

**Research article**

# Interconnectedness of Math, Biology and Islamic Education: Designing Teaching Materials for High School

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**Abstract.**

The interconnectedness of a science is characterized by shared bodies of knowledge and shared vocabulary. Other disciplines, such as education and basic science, should be able to complement science and Islamic studies. Many aspects of the Qur'an and Hadith have been scientifically validated. Islamic studies can also be used to examine the concept of learning in schools and higher education. The interconnectedness of mathematics, biology, and Islamic studies derived from the Qur'an and Hadith, as well as based on the secondary school curriculum, was examined and illustrated in this qualitative study using a content analysis approach. In addition, an integration study was presented, which was part of a material instruction and sample test. The study's findings revealed that mathematics and Islamic education materials, as well as inheritance distribution and the concept of arithmetic operations of whole numbers and fractions, are all interconnected. Gene classification is concerned with problem-solving of binomial odds distributions (statistics) in mathematics, as well as both mathematics and biology materials. At the same time, the human creation, the environment and nature are related materials in Islamic education and biology. The interconnectedness of the three areas of study can thus be seen in classification concepts. In biology and Islamic studies, this concept can be learned in depth through the material classification of lawful and forbidden animals to eat. This classification is discussed in set materials in mathematics. As a result, the discussion of set materials can be traced back to a real-life example in Islamic education and biology. Furthermore, when teaching the concept of permissible and prohibited foods based on the Qur'an and Hadith, mathematics and biology concepts can be used.

**Keywords:** mathematics, biology, Islamic studies, teaching materials, inheritance, classification, human creation, the environment and nature

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## 1. Introduction

Shared bodies of knowledge and shared vocabulary are characteristic of the interconnectedness of a science. Sciences and Islamic studies should be able to complement with other disciplines, such as education and basic science. Many contained things in the Qur'an and Hadith have been proven through science. The concept of learning in schools and higher education, similarly, can be reviewed through Islamic studies. Linking general knowledge and religious is one of the efforts in order to achieve the goals and functions of national education, it is stated in Law Number (No). 20 of 2003 on National education System, National Education function to develop abilities and configuring character as well as dignity of nation civilization, in order to enrich the life nation, aim at developing the potential of students to be a believe and faithful human in God, have a moral character, healthy, knowledgeable, capable, creative, independent, and become a democratic and responsible resident.

In fact, the scientific dichotomy between general knowledge and religious still arises, despite of the desire to combine and bring both of general knowledge and religious is becoming an interesting study among academics and educational practitioners.[1] In the 2013 curriculum of secondary school, this scientific dichotomy is still happening. Some teaching materials have not been integrated between one subject to another. This shows that the transformation of education, including the changing outline and character of Education from science and religious education to non-alcoholic education, demands concrete efforts to make religious education and nondicotomic/integrative science [2]. This research seeks to see and analyze the integrated mathematics and biology field as part of general science or science in relation to Islamic education which is as part of religious science in the 2013 curriculum through studies and analysis referring to Permendikbud number 24 of 2016 on the content and basic competencies in the 2013 curriculum of primary and secondary education.

This research aims to find out and describe the Interconnectedness of teaching materials in the fields of mathematics, biology and Islamic education. So that it can provide information, references and alternative teaching materials that can be used in learning in schools.

## 2. Research Method

This is a qualitative study with content analysis method. The stages of content analysis method according to Fraenkel and Wallen are determine objectives, define terms,

specify the unit of analysis, locate relevant data, develop a rationale, develop a sampling plan, formulate coding categories, check reliability and validity, and analyze data [3]. This research examines the integrated of mathematics, biology, and Islamic education learning in school based on Permendikbud No. 24 of 2016, Basic Competencies and Competencies in the 2013 Curriculum on Primary Education and Secondary Education. Data collection was conducted by means of documentation studies through the teaching books of mathematics, biology and islamic education used in secondary schools. Then the data was analyzed by Miles and Huberman model analysis techniques consisting of three stages, namely: data reduction, data presentation, and withdrawal of conclusion [3].

### 3. Result and Discussion

#### 3.1. Legacy Division

##### 3.1.1. Legacy Division in Islam

The death of someone inevitably presents a polemic for generations of abandoned families, one of which is the issue of the legacy or inheritance. In Islamic studies, a similar term is found which mentions objects of heritage and fair management. Inheritance in Islam called Tirkah. Tirkah is defined as everything left by someone who has passed away, whether in property or otherwise, in the form of rights to others [4]

Inheritance at least has seven classifications. First, permanent property such as buildings, land, gardens and others. Second, movable property such as cash, vehicles and others. Third, the debt of others to the deceased. Fourth, mortgaged and redeemable property. Fifth, property that has been purchased and paid off but has not been received. Sixth, assets in the form of deposits or investments. Seventh, other assets that have a value of property [5]

The inheritance system before Islam is not only due to hereditary factors (nasab) only, but also loyalty and tabanni. Loyalty is agreed as the loyalty of two or more friends by swearing to help each other and inherit if one of them dies first. Tabanni, meanwhile, adopted or raised a person as his son who would have an inheritance after his death. The inheritance system in Islam is related to 2 fundamental aspects and one other thing. 2 fundamental aspects are family or family through a legal marriage agreement and marital relationship. Meanwhile, the third additional aspect is the relationship between the master and the slave, which is no longer recognized.

The source of determining the division of inheritance in Islam refers to the basis for establishing the law, namely the Koran, Hadith, and Ijmak. Al-Quran lists 6 verses that discuss inheritance in Islam. QS al-Nisa: 7-8, 11-12, 176, QS al-Anfal: 75 and al-Ahzab: 6 each verse describes the rights and obligations of the heir to the inheritance of the deceased. QS al-Nisa: 11 very detail shows the division. Among them in verse 11, when a person dies and leaves his offspring with various conditions including; 1) There are boys and girls then should share 2:1 for boys, 2) If girls only and themselves, then get part 1/2. 3) if the daughter is more than one person, then they share 2/3 of the inheritance.

In addition to the child section, this verse also describes the part of the parents who died with two types. First, if the deceased had children, then the two parents who died were 1/6 respectively. Second, if he/she does not have children, then the inherited mother and father only where the mother's share is 1/3 and the rest becomes the father's part which is 2/3. This division is same when the deceased has a brother.

In the Prophet's Hadith, there are also 3 narrations which explicitly mentioned the division of heritage. The hadith about Sa'ad ibn Rabi's wife is sad because of her husband's lack of inheritance for her and her two daughters narrated by Bukhari and Muslim. The hadith of Ibn Abbas related to the phrase of the Prophet (s) to share the inheritance according to his portion. Usama bin Zaid's hadith about the words of the Prophet did not inherit between Muslims and non-Muslims. The consensus of the theologian after the death of the Prophet is about inheritance and statutes that are not found in the Qur'an and Hadith as part of the father's grandfather.

### 3.1.2. Legacy Division as a Learning Resource in Mathematics

The concept of legacy division described in the Qur'an, An-Nisa:11-12, as well as having a connection to the idea of mathematics, has been taught to students in Islamic education and ethics subject of curriculum 2013 (K1-13). The relationship is related to the concept of integers and fractional operations in mathematics materials at the junior high school level. The use of the distribution of inheritance concept in the learning of mathematics becomes a bridge of students to understand the law of legacy division in Islam; moreover, it can form and develop students' ability to accomplish mathematical operations. Here is an example of using the context of inheritance distribution in schools:

*A father, an Islamic family, died and left an inheritance to his heirs consisting of a wife, a son, and a daughter. He left the legacy of Rp. 500,000,000, determine how much of the property each heir gets!*

In this case, before applying the concept of integer and fractional operations, the students are invited to understand the concept of the inheritance division in Islam first then complete it. In curriculum 2013, this concept was taught in the high school, so to design a math problem of the division of inheritance context for junior high school level, it needs to write the rules related to the division of heritage in Islam. As an example:

*A father, an Islamic family, died and left an inheritance to his heirs consisting of a wife, a son, and a daughter. He left the inheritance of Rp. 500,000,000. In Islam, it is stipulated that the wife shall have 1/8 part, and the son shall have twice part of the daughter, then count the part of the wealth of each heir!*

To solve this questions, students need good numerical skills. As Sitriani, et al. explained, that numerical ability is one of the factor that determines a student's success in mastering mathematics [6]. Students need to understand how much part the wife, son and daughter have, as follows:

$$\text{Wife} = \frac{1}{8} \times \text{Rp. } 500.000.000 = \text{Rp. } 62.500.000$$

*As wife get  $\frac{1}{8}$  part, then (son + daughter) get  $\frac{7}{8}$  part. That,*

$$\text{Children} = \text{Son (S)} + \text{daughter (D)} = \frac{7}{8} \times \text{Rp. } 500.000.000 = \text{Rp. } 437.500.000.$$

*Since boys get twice part of girls, the mathematical model can be written:*

$$\text{Children: } L + P = \frac{2}{3} + \frac{1}{3}$$

*Thus, boys have an inheritance of:*

$$L = \frac{2}{3} \times \text{Rp. } 437.500.000.$$

$$= \text{Rp. } 291.666.667$$

*Daughter have an inheritance of:*

$$L = \frac{1}{3} \times \text{Rp. } 437.500.000.$$

$$= \text{Rp. } 145.833.333.$$

This problem is not only seen as a mathematical problem, but also in the Islam context. The use of legacy contexts in mathematics makes math learning have religious values. Students not only understand the concept of mathematical operations but can also recognize and understand the idea of inherited law and the division of inheritance in Islam. Sobarningsih, et al. explained that the mathematics learning which has Islamic values, besides having the aim to achieve students' understanding and ability in math, it also instils Islamic values in their self [7].

### 3.2. Human Creation

### 3.2.1. Human Creation in Islam

Humans as the main and best creatures, are unique from various sides. The process of human creation is very complicated among the uniqueness, in the Qur'an, Allah SWT has explained in detail each phase passed through it. It can be found in surah al-Alaq 1-2 as the beginning of the revelation in Islam indicates its miracles. The word alaq in this verse means a solid blood clot (Zuhaili, Tafseer al-Wajiz). The clot of blood is a continuance of the male's Nutfah phase (embryo). After that successively a fist of flesh, bone and layer will be formed, and finally be blown by the soul. This explanation is illustrated in QS Gafir: 67, al-Hajj: 5, QS al-Muminun: 12-14. In the modern world, the initial process of human creation with alaq or a lump of flesh is known as zygote, which will develop into a baby fetus until it is born as a new human being.

### 3.2.2. Human creation as a Learning Resource in Biology

Human creation was described in the Qur'an Surah Al-Mu'minin: 12-14, which described the early human creation to be the perfect form. Humans are sexually multiplying organisms. Humans begin to form when fertilization occurs between male gamete cells (sperm) and female gamete cells (egg cells) thus forming zygotes, the conception process is known as fertilization. The zygote will then divide into a multicellular organism called an embryo [8]

The use of human creation concept can assist students in identifying the processes that occur in human development, starting from the stage before the zygote is formed to the formation of humans in its entirety. In studying the concept of human creation, it takes a high understanding to improve sTudents' learning outcomes [9]

In the 2013 curriculum, one of the materials taught to high school students related to human creation is about the growth and development of living things. Students are expected to be able to explain the processes that occur in the growth and development of living things so that it needs to present appropriate and good material on related topics. It can be seen in the summary of the "Human Embryonic Phase" material description, in the following excerpt:

The embryonic phase is the growth and development phase of the organism during the embryo period, which is beginning by the fertilization to the fetus forming in the female's body. The embryonic phase begins at the Morula Phase; in this phase, the zygote has been being division. Cell division starts from one to two, two to four, and so on. Next is a Blastula phase, at this phase occurs cytoplasm division into two polar which

are formed on the Moruta Phase. Then the phase is the Gastrula, where the embryonic are in a differentiation process by removing the Blastosol. Furthermore, in Neurula Phase, there is neurulations and notochords formation (the formation of mesoderm rods along the body of the prospective fetus, which will be vertebrae / spine). Last, the Fetal Formation Phase occurs, in this phase cell differentiation occurs to form a fetus [8]

The material excerpt not only supports students' knowledge of the early phases of human development but also explains that humans were created by Allah SWT with a series of complex processes. Biology learning supported by Islamic values not only improves students' understanding in biological sciences, but also encourages the formation of personalities that have good character, both in individual and social contexts [10]

### 3.3. Gene Classification

#### 3.3.1. Gene Classification in Biology

DNA is a carrier of genetic information of organism inherited by parents. DNA provides information on diseases such as cancer [11] and diabetes [12] suffered by living beings. To see the expression of those genes, the related genes are classified and make them as classified samples [13]. DNA Microarray is a technology in the field of molecular biology and bioinformatics that can detect large amounts of gene expression. Gene classification and selection using microarray data were conducted by [13] using the Random Forest method; the results are shown as well as other classification methods such as Diagonal Linear Discriminant Analysis (DLDA), K Nearest Neighbor (KNN), and Support Vector Machines (SVM).

#### 3.3.2. Gene Classification in Mathematics

The concept of gene classification as a learning resource in mathematics is found in many applied statistical studies. Some studies lifted the classification of genes as a case that can be used in supporting the development of a statistical method, such research conducted by Wherdana on the classification of genes related to Alzheimer's syndrome using the naïve bayes classifier, binary logistic regression, and regression logistic ensemble [14] Other research conducted by Luis, et al using Multiple Filter (MF), Genetic Algorithm (GA), and Taboo Search (TS), combined with Support Vector Machine (SVM)

[15]. Chandra and Gupta introduced a novel and efficient feature selection algorithms applied to the classification methods of naïve bayes and SVM in identifying the most relevant genes as carriers of leukaemia, colon tumors, lung cancer, diffuse large B-cell lymphoma, and prostate cancer [16]. And other research conducted by Chen, et al conducted gene selection using a kernel-based clustering method [17].

Learning in schools by the k-13 curriculum has raised the basic material classification of mathematic on high school grade XII in mathematics subjects by interest in the statistical inference chapter. This inference statistic material consists of several subjects; the concept of random variables, probability functions, and binomial distribution functions. These three subjects are hierarchically interconnected among them. It means, before studying the binomial distribution function, then must understand first the concept of random variables and probability functions. Binomial distribution function is not only a basic and simple function that contributes to the presence of complicated classification methods but it is more representative as part of the science development. Binomial distribution functions are defined as:

$$P(x) = \frac{n!}{x!(n-x)!} p^x (1-p)^{n-x} \quad x = 0, 1, 2, \dots, n$$

Where:

$P(x) = P(X=x)$  = probability that  $X$  variable takes  $x$  value

$n$  = number of sample elements or experiments

$x$  = the number of successes or the number of sample elements are being observed characteristics.

In application, binomial distribution can be used in the case of simple gene classification. Example:

10% of tomatoes in Baruga market are categorized as Muna culturist tomatoes. A sample of 30 has been taken randomly. What is the probability of sample will contain all of Muna culturist tomatoes? . What is the probability of sample will contain one of Muna culturist tomatoes?

Solution:

$X$  : Number of Muna culturist tomatoes;  $P$  : Probability of Muna culturist tomatoes = 10% = 0,10.

All of Muna culturist tomatoes is  $X = 30$ ,  $n = 30$

$$P(X = x) = \frac{n!}{x!(n-x)!} p^x (1-p)^{n-x}$$



$$x = 0, 1, 2, \dots, n P(X = 30) = \frac{30!}{30!(30 - 30)!} 0, 10^{30} (1 - 0, 10)^{30-30}$$

$$P(X = 30) = \frac{30!}{30!(0)!} 0, 10^{30} (1 - 0, 10)^0$$

$$P(X = 30) = \left[ \frac{1}{10} \right]^{30} = 10^{-30}$$

So, the probability of whole sample will contain all Muna culturist tomatoes is  $10^{-30}$ .

One Muna culturist tomatoes,  $X = 1, n = 30$ .

$$P(X = x) = \frac{n!}{x!(n - x)!} p^x (1 - p)^{n-x}$$

$$x = 0, 1, 2, \dots, n P(X = 1) = \frac{30!}{30!(30 - 1)!} 0, 10^1 (1 - 0, 10)^{30-1}$$

$$P(X = 1) = \frac{30!}{30!(29)!} 0, 10^1 (1 - 0, 10)^{29}$$

$$P(X = 1) = 0, 1409$$

So, the probability of whole sample will contain all Muna culturist tomatoes is 0,1409

The example above discussed of the Muna culturist tomatoes which can be distinguished from other types of tomatoes by identifying their genes. The integration of biological cases (e.g Muna culturist tomatoes) in mathematics learning in schools can increase students' knowledge. Thus, they learned not only the basic theory of building gene classification methods, students were also introduced to biodiversity which is also distinguished based on the genetic information that builds it. As Sutarno explained that most of the characteristics possessed organism are controlled by genes located in the nucleus of cells (nuclei), but there are also traits of living beings controlled by DNA that are outside the nucleus (mitochondria, chloroplasts) [18]

### 3.4. Classification in Mathematics, Biology and Religion Overview

In mathematics, the classification process is introduced through the concept of set. A set is defined as a group of objects with a particular characteristic and feature [19]. The particular feature or characteristics should be defined clearly. For example, a group of male students and a group of handsome students. A group of male students is a

set, as it can be clearly defined, based on the characteristics and physical appearance of biologically males. However, a group of handsome students is not a set, because everyone has a different concept or understanding of the nature or characteristics of the handsome word.

Based on the 2013 curriculum (K13), the material of the Sets taught in Grade VII Junior High School / Islamic school / Equivalent includes: 1) Set concept, 2) characteristics, 3) set operation [20]. The context used in the student mathematics handbook, strongly related to the concept of Biology and Islamic education, as an introduction to being able to make students easily understand the concepts of the set. In biology like, the classification of two-legged animals, vegetables, freshwater fish, etc. The use of context so that students understand the concept of the set can also be done with a religious approach. For example, regarding the classification of God’s creatures (QS.Al-An’am:128), the classification of angels (QS.Al-Fathir:1), the classification of animals created by Allah (QS.An-Nur:45), the classification of humans (QS.Al-Waqi’ah:7-10), etc.

In Figure 1, we can see that the classification of living things based on their place of life can be divided into several groups, including: sea animals, land animals, and amphibians. This classification can be integrated with Islamic education regarding the law of eating food, namely halal, haram or syubhat as stated in the Prophet’s Hadith narrated by Bukhari and Muslim that “Indeed, it is clear that halal and haram is plain and between the two there is ambiguous thing, most people do not know....”.

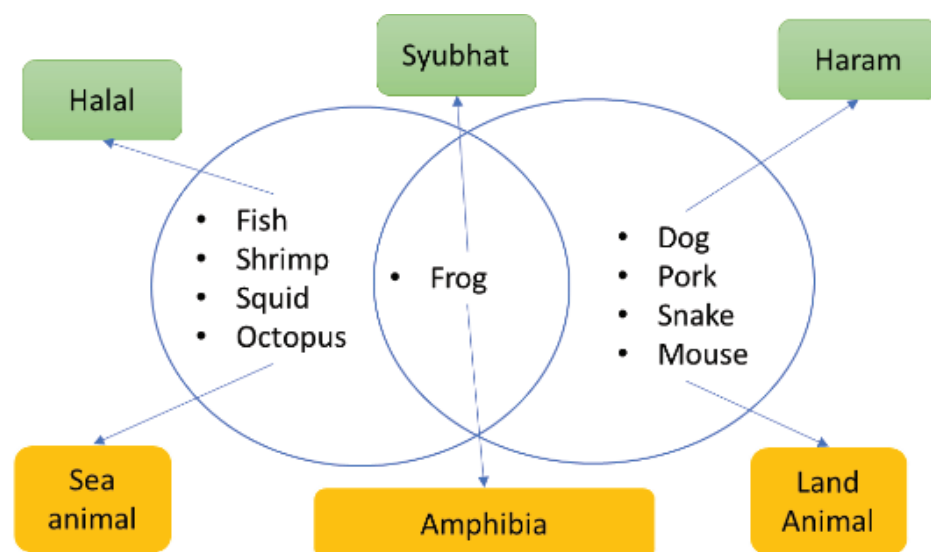


Figure 1: Connectiveness of Mathematics, Biology, and Islamic Education.

Figure 1 is a visual representation of the biological view of the classification of living things based on their place of life and the Islamic Religious Education’s view of the

law of eating food which is represented mathematically using a venn diagram in the concept of set. Learning mathematics helps students understand abstract concepts and natural phenomena which are also discussed in other scientific clusters. Therefore, in the learning process at school, a method or teaching material is needed that is able to connect the concepts of the three scientific clumps of Mathematics, Biology, and Islamic Religious Education, so that students can have a broader insight into the phenomena related to life. daily and religious life.

## 4. Conclusions

There is interconnectedness of material and concepts in three areas of Biology, Mathematics and Islamic Education study. The material of inheritance distribution in Islamic education has interconnected to the concept of arithmetic operations whole number and fractions in Mathematics. Gene classification in Biology concerns with problem-solving of binomial odds distribution (Statistics) in Math. Both Islamic education and Biology have interconnected material that is the human creation. In the concept of classification, Islamic education classified animals based on haram or halal to be eaten. In biology, calcified by place of life. This classification concept, is discussed more extensively in Mathematics namely sets material.

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