasizing teaching based on objectives, and simplifying instruction.*

Keywords: *Islamic Science; Ibn Khaldun; Muqaddimah; at-Tadrij; at-Tajribi; at-Takrir*

INTRODUCTION

Islamic civilization has contributed significantly to the advancement of science today (Ahmed, Ahsani, & Siddiqui, 2005; Wallace-Murphy, 2012). Muslim scientists such as al-Razi, al-Kindi, Ibn Sina, Nasir al-Din al-Tusi, Ibn Rushd, Ibn Haitham, al-Zahrawi, al-Khawarizmi, Ibn Khaldun, and others have made scientific contributions in various branches of modern science (Subagiya, 2022). Zakri Abdul Hamid states that there are around 600 to 1600 Muslim scientists who have become pioneers in various fields such as medicine, medicine, chemistry, engineering, mechanics, architecture, cartography, astronomy, education and others, where at the same time the European nation is still in the Dark Ages (Hamid, 2011).

Muslim scientists have produced works that became references in Europe. Two Muslim doctors who became famous in Europe during this period were Ibn Sina (980-1037) and Al-Razi (865-925). Ibn Sina's work, *Al-Qanun fi al-Thibb (The Canon of Medicine)*, was translated into Latin in the 12th century and used in medical schools across Europe until the advent of modern science. One of Al-Razi's books, *Treatise on Smallpox and Measles*, was translated into Latin, English, and other European languages. In chemistry, the works of Jabir ibn Haiyan and Al-Razi formed the basis of modern science. Ibn al-Baytar's book, *Al-Jami' fi al-Tibb (A Collection of Diet and Simple Medicines)*, contains detailed accounts of the plants in the soil along the Mediterranean coast between Spain and Syria. In addition, he systematically compared this knowledge with that of scientists in previous eras. His book on botany was used until the Renaissance by Europeans. Ibn al-Baytar's book *Al-Jami' fi al-Tibb* contains detailed records of the plants in the soil along the Mediterranean coast between Spain and Syria. In addition, he systematically compared this knowledge with that of scientists in previous eras. His book on botany was used until the Renaissance by Europeans. Thabit bin Qurrah not only translated Greek works but also opposed and elaborated on the widely accepted views of Aristotle. Al-Khwarizmi wrote *Kitab al-Jabr wa al-Muqabalah*. In the second half of the 12th century, the first part of his book was translated and made available in Europe. Ibn al-Shatir's theory of lunar motion was very similar to that attributed to Copernicus some 150 years later (Faruqi, 2006).

Several factors drove the progress of science in the history of Islamic civilization. Syamsuddin Arif explained that the first significant factor that makes science develop is the purity and firmness in believing, understanding

and practicing Islamic teachings in the Qur'an and Sunnah. The second factor is the existence of religious motivation characterized by the doctrine for every Muslim to study, the command to read (*iqra'*), make observations (*a-fala yarawna*), conduct explorations (*a-afala yandzuruna*), conduct expeditions (*siru fil-ardhi*), rational scientific thinking (*ya'qilun, yatafakkarun*) and others have had a positive impact. All that has been described is a driving factor in forming a knowledge society and culture. The next factor is the socio-political factor, where the condition of Islamic society at that time was perfect for stability, security and unity. Seekers of knowledge from various ethnicities (Arabs et al., and others) could freely and safely travel and wander to centers of education and scholarship, from Seville to Baghdad, from Samarkand to Medina, from Isfahan to Cairo, from Yemen to Damascus, or for those who freely explored the corners of the Islamic world, such as Ibn Zubair and Ibn Batutah (Arif, 2016).

Another factor that is no less important is the economic factor, the existence of community welfare has guaranteed the educational process, as well as the existence of waqf bodies that have guaranteed the scientific process to realize the total concentration of knowledge seekers in their fields of study, and productive in producing high-quality scientific works. Another factor that should be remembered is full political support and protection from the ruler (Zarkasyi et al., 2016). Unfortunately, the glory of science in Islamic civilization stopped. The decline of science in the Islamic world has become a puzzle and a debate among Muslims and non-Muslims.

Sabra explains that the decline of Islamic science is due to its reduction because it is more directed towards practical needs. Science narrows its area and role to become just a servant of religion. David C. Lindberg mentions (1) the opposition of conservatives, (2) economic and political crises, and (3) isolation and marginalization as causes of the decline of science in Islamic civilization. Pervez Hoodbhoy mentions Asy'ari theology as one of the causes of the decline of science. According to Arif, the opinions of figures who reveal the causes of the decline of science during the Islamic civilization need research and reassessment, which are factual and mythical, and are data-based and just speculation (Arif, 2016).

The development and study of science in the West is comprehensive and emphasizes aspects of the physical world, about the universe by observing, studying, and conducting experiments to determine the nature or principles

studied. However, the study of science has narrowed. The scope of science that developed became limited to the physical-empirical field with its secular-materialistic worldview, so the cosmology created denied spiritual elements, such as God, angels, and spirit. This empirical or physical view of science forms a materialistic worldview, as has been expressed by Western scientists such as Laplace, Darwin, Freud, Durkheim, Marx and others (Kartanegara, 2003).

Handrianto (2019) explains that modern Western science developing this century has severe problems when applied in Muslim communities. The basis of the problem is the foundation of Western science which has the idea of positivism that denies the existence of God in science. Western science is considered neutral, in the sense of value-free, because of its positivistic nature towards assumptions and prepositions that do not involve God, aka atheistic and secular. Whereas the teachings of Islam strongly reject secularism and atheism. God, in the view of Islamic nature, is the Creator of all creatures and the Manager of the universe of His creation (Handrianto, 2019). This statement has also been revealed by Whitehead, who states that the development of modern science in the West is opposite to the religious movement that existed at that time (Whitehead, 2005).

In addition, the epistemological view of science, both Western and Islamic, significantly influences the axiology of science itself. The West investigates and develops science for power, economy and material. While the Islamic view, the purpose of studying and developing science is to get closer to Allah and utilize nature to benefit the universe. Science can reveal natural phenomena as signs of God's greatness, which can be seen and felt in how God's attributes, wisdom, majesty, and intelligence can be seen in the nature He created (Zarkasyi et al., 2016). Therefore, it is imperative to re-explore the methods of teaching science in the history of Islamic civilization, which has its Islamic characteristics.

From several search sources, the author has yet to find a specific article that examines the analysis of science teaching methods in the book of Muqaddimah Ibn Khaldun. Some articles have discussed the relationship between Religion and Science in Islamic civilization in Spain, written by Halilović (2017). He revealed the critical role of Islamic civilization in Andalusia on the world stage for over a thousand years. Islamic civilization is a balanced civilization, which has united science and faith, achieved a balance

between spirit and matter and did not separate this world from the afterlife, created a balance between mind and heart, and created a connection between science and faith by raising the importance of moral development. Osman Bakar has published his study *Towards a New Science of Civilization*, a synthetic study of the philosophical views of several scholars, namely al-Farabi, Ibn Khaldun, Arnold Toynbee, and Samuel Huntington. In his discussion, he revealed that it was Ibn Khaldun who transformed al-Farabi's *al-'ilm al-Madani* into a more comprehensive science of civilization through his conception of *'umran* - 'human social organization' -, in which Ibn Khaldun was the first pioneer of sociology (Bakar, 2016). Another research was conducted by Nurullah Ardiç who analyzed Ibn Khaldun and Weber's views on knowledge and science influenced by Islamic and Western epistemological paradigms, respectively. Based on his reading, there are some similarities and significant differences between Ibn Khaldun and Weber, which can be explained by referring to the epistemological paradigm of civilization (Ardiç, 2008).

Meanwhile, research on Ibn Khaldun's thought and his work, *Muqaddimah*, has been widely done and linked to various scientific fields, such as education (Dajani, 2015; Effendi, 2019; Falah, 2018; Kulu, 2013; Qobbaj, 2017; Vivanco, 1997), economics (Abbadi, 2004; Henry, 2020; Hidayatullah, 2018; Islahi, 2015), politics (Elbih, 2020; Maslan Baharudin & Shamsudin, 2016; Sulastri, 2019), history (Hasyim, 2010), sociology (Cory, 2018; Shahidipak, 2020), psychology (Wan Razali & Awang, 2019), law (Abrar, 2017), and other fields (Çetinkaya, 2017). None of these studies specifically discuss science teaching methods.

From some of these searches, the theme of discussing science-Islamic teaching methods is still minimal. This condition is revealed by Mujahidin & Martanegara's (2020) research on science-religion education trends in Indonesia, where research on science-religion teaching methods still occupies a minor position compared to other objects. This research aims to discover the methods of teaching science that developed in the Islamic world by analyzing Ibn Khaldun's *Muqaddimah*.

METHOD

This qualitative research uses a literature review approach (Fink, 2019). Information and data collection is taken from the study of Ibn Khaldun's *Muqaddimah* as the primary source. The author made the *Muqaddimah* the primary source in this research because of the following reasons: First, the

book presents an in-depth analysis of human history and civilization and outlines the principles that influence the formation of society and the state. Secondly, Ibn Khaldun was a scholar who combined social, political and economic thought with an innovative scientific approach. Thirdly, the *Muqaddimah* offers a comprehensive perspective on the dynamics of history, including the factors that influence the progress and decline of a civilization. Fourth, the work has universal appeal and relevance for historians and social scientists and those interested in studying civilization and humanity in general. In addition, in this research, the author uses other relevant sources from journal articles or proceedings, books, documents, and other references related to the theme of science teaching methods in Islamic civilization.

There are four stages that the author did in writing this article, namely (1) Problem formulation, namely by choosing the topic to be researched. (2) Literature search, which is finding materials that are relevant to the topic being studied. (3) Data evaluation, i.e., determining which literature significantly contributes to the topic's understanding. (4) Analysis and interpretation, i.e., discussing the findings and conclusions from the relevant literature.

DISCUSSION

THE DEVELOPMENT OF SCIENCE DURING THE ISLAMIC CIVILISATION

In *Muqaddimah*, Ibn Khaldun reveals a lot about the development of science in his time. These sciences are part of the educational materials that are very important in building Islamic civilization. Ibn Khaldun has classified science into two major groups: traditional sciences (*naqliyah*) and philosophical or rational sciences (*aqliyah*). *Naqliyah* sciences are sciences that are taught or transformed. In other words, sciences are based on information from people sent to convey it. This science is sourced from revelation, the Qur'an and Hadith, where the role of reason, in this case, is only limited to connecting the branch of the problem with the main branch; this is because scientific information is based on the authority of *shari'a* taken from these two sources. As for the science of *aqli*, it is natural knowledge for humans that can be obtained with their intellect and mind. This knowledge is learnt by humans through their intellect and thinking naturally. Humans can study various themes, problems and proofs and how teach them with their human insights so that they can study them, learn the theories, and encourage them to make

corrections from existing errors with the power and strength of their thinking as humans (Effendi, 2019; Khaldun, 2004, 2011).

Table 1
Classification of Knowledge in Ibn Khaldun's View

Types of Science	Definition	Classification
<i>Naqli</i>	The sciences are taught, transformed or based on information from the person sent to convey it.	Knowledge of the Qur'an, tafsir, <i>qira'at</i> , <i>hadith</i> , <i>ushul fiqh</i> , <i>fiqh</i> , <i>faraidh</i> , <i>kalam</i> , <i>tasawwuf</i> , dream interpretation, language, grammar, <i>bayan</i> , and literature.
<i>Aqli</i>	The knowledge that humans can learn through their natural reasoning and thinking.	Number science, engineering, astronomy, logic, nature, medicine, agriculture, theology, magic and <i>thalasim</i> , chemistry and philosophy

Although Ibn Khaldun classified the sciences that developed in his time, he did not include geography, history, and sociology, which are widely discussed in his book. It may not have been classified like the classification in modern times. In addition, the discussion of science contained in his book has no discourse. He discusses explicitly only the outer shell. However, Ibn Khaldun has provided an important note that the sciences that developed at that time were beneficial to the lives of Muslims in building their civilization (Effendi, 2019; Khaldun, 2011).

What Ibn Khaldun has revealed in his work discusses the science that has developed in this era. The term science used in Indonesia refers to the word 'science' in English. Science is also an absorption word from Latin, namely *scire*, which means 'knowing'. In its history, the word science, according to language, is the state or fact of knowing and is often taken in the sense of knowledge (knowledge) contrasted with intuition or belief. Mulyadi Kartanegara (2003) argues that science in Western epistemology is distinguished from knowledge. Science is understood as any organized knowledge, "any organized knowledge," or can also be said to have been tested for truth, while knowledge is understood as all general knowledge that

has not been tested for truth (can also be said to be ordinary senses). The term science here has similarities with the term science in Islamic epistemology which is also distinguished from opinion (*ra'y*). In the scholars' definition, science is interpreted as knowledge about everything as it is. The science here is not just any knowledge or an opinion; it has also been tested for truth. However, science and knowledge have differences. Science is only limited to the physical or sensory fields, while science is more than that. Science in Islamic epistemology includes the physical and non-physical, such as metaphysics.

Arif revealed that there is no single definition of science, but there is agreement from scientists, historians and philosophers of science that science is a human effort to research, understand, and explaining nature with all its contents. He cites Richard Olson's epistemological opinion that views science as several activities and habits of the human mind aimed at building well-organized, valid, and testable knowledge about phenomena in nature. In his book, Ibn Khaldun discussed the sciences included in this group of sciences, including the sciences of numbers, engineering, astronomy, logic, natural sciences, medicine, agriculture, chemistry and others (Arif, 2020).

Divining sciences into traditional sciences (*naqliyah*) and philosophical or rational sciences (*Aqliyah*) does not mean dualism between these sciences. As a Muslim, Ibn Khaldun had a universal view of the sciences that developed in his time. He believed that all knowledge comes from God. This view can be seen in every discussion of the *aqliyah* sciences (which can be classified into science today). For example, when discussing astronomy, he said that the positions of the planets in their orbits are the basic knowledge needed to formulate the laws of astrology, namely knowing the various effects they cause. At the end of his discussion, he would always say, "May Allah show us the way that He loves and is pleased with us and that no one has the right to be worshipped but Him." (Khaldun, 2011).

PRINCIPLES OF SCIENCE TEACHING IN IBN KHALDUN'S VIEW

Humans can continue learning and inherit what they know to the next generation. The process, ability and results of learning continue to develop with the guidance of the times. This condition makes human civilization experience continuous development (Jufri, 2013). Historically, science teaching has inspired the development of science in the following periods. A

great young scientist who has learnt from the experiences of his predecessors can develop science even better and avoid the fatal mistakes that have been made (Supraha, 2018). All of that is in line with what has been explained by Ibn Khaldun, that humans have been given the ability to think, which guides them, get a livelihood, cooperate with their group, accept and carry out the teachings brought by the Prophets, and follow the teachings of goodness that lead him to the afterlife (Khaldun, 2004).

Ibn Khaldun explains in the discussion that science and teaching are natural in human civilization and that Allah has bestowed thought and instinct to humans, with which humans are always eager to acquire unknown knowledge. As a result, humans must learn from their predecessors who already know that they do not know, increase knowledge and insight, or learn from people who have met and received teaching from the Prophets and Messengers (Khaldun, 2004).

The principle of teaching science, according to Ibn Khaldun, begins with faith in God, which does not deny the role of God in the occurrence of the universe. God has given human beings reason and instinct to develop science. On this basis, several principles are presented for the teaching of science. The recommended principles include understanding scientific theories in a historical context, freedom of learners in scientific research beyond common beliefs and present theories based on aesthetics, meta-physical and even religious tendencies, incommensurability and non-falsifiability and testability of available theories based on criteria such as coherence, degree of adaptation to the conditions of "a posteriori" experience and adventure approach, conceptual teaching instead of algorithmic teaching and subject-based teaching (Bazghandi & Hamrah, 2011).

SCIENCE TEACHING STRATEGIES AND METHODS IN IBN KHALDUN'S VIEW

Ibn Khaldun explained that teaching science to students must be done in stages (*at-tadrij*), beginning with fundamental problems in each discussion material. He says this is to understand better and explain it globally to students. In addition, another essential point for a teacher is to understand the learner's thinking and readiness at the time of receiving the lesson. If a teacher takes these steps, he has taken the proper steps that provide comfort and motivation to students to study the field of knowledge (Khaldun, 2004).

The purpose of teaching in stages is to prepare the learner to understand the field of study and map out its issues. After that, a teacher needs to repeat the lesson (*at-takrir*) for the second time by adding a higher level of teaching than the first by providing some explanations and more information, elaborating on points that are still global, expressing differences of opinion accompanied by the primary points of difference so that the entire field of knowledge can be deciphered. Ibn Khaldun also suggested that a teacher may repeat the teaching for the third time with more firmness so that it is well understood and there is no longer any difficulty or obscurity in their minds. This teaching method will hone the learner's instincts to improve (Khaldun, 2004).

The gradual method of teaching is fundamental in all disciplines. Several studies have revealed positive learner outcomes when applying the step-by-step teaching method. Liu et al. (2019) and Yuan et al. (2020) studied some students by applying this teaching method in medicine. The results showed an increase in students' learning achievement and skills acquired. Meanwhile, McDonald (2013) examined this teaching method for adult learners in math. The results found an overall positive change in achievement, attitude, beliefs and confidence towards learning.

As for the repetition method (*at-takrir*), which Ibn Khaldun also mentioned, in many contemporary studies today has been effectively tested in increasing students' learning creativity during learning (Nursehah & Rahmadini, 2021), easy understanding and problem-solving by solving a problem well (Amin & Rahayu, 2021), and helpful in improving students' ability to deal with learning difficulties (Ayu Anisa Fitri, Rusdiyani, Maemunah, Harkat Hadi Miharja, & Alisah Putri, 2018; Sobah Ch., Suherman, & Wiharna, 2018), this method has also been applied to various fields of knowledge, such as engineering, mathematics, art, sports, religion, and others.

Another method used in teaching science is *at-Tajribi*. Ibn Khaldun said that experience and experimentation (*at-Tajribi*) could be done repeatedly to achieve explicit empirical knowledge or just assumptions. It will help the development of reason and perfect civilization and also helps the development of intelligence because civilization is a collection of several skills. He quoted Ibn Battuta, who recounted his experiences during his expeditions with the marvelous wonders of the various governments on earth that he had seen. This meaning reinforces the concept that experience (empirically) and

experimentation will strengthen knowledge and intelligence. It is also that perfect perception (knowledge supported by evidence of truth) is the core goal to be achieved by knowledge (Khaldun, 2004).

The concept of experiential learning continues to grow in various scientific fields. Experiential learning results in several studies resulted in acquiring new skills or personal development to increase social awareness (Fowler, 2008). In addition, designing and implementing experiments for students can foster a better understanding of the material than simply participating in classroom experiments (Egbert & Mertins, 2010).

The success of science learning must be connected to the teacher or teacher who teaches it. Ibn Khaldun explained that what depends on teaching in every branch of science or expertise is the popularity of the expertise of the teachers expressed in the form of community recognition in various places and generations. Teaching science is also an expertise that creates differences in the use of terms in it. Therefore, one of the strategies that can be applied is to choose teachers who are indeed experts in their fields. In Ibn Khaldun's view, this teacher's expertise must be demonstrated by recognition in the community, in this case, the scientific community (Khaldun, 2004).

According to Ibn Khaldun, another vital factor in successful teaching is understanding the learner's thinking and readiness when receiving the lesson. Learning readiness is the most essential factor in determining students' success in learning. Research by Mulyani (2013) revealed a very significant relationship between student readiness and learning achievement. Ready students will undoubtedly be easier to accept lessons than students who are not ready. As revealed by Achterberg (1988) in his research, the factors that influence students' readiness to learn are information processing capacity, affective state, prior learning and experience, and "way of knowing" or learning philosophy. Of course, to understand the learner's thinking and readiness, a teacher must have many skills to strengthen the teaching process. Teacher skills are also one of the success factors of a student in learning (Alwiyah & Imaniyati, 2018).

Ibn Khaldun also strongly emphasized that teaching should be based on the objectives to be achieved. He warned teachers to distinguish students from the number of books that must be mastered, the number of terms in teaching, and the number of methods used, all of which sometimes forget the objectives to be achieved and hinder the achievement of knowledge. The

learners will need help understanding the lessons and achieving the expected results. On the other hand, if a teacher simplifies his teaching by choosing only authoritative books, simplifying the terms, and simplifying the methods that are easy to understand, then the teaching will be easier and faster to understand.

CONCLUSION

From the above discussion, it can be concluded that the development of science included in the category of science during the Islamic civilization in the book *Muqqadimah* by Ibn Khaldun, namely, engineering, astronomy, logic, natural science, medicine, agriculture, chemistry, number science, and others. The principles of science teaching in Islamic civilization that the author concludes from the book are: Science is integrated with faith and does not deny the role of God in the events of the universe, while the methods that can be applied in teaching science are gradual teaching (*at-tadrij*), repeating lessons (*at-takrir*), and experience and experimentation (*at-tajribi*). These three methods continue to develop in the present day and with their diverse derivatives, and are applied in all scientific fields. Finally, regarding science teaching strategies that need to be applied in teaching are the selection of authoritative teachers by educational institutions who are recognized by the scientific community, understanding the learner's thinking and readiness, emphasizing teaching based on the objectives to be achieved, and simplifying teaching to facilitate learner understanding.

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