ISLAMIC INTEGRATED MATHS: MATHEMATICAL LOGIC IN THE QUR’AN

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Abstrak

Kata Kunci: Matematika terintegrasi Islam, logika matematika, Al-Quran.

Abstract
One of the goals of national education is to form students who are faithful and devoted to God Almighty. Islamic-integrated mathematics learning is a bridge to achieving this goal. This study aims to explore the verses in the Quran related to the concept of mathematical logic. A literature review using qualitative research was conducted in this research. Data were obtained from the Quran, the Book of Tafsir, and relevant journal articles. The results showed the concept of mathematical logic in the Quranic verses. The conjunction form is found in surah Al-Baqarah verse 25, the disjunction form is found in surah Al-Balad verses 12 to 16, and the negation form is found in surah Al-Kafirun verses 2 to 5. Implication form is found in surah Al-Fatihah verses 6 and 7.
The results of this study can be a reference for learning resources in mathematical logic and logic and set integrated with Islam at the school and lecture levels.

Keywords: Islamic integrated mathematics, logical mathematics, Quran.

A. INTRODUCTION

As part of education, mathematics learning has the responsibility to shape students with character and morality. (Abdussakir & Rosimanidar, 2017). This responsibility is confirmed in the Law of the Republic of Indonesia number 20 of 2003, which states that one of the objectives of education is to unleash the potential and make students devoted to God Almighty (Undang-Undang Republik Indonesia, 2003). That means that learning mathematics not only plays a role in training thinking and reasoning skills but also in shaping students’ morals (Alghar et al., 2023; Cipta & Hori, 2018). Therefore, a unique approach is needed that involves religious aspects and values in learning mathematics, one of which is through integrated mathematics.

Integration in mathematics is defined as an approach that links, fuses and connects mathematics with various disciplines (Kelley & Knowles, 2016; White et al., 2014). This integration is not limited to linking alone but building correlations and perfecting between sciences to become complete knowledge (White et al., 2014). Several forms of integrative mathematics have been formulated, such as the approach of mathematics with science, technology, engineering, and art known as STEAM (Bedewy & Lavicza, 2023; Margot & Kettler, 2019), a mathematical approach with a cultural scope known as ethnomathematics (Akbar et al., 2023; Alghar et al., 2022; Alghar & Marhayati, 2023), and the approach of mathematics with Islamic values, known as Islamic integrated mathematics. (Hendrawati et al., 2020; Radjak et al., 2023; Safitri et al., 2020).

The term Islamic integrated mathematics (some studies refer to it as integrative mathematics) is an approach that links, connects, and integrates mathematical concepts and principles with Islamic values (Abdussakir, 2017; Abdussakir & Rosimanidar, 2017). Islamic values can be sourced from the Quran, Hadith, the History of Islamic Civilisation, Fiqh, and Islamic Law (Abdussakir, 2017; Hapiz et al., 2019; Rosikhoh & Abdussakir, 2020). Islamic
Integrated mathematics uses the context of everyday problems related to Islam, such as worship, Islamic behavior, and business by Islamic law (Sugilar et al., 2019; Supriyadi, 2020).

Islamic integrated mathematics cannot be separated from various Islamic-based educational institutions. In Indonesia, various educational institutions, from primary to tertiary levels, are based on Islam (Bafadhol, 2017; Rahman, 2018). That is demonstrated by the existence of *raudhatal aftal* (Islamic kindergarten), *madrasah ibtidaiyyah* (Islamic-based primary school), *madrasah tsanawiyah* (Islamic-based junior high school), *madrasah aliyah* (Islamic-based senior high school), as well as Islamic-based universities such as STAIN, IAIN, and UIN (Bafadhol, 2017; Hapiz et al., 2019). This means that Islamic integrated mathematics is applied and developed in these institutions.

Various researchers have conducted several developments in Islamic integrated mathematics studies through various Islamic sources. Such as the study of numbers in the Quran (Abdussakir, 2017; Pujilestari et al., 2022), the secret of numbers in the Quran (Irawan et al., 2005), and operations of addition and subtraction in the Quran (Abdussakir & Rosimanidar, 2017). Furthermore, there is also a study of number operations in hadiths (Supiarmo, 2022), fractional numbers in hadith (Hapiz et al., 2019; Rosikhoh & Abdussakir, 2020), as well as the concept of linear function and comparison in hadith (Alghar et al., 2023). These studies indicate that the theme of integrating mathematics and Islam has begun to be widely explored.

However, previous integration studies were still conducted exploring basic mathematical concepts, such as numbers, sets, number operations, set operations, and functions. That means that there is still a void in the research to examine other mathematical concepts derived from the Quran. On the other hand, the study of mathematical logic integrated with the Quran has not been done much. Therefore, this study aims to explore the concepts of mathematical logic derived from the Quran. Thus, this research can provide benefits in providing learning resources related to Islamic integrated mathematical logic that can be used in mathematical logic lectures as well as logic and sets.
B. RESEARCH METHODS

A descriptive qualitative method with a literature study approach was used in this research. The literature is in the form of the Quran, books of interpretation, books related to mathematical logic, and relevant journal articles. Then, the researcher examines all the literature in detail and in-depth to be compared, concluded, and presented in the research results section. (Creswell & Creswell, 2017; Moleong, 2013). Secondary sources are used in this research technique. In other words, the data obtained is not data obtained through field research but data sourced through other intermediaries (Sugiyono, 2013). The secondary data are books, articles, and documents related to the Quran, tafsir books, mathematical logic, and Islamic integrated mathematics. The data is then presented descriptively in words, tables, and pictures.

This research procedure uses a standardized form of synthesis in the literature study (Moleong, 2013), conducted through four stages. (1) Determining the research theme: in this section, the researcher chooses the study theme, namely exploring Quranic verses relevant to the concept of mathematical logic. (2) Collecting data: at this stage, the researcher collects data from sources relevant to the research theme. (3) Conducting a review: At this stage, the researcher examines each piece of literature used in detail and in-depth. (4) Performing data analysis: Data analysis uses content analysis techniques to discuss in-depth information related to the research theme based on the literature used. (5) Writing down the results of data analysis. In this section, the analysis results are presented, discussed in depth, and supported by other relevant research results.

C. RESULTS AND DISCUSSION

1. Conjunctions

Surah Al-Baqarah verse 25:

وَبَشِّرُ ٱلَّذِينَ ءَامَنُواْ وَعَمِّلُواْ ٱلصَّٰلِّحََّٰتِّ أَنَّ لَهُمۡ جَنََّّٰتٖ تَجۡرِي مِّن تَحۡتِّهَا ٱلَۡۡنۡهََّٰرُُۖ كُلَّمَا رُزِّقُواْ مِّنۡهَا مِّن ثَمَرَةٖ رُزۡقٗا قَالُواْ هََّٰذَا ٱلَّذِّي رُزِّقۡنَا مِّن قَبۡلُُۖ وَأُتُواْ بِّهِّٖ مُتَشََّٰبِّهٗاۖ وَلَهُمۡ فِّيهَا أَزۡوََّٰٓجٞ مُّطَهَّرَةُٞۖ وَهُمۡ فِّيهَا خََّٰلِّدُونَ

خَٰلِدُونَ
And convey good news to those who believe and do good deeds, that they shall have gardens in which rivers flow; whenever they shall be given a portion of the fruit thereof, they shall say: This is what was given to us before; and they shall be given the like of it, and they shall have pure mates in them, and in them, they shall abide (Q.S. Al-Baqarah: 25).

The mathematical logic formed in the verse is conjunction indicated by the proportion \( p \land q \). The form of the premise built in the verse according to the terms of the conjunction is explained as follows.

\( p \): those who believe (true)

\( q \): those who do good (true)

\( p \land q \): those who believe and do good (true)

Based on the mathematical logic of conjunction, the statement will be true if the first and second statements are true. That is shown in the truth table in Table 1

**Table 1.** The truth value of the conjunction

<table>
<thead>
<tr>
<th>The first statement (( p ))</th>
<th>The second statement (( q ))</th>
<th>( p \land q )</th>
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Based on the mathematical logic of conjunction in Table 1, the statement \( p \land q \) can be true-valued and false-valued. In detail, the conjunction statement is interpreted as follows:

i. If one believes (true) and does good (true), heaven and the pleasures therein will be provided (true).

ii. If one believes (true) and does not do good deeds (false), heaven and the pleasures therein will not be provided for (false).

iii. If one does not believe (false) and do good (true), there will be no paradise and enjoyment therein (false).

iv. If one does not believe (false) and does not do good (false), heaven and the pleasures therein will not be provided (false).
Apart from QS. Al-Baqarah verse 25, statements containing conjunctions can be found in other verses in the Quran, such as in QS. Al-Asr verses 1 to 3, QS. Al-Maun verses 1 to 3, QS. The conjunction statement is always true if both statements are true. Conversely, a conjunction statement is false if one or both statements are false.

2. Disjunction

Surah Al-Balad verse 12 to 16:

وَمَا أَدۡرَىَّٰكَ مَا ٱلۡعَقَبَةُ ٢١
فَكُّ رَقَبَةٍ ٣١
أَوۡ إِّطۡعََّٰمٞ فِّي يَوۡمٖ ذِّي مَسۡغَبَةٖ ٤١
يَتِّيمٗا ذَا مَقۡرَبَةٍ ٥١
أَوۡ مِّسۡكِّينٗا ذَا مَتۡرَبَةٖ ٦١

And what will make you comprehend what the uphill road is? (It is) the setting free of a slave; Or the giving of food in a day of hunger. To an orphan, having relationship; Or to the poor man lying in the dust. (Q.S. Al-Balad: 12-16).

The mathematical logic formed in verse is a disjunction indicated by the word ‘or’. The form of the premise built in the verse according to the terms of the disjunction is explained as follows.

\[ p: \text{one who releases an enslaved person from slavery} \quad (\text{true}) \]
\[ q: \text{one who feeds orphans} \quad (\text{true}) \]
\[ r: \text{one who feeds the poor} \quad (\text{true}) \]

Based on the mathematical logic of disjunction, the statement will be false if the first and second statements are false. That is shown in the truth table in Table 2:

**Table 2. The truth value of the conjunction**

<table>
<thead>
<tr>
<th>(p)</th>
<th>(q)</th>
<th>(r)</th>
<th>( p \lor q )</th>
<th>( p \lor r )</th>
<th>( q \lor r )</th>
<th>( p \lor q \lor r )</th>
</tr>
</thead>
<tbody>
<tr>
<td>True</td>
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</table>
Based on the mathematical logic of disjunction in Table 2, eight statements fulfill the disjunction form \( p \lor q \lor r \). Of the eight statements, seven are true, and one is false. The disjunction form on the statements \( p \), \( q \), and \( r \) can be interpreted as follows:

\( p \lor q \): The uphill path is to release an enslaved person from slavery (true) or feed an orphan (true).

\( p \lor r \): the uphill path is to release an enslaved person from slavery (true) or feed the poor (true).

\( q \lor r \): the uphill path is to feed the orphan (true) or the poor (true).

Apart from Surah Al-Balad verses 12 to 16, statements containing disjunctions can be found in other verses in the Quran. Such as in Surah Abasa verses 3 to 4. A disjunction statement is always true if one or both statements are true. Conversely, a disjunction statement is false if both statements are false.

### 3. Negation

Surah Al-Kafirun verse 2 to 5:

\[
\text{لا أَعْبَدُ مَا تَعْبَدُونَ ۡوَلَّا أَنْتُمۡ عََّٰبِّدُونَ مَا أَعۡبُدُ} \quad 3
\text{وَلَّا أَنَا عَابِّدٞ مَّا عَبَدتُّمۡ ۡوَلَّا أَنَا عَابِّدٞ مَا عَبِدتُّمۡ مَا أَعۡبُدُ} \quad 4
\text{I do not worship what you worship, nor do you worship what I worship, I} \quad 5
\text{will never worship what you worship, nor will you ever worship what I} \quad (Q.S. Al-Kafirun: 2-5).

The mathematical logic formed in verse is negation, indicated by the word ‘not’. The form of the premise built in the verse according to mathematical logic provisions is explained as follows.
~p: I do not worship what you worship (true)

~q: you do not worship what I worship (true)

~r: I will never worship what you worship (true)

~s: You will never worship what I worship (true)

Based on the mathematical logic of negation, the statement will be true if the first and second statements are true. That is shown in the truth table in Table 3.

Table 3. The truth value of negation

<table>
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<th>~p</th>
<th>~q</th>
<th>~r</th>
<th>~s</th>
<th>p</th>
<th>q</th>
<th>r</th>
<th>s</th>
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</table>

Based on the mathematical logic of negation in Table 3, a statement with a negation value will always be opposite to a statement without a negation. That means that:

p: I worship what you worship (false)

q: you worship what I worship (false)

r: I will worship what you worship (false)

s: You will worship what I worship (false)

In addition to Surah Al-Kafirun verses 12 to 16, statements that contain negation can be found in other verses in the Quran. Such as in Surah At-Takwir verses 22 and 24, Surah Al-Adiyat verse 6, and Surah Al-Ikhlas verses 3 and 4. The negation statement will always be opposite to the original statement. That also applies to the truth value, which will always contradict the original statement.

4. Implications

Surah Al-Fatihah verse 6 to 7:

آهِدِنَا ال‌صِّرَاطَ ال‌مُسْتَقِيمَ ۶ صِرَاطَ الَّذِينَ آمَنُواَ غَيْرِ ال‌مُجَٰفِرِينَ عَلَيْهِمْ وَلَا الْجِهَٰلِينَ ۷

Keep us on the right path. The path of those upon whom Thou hast
bestowed favors. Not (the path) of those upon whom Thy wrath is brought down, nor of those who go astray. (Q.S. Al-Fatihah: 6-7).

The mathematical logic formed in the two verses is the implication, shown by the existence of two mutually sustainable premises. The form of the premise built in the verse, according to the terms of implication, is explained as follows.

\( p \): People are on the right path (true)

\( q \): Allah will favor him (true)

\( p \rightarrow q \): If people are on the right path, then Allah will favor them (true)

Based on the mathematical logic of implication, the statement will be false if the first statement is true and the second statement is false. That is shown in the truth table in Table 4.

**Table 4.** The truth value of the implication

<table>
<thead>
<tr>
<th>The first statement ((p))</th>
<th>The second statement ((q))</th>
<th>( p \rightarrow q )</th>
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Based on Table 4, there are four truth values in the Implication form. The details of the truth value of each implication statement are explained as follows.

i. If \( p \) is true and \( q \) is true, then \( p \rightarrow q \) is true. The two premises imply that if a person is on a straight path, Allah will favor him. This statement occurs in life. Someone who always performs obligatory sunnah prayers will feel peace of mind and inner pleasure.

ii. If \( p \) is true and \( q \) is false, then \( p \rightarrow q \) is false. The two premises imply that if a person is on the straight path, Allah will not favor him. The statement is false. That is because Allah always fulfills His promises to His servants. As Surah Maryam verse 96 explained, people who believe and do good deeds will get favor from Allah.
iii. If $p$ is false and $q$ is true, then $p \rightarrow q$ is true. The two premises imply that if a person is not on the straight path, Allah will favor him. The statement is true. It can be found in everyday life, such as in non-Muslims to whom Allah gives worldly favors.

iv. If $p$ is false and $q$ is false, then $p \rightarrow q$ is false. The two premises imply that if a person is not on the straight path, Allah will not favor him. The statement is true. It is reinforced in surah al-Mulk verses 16 to 30 that those who do not believe will receive threats and disasters Allah gives in the hereafter.

Besides Surah Al-Fatihah verses 6 to 7, statements containing implication can be found in other verses in the Quran. Such as in Surah An-Naziat verses 40 and 41, Surah Abasa verses 5 and 6, and Surah Al-Infithar verses 4 and 5. The implication statement will always be false if the first and second questions are true. Conversely, the implication statement will always be true if the first question is not false.

5. Implication and Disjunction

Surah An-Nisa ayat 86:

وَإِذَا حُيِّيتُم بِتَحِيَّةٖ فَحَيُّواْ بِأَحۡسَنَ مِّنۡهَا أَوۡ رُدُّوهَا ٓۗ إِنَّ ٱللَََّّ كَانَ عَلَىَّٰ كُل ِّ شۡيۡءٍ حَسِّيب

And when you are greeted with a greeting, greet with a better (greeting) than it or return it; surely Allah takes account of all things. (Q.S. An-Nisa: 86).

The mathematical logic formed in Surah An-Nisa verse 86 is based on implication and disjunction, shown by three mutually sustainable statements. The form of premises built in the verse according to the terms of implication and disjunction is explained as follows.

$p$: You get a greeting (true)

$q$: You return the greeting equally (true)

$r$: You repay the greeting with something better (true)

$p \rightarrow q \lor r$: If you receive a greeting, then return the greeting in kind or better kind (true)

Based on the mathematical logic of implication and disjunction, the
statement will be false if the first statement is true, the second statement is false, and the third statement is false. That is shown in the truth table in Table 5.

Table 5. The truth value of implication

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<td>p → q ∨ r</td>
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Based on Table 5, there are eight truth values in the form of implication and disjunction in Surah An-Nisa verse 86. Of the eight statements, only one statement is incorrect. The statement reads, 'When you are honored, repay the honour neither with a better nor an equal. The statement is incorrect because the honor is not reciprocated. In addition, the statement contradicts the messages conveyed by the Prophet to always do good to family, guests, neighbors, and everyone.

6. Implication and Conjunction

Surah Ibrahim verse 7:

وَإِذۡ تَأَذَّنَ رَبُّكُمۡ لَئِّن شَكَرۡتُمۡ لََۡزِّيدَنَّكُمُۡۖ وَلَئِّن كَفَرۡتُمۡ إِّنَّ عَذَابِّي لَشَدِّيدٞ

And when your Lord made it known: If you are grateful, I would certainly give to you more, and if you are ungrateful, My chastisement is truly severe.

(Q.S. Ibrahim: 7).

The mathematical logic formed in Surah Ibrahim verse 7 is implication and conjunction, shown by four interconnected statements. According to the terms of implication and conjunction, the form of premises built in the verse is explained as follows.
You are grateful (true)
You are given pleasure (true)
You are ungrateful (true)
You are afflicted with a painful punishment (true)

$p \rightarrow q \land r \rightarrow s$: If you are grateful, then Allah will increase favors to you, and if you disbelieve in favors, then you will be afflicted with a painful punishment.

Based on the mathematical logic of implication and conjunction, the statement's truth value can be true or false. The truth value depends on the value of the given premise. That is shown in the truth table in Table 6.

**Table 6.** The truth value of implication and conjunction

<table>
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<th>p</th>
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<th>p → q</th>
<th>r → s</th>
<th>p → q ∧ r → s</th>
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Based on Table 6, there are 16 truth values in the form of implication and conjunction in Surah Ibrahim verse 7. Of the 16 statements, there are nine true statements and seven false statements. One of the true statements reads, 'If you are grateful, then Allah will add favors to you, and if you disbelieve in favors, then you will be afflicted with a painful punishment'. The statement is true because gratitude will always result in favors and rewards in life. On the other hand, disbelief in favors will lead to dissatisfaction and disrespect for all one has received.

Meanwhile, one of the false statements is 'If you are grateful, then Allah will not increase blessings to you, and if you disbelieve in blessings, then you will not be afflicted with a painful punishment'. The statement is false because gratitude will produce pleasure in appreciating everything that happens. That is in line with QS. Lukman verse 12 says that whoever is grateful is grateful to himself.

D. CONCLUSIONS

Based on the results of data analysis and discussion, it is concluded that several forms of mathematical logic exist in the Quran. The logical forms listed are conjunction, disjunction, negation, and implication. The conjunction form is found in surah Al-Baqarah:25. The disjunction form is found in surah Al-Balad verses 12 to 16. The negation form is found in surah Al-Kafirun verses 2 to 5. The implication form is found in surah Al-Fatiyah verses 6 and 7. In addition, there are combined forms of mathematical logic, such as implication and disjunction in surah An-Nisa verse 86 and implication and conjunction in surah Ibrahim verse 7.

This research can be a gateway to the opening of other relevant research. It is hoped that further research can deepen the combination of forms of mathematical logic contained in the Quran. The researcher also hopes that this research can be developed into learning tools in schools and lectures on mathematical logic material.
E. REFERENCES


