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Integration of Islam and Science in Physics Learning: A Case Study of The First Law of Thermodynamics

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Abstract

There is a strong belief in society that religion and science are two entities that cannot be reconciled. They are separate from one another and have their domains. Integration is the keyword for discussing the relationship between science and religion. The integration of science and religion can be achieved by taking the philosophical core of fundamental Islamic religious sciences as a paradigm for future science. This integration process can be seen as the Islamisation of science as part of the Islamisation of civilization. One example of this integration can be seen when discussing one branch of science, namely physics, about Islamic studies. In this case, one topic is taken from the First Law of Thermodynamics. Thermodynamics is the science that discusses heat and its changes. Heat and its changes have been explained in the Qur'an, as stated in the words of Allah SWT in Surat Al-A'raf, verse 52. For example, the source of heat energy has been explained in Surat Yaasin, verse 80, and Surat Yunus, verse 5, which state that fire is the source of heat. In its transformations, according to the First Law of Thermodynamics, this heat energy can change into changes in internal energy and work. Changes in internal energy occur due to an increase in the system's temperature after heat energy is added, while work arises due to a change in the system's volume after heat energy is added. As an illustration of the First Law of Thermodynamics, let us imagine a balloon. If the balloon is heated, the air particles inside the balloon will experience an increase in temperature. It is the nature of a particle that when its temperature increases, its energy also increases. This increase in energy is what we call an increase in internal energy. Since the internal energy of the gas particles inside the balloon increases, there will be more energy for the gas particles inside the balloon to move and collide with the walls of the balloon. As a result, the volume of the balloon will increase, and work will be done. If the elasticity of the balloon can no longer withstand the collisions of the gas particles inside it, the balloon will burst.

INTRODUCTION

Physics can be considered a science that seeks to describe and explain natural laws and events in nature with descriptions according to human thinking [1], [2], [3]. Learning carried out by students is done by identifying physical events that occur in the surrounding nature to understand concepts [4], [5], [6]. Because it is an observation of the surrounding nature, physics can be said to be physical

knowledge that occurs due to the abstraction of the surrounding nature. This is evidence that physics learning is related to understanding concepts of events in the surrounding environment [7], [8].

Physics is a science that studies natural phenomena in terms of matter and energy, which has been widely used as the basis for other related sciences [9]. Physics is also a subject that is considered difficult to understand and boring [10]. So that there is a lack of interest in learning physics, which leads to a low level of learning in children, because there is an assumption that physics is a subject that uses many formulas, so it is very difficult to quickly understand the learning [11], [12]. Therefore, education must follow the development of society. Thus, so that learning is not boring, every school with a background in religious education can include materials that connect [13], [14], [15].

To date, there is a strong belief among the general public that religion and physics learning are two entities that cannot be reconciled [16]. They are separate from one another and have their distinct domains, whether in terms of formal material objects, research methods, criteria for truth, the role played by scientists, or the status of their respective theories, even down to the institutions that oversee them. Or, in other words, does not concern itself with religion, and religion does not concern itself with physics learning.

However, if religion can be a blessing for its adherents, for humanity, and the entire universe, then religion must be integrated or combined with the various aspects of human life. Therefore, it is natural that the term 'integration' is the appropriate keyword for discussing science and religion, particularly from the perspective of religious communities.

Integration is the opposite of separation, which involves placing each area of life into separate boxes [17]. Religion and science are placed in their separate boxes. However, if we revisit the past, the expansionist attitudes of religion and science reject this compartmentalisation of domains. Science and religion tend to expand their respective domains, thereby creating opportunities for conflict between them. Integration aims to mediate such conflicts, thereby establishing an appropriate attitude that science and religion should indeed be integrated. Going forward, this integralistic scientific approach, grounded in humanistic religious morality, is expected to expand into broader fields such as psychology, sociology, anthropology, health, technology, science, and other branches of knowledge.

The primary objective of this integration of science and Islamic studies is to demonstrate the broad scope and proficiency of integralistic scientific horizons in both traditional and modern sectors of life, as it masters one of the foundational sciences and skills that support life in the era of globalisation. Additionally, it will also highlight the figure of a religiously devout individual who is skilled in addressing and analysing issues related to social and religious problems through the mastery of various new approaches provided by natural sciences, social sciences, and humanities. In each of these fields of knowledge, every step taken is guided by a strong, objective religious moral ethic, as the Quran and Sunnah are interpreted in a new way.

Thus, the integration of science and religion can be achieved by taking the philosophical core of fundamental Islamic religious sciences as the paradigm for future science. This integration process can be considered as the Islamisation of science as part of the process of Islamising future civilisation. Due to the lack of examples of scientific and religious integration, the author attempted to write an article combining the field of science, in this case physics, integrated with Islam through the sources of Islamic knowledge, namely the Qur'an and Hadisth.

Currently, there are many studies on the integration of Islam in physics learning. Fikri & Nurul developed an integrated Islamic and science textbook on temperature and heat material [18]. Firdaus et al. developed an augmented reality (AR) based physics learning module on fluid material [19]. Khoiri et al. tried to apply the integration of Islam and science in physics learning using a classroom on fluid material [14]. Rusydi developed a module on Islamic science integration on kinematics materials [20]. However, there has never been a discussion of the integration of Islam in thermodynamic material, especially law 1 of thermodynamics.

This research will focus on discussing the integration between Islam and science in physics learning on the material of the first law of thermodynamics. It is hoped that this research will provide the media as a reference in the integration of Islam and science in physics learning.

METHOD

Research on the integration of Islam and science in physics learning material of the first law of thermodynamics uses the systematic literature review method [21], [22], [23]. This systematic literature review method uses the Qur'an as a source of understanding [24]. In this study, researchers view the Qur'an as a medium for understanding concepts connected to physics theory, especially pressure material. The connection is obtained with the help of philosophy. Philosophy is seen as the root of science in approaching using reason, feeling, and logic. The philosophy of education is carried out to explore the implicit relationship of the theory studied and how its analogies in life.

RESULT AND DISCUSSION

The First Law of Thermodynamics from the Perspective of Science and Islam

The First Law of Thermodynamics is a law that studies heat and its changes. The First Law of Thermodynamics states the law of conservation of energy, whereby energy derived from heat energy is converted into internal energy and work [25], [26]. A change in internal energy is indicated by an increase in the temperature of a system, and the presence of work is indicated by a change in volume. To examine the First Law of Thermodynamics, we only need to discuss the issues of heat, changes in internal energy, and work.

Concerning the integration of science and Islam, we only need to study these three physical quantities in the Qur'an and Hadith. Why is that? Allah SWT states in the Qur'an:

> *And indeed, We have sent down to them a Book (the Qur'an) which We have explained in detail with knowledge; as guidance and instruction for the believers (Al-A'raf: 52).*

The Qur'an has already explained to us the scientific concepts we seek. For example, when discussing thermal energy. Heat (Q) is energy that transfers from one object to another due to a temperature difference. Concerning systems and the environment, it can be said that heat is energy that transfers from the system to the environment or energy that transfers from the environment to the system due to a temperature difference. If the system's temperature is higher than the environment's temperature, then heat will flow from the system to the environment. Conversely, if the environment's temperature is higher than the system's temperature, then heat will flow from the environment to the system. If heat (Q) is related to the transfer of energy due to a temperature difference, then work (W) is related to the transfer of energy that occurs through mechanical means [27]. For example, if a system performs work on the environment, then energy will naturally transfer from the system to the environment. Conversely, if the environment performs work on the system, then energy will transfer from the environment to the system.

Where does heat energy come from? Can this energy just appear out of nowhere? Allah says in the Qur'an,

> *It is He who has made for you fire from green wood, so that you may kindle it. (Q.SYasin: 80)*

Fire is the primary source of heat. Although many other sources of heat have been discovered today, such as nuclear energy, the fundamental principle remains the same: converting nuclear energy into heat or fire [28].

Energy in a system is the total kinetic energy of the system's molecules, plus the total potential energy resulting from interactions between the system's molecules [29]. If heat flows from the environment into the system (the system receives energy), the energy within the system increases [30], [31]. Conversely, if the system performs work on the environment (the system releases energy), the energy within the system decreases. Thus, from the conservation of energy, we can conclude that the change in energy within the system is equal to the heat added to the system (the system receives energy) [32].

As an illustration of the first law of thermodynamics, let us imagine a balloon. If the balloon is heated, the air particles inside the balloon will experience an increase in temperature. It is the nature of a particle that when given an increase in temperature, the energy of that particle will also increase. This increase in energy is what we call an increase in internal energy. Since the internal energy of the

gas particles inside the balloon increases, there will be more energy for the gas particles inside the balloon to move and collide with the walls of the balloon. As a result, the volume of the balloon will increase, and work will be done. If the elasticity of the balloon can no longer withstand the collisions of the gas particles inside the balloon, the balloon will burst.
So, in the first law of thermodynamics, the heat supplied will be converted into a change in internal energy and work, or mathematically, it can be written equation 1.

$$Q = \Delta U + W \quad (1)$$

Where, ΔU = Change in internal energy (J); Q = Heat (J); and W = Work (J)

The Philosophical Meaning of the First Law of Thermodynamics in Islam

In the first law of thermodynamics, three physical quantities are studied, namely heat, internal energy change, and work. If we relate this to the socio-humanistic system, heat can be associated with warmth in a person's surroundings, internal energy change can be associated with changes that occur within a person, and work can be associated with the efforts made by a person.

When linked to the equation of the First Law of Thermodynamics, there is a profound message conveyed. The heat provided will result in changes in internal energy and work. In the context of socio-humanism, the equation of the First Law of Thermodynamics signifies that the warmth provided by the environment to an individual can transform that individual, thereby motivating them to strive harder for their betterment. With warmth from the environment, someone who was initially lazy can become more diligent in their efforts. In this case, it is the environment that influences the transformation of an individual.

While the first concept emphasises the environment's influence on an individual, we can also interpret the philosophical meaning of the First Law of Thermodynamics from the opposite perspective. By transforming ourselves into better individuals and exerting diligent effort, we can positively impact our environment. We simply choose to be passive or active individuals. The words of Allah SWT in the Qur'an;

> *"Indeed, Allah does not change the condition of a people until they change what is within themselves." (QS Ar Ra'du:11)*

Allah SWT has entrusted this to each of us individually. We can choose to be influenced by our environment, or we can strive to become better individuals so that we can have a positive impact on our environment.

CONCLUSION

The integration of science and religion can be achieved by taking the philosophical core of fundamental Islamic religious sciences as a paradigm for future science. This integration process can be considered as the Islamization of science as part of the Islamization of future civilization. The First Law of Thermodynamics is a law that studies heat and its changes. The First Law of Thermodynamics states the law of conservation of energy. Where energy derived from heat energy is converted into internal energy and work. A change in internal energy is indicated by an increase in the temperature of a system, and the presence of work is indicated by a change in volume. To examine the First Law of Thermodynamics, we only need to discuss the issues of Heat, Changes in Internal Energy, and Work.

In the context of socio-humanism, the equation of the First Law of Thermodynamics implies that the warmth provided by the environment to an individual can transform that person, making them more diligent in striving for their good. Alternatively, it can also mean the opposite: an individual can transform themselves and become diligent in striving, thereby being able to have a positive impact on their environment. We simply choose to become the kind of person described in the words of Allah SWT,

> *"Indeed, Allah will not change the condition of a people until they change what is within themselves" (QS Ar Ra'du: 11).*

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