THE EFFECTIVENESS OF HILAL OBSERVATION ACTIVITIES IN IMPROVING STUDENTS' UNDERSTANDING OF DETERMINING THE BEGINNING OF THE HIJRI MONTH

Vania Azzahra Lubis[1]
Rumaisha Zahira[2]
Anas Mahrus Harefa[3]
Safrizal Jailani Simamora[4]

[1,2,3,4]Universitas Muhammadiyah Sumatera Utara
azzahraa.zahraaa05@gmail.com

Abstract: *This study aims to examine the effectiveness of hilal observation activities in enhancing students' understanding of the determination of the beginning of the Hijri month. Hilal observation is an essential component of Islamic astronomy, as it integrates theoretical knowledge of hisab with direct rukyat practices. This research employed a descriptive quantitative method using a questionnaire distributed to 30 students of the Ilmu Falak study program who had participated in hilal observation activities. The data were analyzed using descriptive statistical techniques, including frequency distribution, graphical presentation, and measures of central tendency and data dispersion. The results indicate that the mean score was 44, the median was 46.2, and the mode was 47.63, indicating that students' understanding was at a good to very good level. The standard deviation of 5.33 and variance of 28.4 suggest that the data distribution was relatively homogeneous and consistent. These findings demonstrate that hilal observation activities are effective in improving students' understanding of the determination of the Hijri month and play a significant role in strengthening applied learning in Islamic astronomy.*

Keywords: *Hilal Observation, Islamic Astronomy, Hijri Month Determination, Student Understanding, Ilmu Falak.*

Introduction

The determination of the beginning of the Hijri month is a fundamental aspect of Islamic worship practices, as it is directly related to the performance of obligatory and recommended acts of worship such as the Ramadan fast, Eid al-Fitr, Eid al-Adha, and various other acts of worship that are bound to lunar time. As is well known, the determination of the beginning of the lunar month in Islam begins with the appearance of the hilal, namely the crescent moon that is first observed (Jamaludin, 2018). The determination of the beginning of the Hijri calendar month is marked by the emergence of the hilal as the start of the month (Wathoni, 2021). The word for month in Arabic is *syahr*. The word *syahr* (رهش), which consists of the letters *syin*, *ha*, and *ra'*, is an original word that indicates the clarity and brightness of a matter. The word *syahr* in Arabic is often associated with the term *hilal* (Khusurur, 2020). In the context of determining the beginning of the Hijri month, the term *rukyah al-hilal* refers to the activity of observing the hilal directly with the naked eye or by using observational instruments. The activity of *rukyah al-hilal* is carried out at the time just before sunset for the first time or at the beginning of sunset approaching *ijtima'* (at this time the position of the moon is on the western horizon and the moon sets shortly after sunset). If the hilal is observed, then at the local evening/maghrib time it has already entered the first date of the new month (Furqon Ahsani & Fitia Maliha, 2021).

Determining the beginning of the month in the Hijri calendar plays a vital role in various Islamic religious observances, such as the Ramadan fast, Eid al-Fitr, and Eid al-Adha. *Ḥisāb* (calculation method) and *rukyat* (observational method) are two popular approaches among Islamic astronomy scholars in Indonesia (Anaam, 2024). The accuracy of determining the beginning of the Hijri month is very important because it has direct implications for the validity of worship from a *shar'i* perspective. Therefore, studies on the methods and mechanisms of determining the beginning of the Hijri month continue to be a major concern in the discipline of Ilmu Falak. The determination of the beginning of the Islamic month is always associated with the methods of *hisab* and *rukyat*. Both are very important for Muslims because they are used to determine the beginning of the lunar months, especially Ramadan, Shawwal, and Dhu al-Hijjah, which are related to the observance of fasting and pilgrimage (Isroqunnajah et al., 2022). The *hisab* method is based on astronomical calculations regarding the positions of the sun and the moon, while *rukyat* is carried out through direct observation of the appearance of the hilal after the occurrence of *ijtima'*. These two methods are not contradictory to each other but rather complement one another in providing certainty regarding the beginning of worship times. *Hisab* provides accurate scientific predictions, while *rukyat* functions as empirical verification of the calculation results. In the traditional context, the determination of the beginning of the Hijri month, including Shawwal, is often carried out through the *rukyat* method (direct observation of the hilal) or *hisab* (astronomical calculations) (Bagus Pratama & Sukma, 2025). With an understanding of the methods of *hisab*, *rukyat*, and the criteria of *imkanur rukyat*, students are able to perform religious practices in accordance with Islamic law while utilizing developments in science (Cholis et al., 2024).

In the Hijri calendar system, the beginning of the month (*new moon*) is marked by the appearance of the first crescent after the occurrence of *ijtima'* (conjunction). At this phase, the moon sets shortly after sunset, so the position of the hilal is near the western horizon at sunset (Khasan et al., 2024). Hilal observations have been recorded since the 5th century STU by ancient Babylonian astronomers, which were conducted at sunset at certain times without the aid of optical instruments (Rohmah, 2018). Hilal observation has a strategic role because it connects astronomical theory with field practice. This activity is not only religious in nature but also scientific, as it involves various astronomical aspects such as lunar elongation, hilal altitude, lunar age, and atmospheric conditions. Ilmu Falak not only studies the theories of *hisab* and *rukyat* but is also directly involved in hilal observation practices. This involvement aims to provide practical experience, sharpen skills, and prepare students to become competent experts in Islamic astronomy (Ashfiya et al., 2025). In the context of higher education, especially in the Ilmu Falak Study Program, hilal observation serves as an applicative learning medium that enables students to understand the concept of determining the beginning of the Hijri month in a comprehensive and contextual manner. Experiential learning approaches, such as hilal observation, are believed to enhance students' conceptual understanding more deeply than learning that is purely theoretical. The determination of the beginning of the lunar month through empirical *rukyatul hilal* is one form of obedience to religious commands by following the Sunnah of the Prophet Muhammad SAW (Khasan et al., 2024). Through direct involvement in the observation process, students can relate abstract concepts in Ilmu Falak to real astronomical phenomena. This is in line with the objectives of Ilmu Falak education, which emphasize not only mastery of theory but also practical skills and scientific analytical abilities.

Nevertheless, in practice, the effectiveness of hilal observation activities as a learning medium still needs to be systematically examined. Differences in students' levels of understanding after participating in observation activities indicate variations in learning outcomes. Therefore, a scientific evaluation is needed to determine the extent to which hilal

observation activities contribute to improving students' understanding of the determination of the beginning of the Hijri month. Based on this background, this study aims to analyze the effectiveness of hilal observation activities in enhancing students' understanding, particularly among students of the Ilmu Falak Study Program.

Literature Review

This literature review is prepared to provide a strong theoretical and empirical foundation related to the study of determining the beginning of the Hijri month and its relevance to the development of learning in Ilmu Falak. The discussion is focused on five main aspects, namely: (1) the concept of the Hijri calendar from Islamic and astronomical perspectives, (2) the *shar'i* and scientific foundations of hilal observation, (3) the development of contemporary *hisab* and *rukyat* methods, (4) the learning of Ilmu Falak in higher education, and (5) the contribution of observation activities in improving students' understanding.

First, the Hijri calendar is a lunar-based calendrical system used by Muslims as a reference for the performance of religious worship. A calendar is a system of organization used to calculate time within a certain period (Rofiuddin, 2019). In various pieces of literature, the term calendar is commonly referred to as *tarikh*, *takwim*, *almanak*, and *penanggalan*, which in principle have the same meaning (Isfihani, 2023). This calendar has a purely lunar characteristic, in which the beginning of the month is determined by the appearance of the hilal after the occurrence of *ijtima'*. In falak studies, the Hijri calendar is not only understood as a time system but also as a scientific construction involving astronomical, fiqh, and socio-religious aspects. Several studies emphasize that the accuracy of determining the beginning of the Hijri month is highly dependent on an understanding of the dynamics of the motions of the moon and the sun as well as the criteria for hilal visibility. Second, hilal observation has a strong normative basis in Islamic teachings, as stated in the hadith of the Prophet that instructs *rukyat* as the basis for determining the beginning of Ramadan and Shawwal. In addition, hilal observation also has scientific value because it involves the observation of astronomical phenomena influenced by geometric and atmospheric factors. Modern astronomical studies show that hilal visibility is influenced by the altitude of the moon, elongation, lunar age, and sky conditions at the time of observation. Therefore, hilal observation becomes a meeting point between the *shar'i* approach and modern science.

Third, the methods of *hisab* and *rukyat* have experienced significant development along with advances in science and technology. Modern *hisab* utilizes high-precision astronomical data that allow accurate prediction of the moon's position, while *rukyat* is maintained as a method of empirical verification. Several falak scholars emphasize the importance of integrating *hisab* and *rukyat* to produce a more comprehensive and widely acceptable determination of the beginning of the month. This integrative approach is also in line with the principle of precaution (*iḥtiyāṭ*) in Islamic law. Fourth, learning Ilmu Falak in higher education requires mastery of both theory and field practice. Practice-based learning models are considered effective in improving students' conceptual understanding. Astronomical observation activities, including *rukyat* of the hilal, provide direct experience that can strengthen the relationship between theoretical concepts and empirical reality. Research in the field of science education shows that experiential learning is able to significantly enhance students' critical thinking skills and conceptual understanding.

Finally, the contribution of hilal observation to students' understanding can be seen from the improvement in their astronomical analytical abilities and their understanding of fiqh falak. Through direct involvement in observation activities, students not only understand theory textually but are also able to relate it to real natural phenomena. Several studies conclude that field practice activities such as hilal observation play an important role in shaping scientific

attitudes, accuracy, and awareness of the integration between science and religion in the study of Ilmu Falak.

Method

This study employs a descriptive quantitative approach, which aims to describe and systematically analyze the effectiveness of hilal observation activities in improving students' understanding of the determination of the beginning of the Hijri month. The descriptive quantitative approach is chosen because this study does not aim to test cause-and-effect hypotheses, but rather to describe conditions, tendencies, and levels of students' understanding based on numerical data obtained from the research instrument in the form of a questionnaire. Quantitative data are considered capable of providing an objective overview of students' perceptions and understanding after participating in hilal observation activities. The subjects of this study are 30 students of the Ilmu Falak Study Program who have participated directly in hilal observation activities. The selection of research subjects is carried out using the total sampling technique, which is a sampling technique in which all members of the population are used as research samples. This technique is applied because the population size is relatively limited and all students possess characteristics relevant to the research objectives, so it is expected to provide a comprehensive picture of the effectiveness of hilal observation activities in the context of Ilmu Falak learning.

The research instrument used is a closed-ended questionnaire designed based on indicators of students' understanding of the determination of the beginning of the Hijri month. These indicators include conceptual understanding of the hilal and *ijtima'*, understanding of the *hisab* and *rukyat* methods, the ability to relate falak theory to field observation results, and understanding of the role of hilal observation in determining the beginning of the Hijri month. The questionnaire is constructed using a rating scale that allows respondents to provide structured answers according to the level of understanding they perceive after participating in the observation activities. The development of the instrument is aligned with the research objectives so that the data obtained are relevant and can be analyzed quantitatively. Data collection is conducted after students have participated in hilal observation activities, with the aim that respondents already have empirical experience that can serve as a basis for assessing their understanding. The procedure for filling out the questionnaire is carried out directly, accompanied by a brief explanation of the research objectives, so that respondents can provide objective answers in accordance with the conditions they experienced.

The collected data are then analyzed using descriptive statistical techniques. Data analysis includes the construction of frequency distribution tables to examine the distribution of respondents' answers, the presentation of data in the form of diagrams to facilitate visual interpretation, and the calculation of measures of central tendency and data dispersion, such as the mean, median, mode, standard deviation, and variance. The results of the descriptive statistical analysis are used to describe the overall level of students' understanding and to draw conclusions regarding the level of effectiveness of hilal observation activities in improving students' understanding of the determination of the beginning of the Hijri month.

Results and Discussion

Astronomy is one branch of science that has a close relationship with the determination of time, calendars, and religious observances in Islam. One of the most important aspects of Islamic astronomy is the determination of the beginning of the Hijri month. The determination of the beginning of the month is not only related to acts of worship such as fasting during Ramadan and Eid al-Fitr, but also forms part of the Islamic calendar system or the Hijri calendar, which serves

as the basis for time calculation for Muslims. The Hijri calendar is a calendrical system based on the motion of the Moon around the Earth (Ritonga et al., 2024). Therefore, a good understanding of astronomical phenomena related to the phases of the Moon becomes very important, especially for students who study Ilmu Falak. In Indonesia, public literacy in astronomy, particularly regarding the hilal phenomenon, is still relatively low. Many people understand the hilal merely as the "first crescent moon" without knowing the process of its formation, the factors affecting its visibility, and the methods used to determine it. This low level of astronomical literacy can lead to misunderstandings in responding to differences in the determination of the beginning of the Hijri month, which often occur. In this context, the role of educational institutions, especially the Ilmu Falak Study Program, becomes very important in bridging this gap in understanding through theoretical and practical education.

One activity that plays an important role in improving astronomical literacy and students' understanding of the determination of the beginning of the Hijri month is hilal observation. Hilal observation is the process of observing the young crescent moon after the occurrence of ijtima' or conjunction to determine the possibility of the beginning of a new month. Hilal observation is conducted by observing a specific zone in the western sky that has been predicted through hisab calculations (Arkanuddin & Sudibyo, 2015). This activity not only teaches the theory of astronomical calculations (hisab), but also provides direct experience for Ilmu Falak students to observe the differences between calculated predictions and phenomena that occur in the field. Hilal observation activities have high educational value. Through this activity, students can understand that the determination of the beginning of the Hijri month is not merely the result of numerical calculations, but is influenced by various astronomical factors such as the altitude of the hilal, elongation, lunar age, and atmospheric conditions that determine its visibility. By being directly involved in the observation process, students are able to connect the hisab theories learned in the classroom with the more complex realities in the field. This is in line with the experiential learning approach, in which direct practice has been proven to be more effective in improving conceptual understanding. In the context of Ilmu Falak learning, the effectiveness of hilal observation activities can be measured by the increase in students' understanding of the basic concepts of Islamic astronomy, their ability to interpret data on lunar motion, and their skills in applying hisab-rukyat theory in determining the beginning of the Hijri month. Therefore, hilal observation activities become one of the important pillars in Islamic astronomy education and directly support the objectives of the Ilmu Falak Study Program to produce graduates who are competent in both theoretical and practical aspects.

Based on the above description, the effectiveness of hilal observation activities was then analyzed through questionnaire data administered to Ilmu Falak students. The results of the data processing are subsequently presented in the following distribution table to more clearly observe the tendencies of respondents' answers.

Table 1.

Data Value	Frequency (fi)	FR (%)	F.K (<)	F.K (>)
30-32	2	7%	0	30
33-35	1	3%	2	28
36-38	2	7%	3	27
39-41	3	10%	5	25
42-44	3	10%	8	22
45-47	10	33%	11	19
48-50	9	30%	21	9
JUMLAH	30	100%	30	0

Based on the questionnaire data collected from 30 respondents, score grouping was conducted with a class width of 3. The range of scores extended from a minimum score of 30 to a maximum score of 50, resulting in a range of 20. The results of the data processing were then presented in the following frequency distribution table to facilitate the analysis process.

From the distribution table, it can be seen that the 45-47 interval is the class with the highest frequency, consisting of 10 respondents (33%), while the 33-35 interval is the class with the lowest frequency, consisting of 1 respondent (3%). This indicates that most Ilmu Falak students obtained relatively high scores on the questionnaire, which suggests a good level of understanding of hilal observation material and the determination of the beginning of the Hijri month. In addition, the 48-50 interval also shows a fairly high frequency, with 9 respondents (30%), further reinforcing the finding that the majority of participants fall into the category of very good understanding. Meanwhile, the 30-32 and 36-38 interval classes each have the same frequency, namely 2 respondents (7%), indicating that only a small proportion of students obtained low scores.

When viewed from the less-than cumulative frequency (CF <), the cumulative values increase gradually until reaching a total of 30 in the highest class. This pattern indicates a distribution that tends to be skewed toward higher values. Meanwhile, the greater-than cumulative frequency (CF >) shows a consistent decrease from 30 to 0, illustrating a data distribution that is relatively normal but tends to cluster in the upper-middle score range. This data distribution indicates that the effectiveness of hilal observation activities is at a good level, with the majority of students demonstrating strong understanding of *hisab-rukyat* concepts, hilal phenomena, and the process of determining the beginning of the Hijri month. This finding shows that hilal observation activities make a positive contribution to improving Islamic astronomical literacy among Ilmu Falak students. To further clarify the pattern of data distribution, the questionnaire results are subsequently presented in the form of a bar chart.

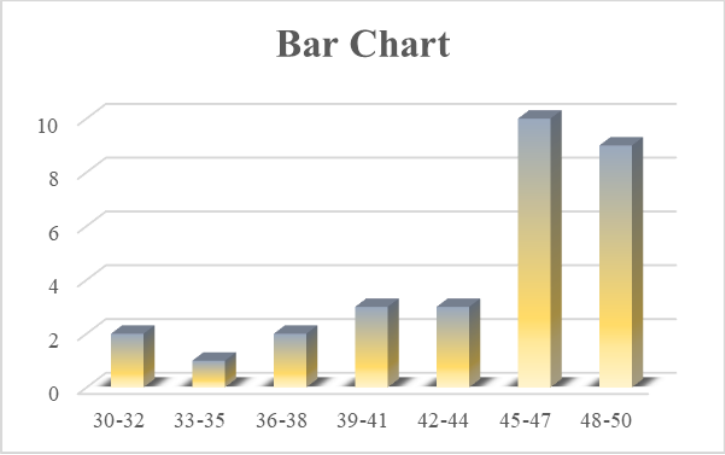

Image 1.

The bar chart constructed from the frequency distribution table illustrates the distribution of students' questionnaire scores regarding the effectiveness of hilal observation activities. In the chart, the X-axis represents the questionnaire score class intervals (30-32, 33-35, 36-38, 39-41, 42-44, 45-47, and 48-50), while the Y-axis represents the number of respondents (frequency) in each interval. Based on the chart, it is evident that the 45-47 interval forms the tallest bar with a frequency of 10 respondents, followed by the 48-50 interval with a frequency of 9 respondents. These two intervals dominate the chart, indicating that most students obtained scores in the good to very good understanding categories. In contrast, the 33-35 interval appears as the lowest bar

with only 1 respondent, while the 30-32 and 36-38 intervals each consist of 2 respondents. The clear difference in bar heights between the higher score intervals and the lower score intervals indicates that the score distribution is not evenly spread but tends to cluster within the middle to higher score ranges.

The pattern becomes more apparent in the bar chart, where most bars are positioned at higher frequencies toward the end of the X-axis. This indicates that hilal observation activities have a positive influence on students' understanding, particularly in aspects of *hisab-rukyat* theory and the determination of the beginning of the Hijri month. Thus, the bar chart visually supports the finding that the majority of students have a good level of understanding after participating in hilal observation activities. In addition, the data presentation is also visualized in the form of a pie chart so that the proportion of each score interval can be seen more clearly.

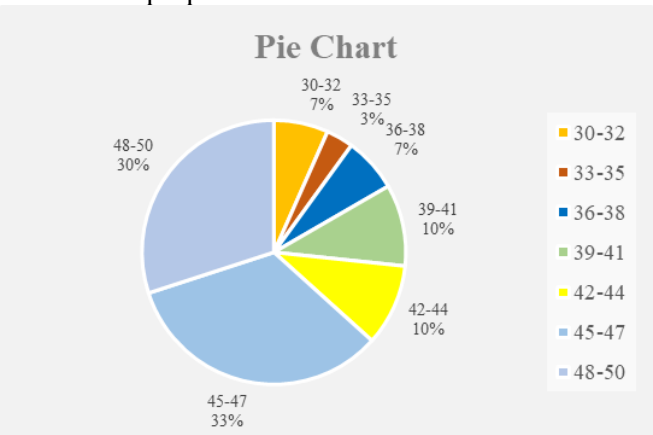

Image 2.

The pie chart presented illustrates the percentage distribution of students' questionnaire scores regarding the effectiveness of hilal observation activities in improving understanding of the determination of the beginning of the Hijri month. Each sector of the pie chart represents the percentage (FR%) of each score class interval. Based on the chart, it can be observed that the largest sector comes from the 45-47 interval with a percentage of 33%, followed by the 48-50 interval with a percentage of 30%. The dominance of these two sectors indicates that most students obtained high scores, reflecting a good to very good level of understanding after participating in hilal observation activities. Meanwhile, the 33-35 interval has the smallest sector with a percentage of only 3%, indicating that only a small number of students fall into the low understanding category. The 30-32 and 36-38 intervals each have a percentage of 7%, which is still relatively small compared to the higher score sectors.

Visually, the pie chart clarifies that the largest proportion of scores is concentrated in the upper-middle range. This indicates that hilal observation activities have a positive impact on students' understanding, as the majority of respondents demonstrate high score achievements. Thus, the pie chart supports the previous findings that hilal observation activities are effective in strengthening students' understanding of Islamic astronomical concepts, particularly in the process of determining the beginning of the Hijri month. In addition to the bar chart and pie chart, the questionnaire data are also visualized in the form of a line chart to more clearly observe trends in score distribution.

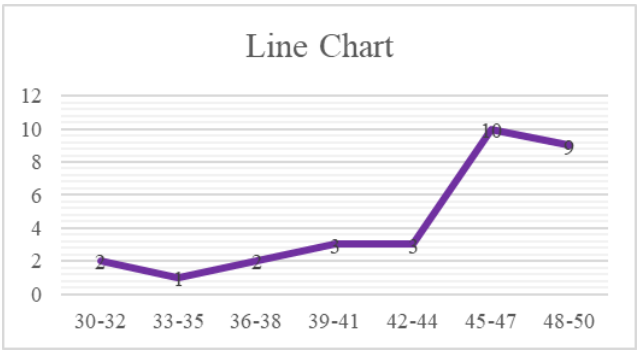

Image 3.

The line chart presented illustrates the pattern of distribution of questionnaire scores among Ilmu Falak students regarding the effectiveness of hilal observation activities in improving understanding of the determination of the beginning of the Hijri month. In this chart, the X-axis represents the score class intervals, while the Y-axis represents the frequency of respondents in each interval. The points on the chart are connected to form a line pattern that shows the upward and downward tendencies of the data distribution. Based on the pattern in the line chart, it can be observed that the frequency values increase significantly in the 45-47 interval, which reaches the highest point with 10 respondents. This point becomes the peak of the graph, indicating that this interval is the group with the highest number of respondents. The line pattern then slightly decreases in the 48-50 interval, although it remains at a high frequency with 9 respondents. Meanwhile, the lowest point occurs in the 33-35 interval with only 1 respondent, followed by the 30-32 and 36-38 intervals with 2 respondents each. The fluctuation of the line in the early part of the graph shows that only a small number of students obtained low scores, while the majority of respondents are in the middle to high score ranges.

Overall, the pattern of the line chart shows a tendency toward increasing frequency in the higher score intervals. This indicates that hilal observation activities have a positive impact on improving students' understanding, as reflected by the dominance of higher scores on the graph. Thus, the line chart supports previous findings that hilal observation activities are effective in strengthening understanding of *hisab-rukyat* concepts and the process of determining the beginning of the Hijri month. To further clarify the distribution of data based on score intervals, the questionnaire results are also presented in the form of a histogram that visually displays the frequency distribution.

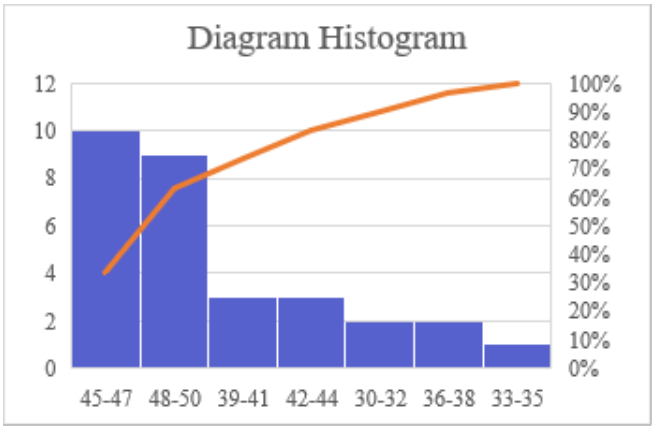

Image 4.

The histogram presented displays the frequency distribution of questionnaire scores of Ilmu Falak students related to the effectiveness of hilal observation activities in improving

understanding of the determination of the beginning of the Hijri month. In this histogram, the X-axis represents the score class intervals, while the Y-axis shows the number of respondents (frequency) in each interval. Each bar in the histogram represents the height of the frequency corresponding to a specific score range.

Based on the histogram, it can be seen that the 45-47 interval forms the bar with the highest frequency, consisting of 10 respondents, indicating that most students fall into the good understanding category. A bar with nearly the same height appears in the 48-50 interval, with a total of 9 respondents, showing that the very good understanding category is also dominated by many students. In contrast, the 33-35 interval displays the lowest bar with only 1 respondent, while the 30-32 and 36-38 intervals each have a frequency of 2 respondents. These low-frequency bars illustrate that only a small number of students obtained low scores on the questionnaire.

Overall, the shape of the histogram shows that the majority of the data are concentrated in the upper-middle class intervals, resulting in a distribution that is skewed toward higher score values. This pattern reinforces previous findings that hilal observation activities make a significant contribution to improving students' understanding, particularly in aspects of *hisab-rukyat* theory, hilal phenomena, and the concept of determining the beginning of the Hijri month. Thus, the histogram further strengthens the conclusion that the effectiveness of hilal observation activities falls within the good to very good category. To provide a more comprehensive overview of the cumulative data distribution, the questionnaire results are also presented in the form of a combined ogive diagram, which simultaneously displays the less-than and greater-than cumulative frequency curves.

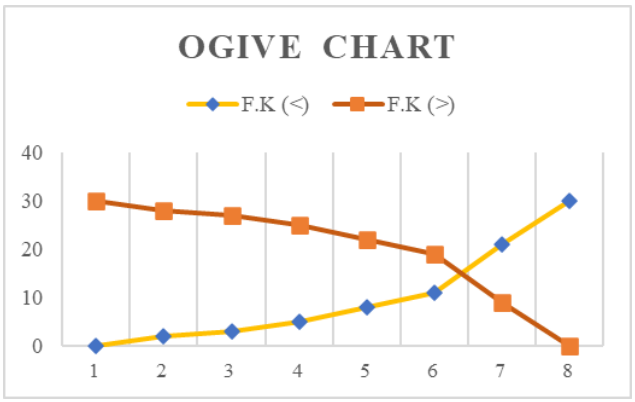

Image 5.

The combined ogive diagram presented illustrates two curves simultaneously, namely the less-than cumulative frequency (C.F. <) curve and the greater-than cumulative frequency (C.F. >) curve. In this graph, the X-axis represents the class intervals of the questionnaire scores, while the Y-axis shows the cumulative frequency for each interval. The combination of these two ogives provides a more comprehensive visualization of the distribution pattern of respondents' scores.

In the less-than cumulative frequency curve, the cumulative values increase gradually, starting from 0 in the 30-32 interval, rising to 2, 3, and 5 in the subsequent intervals, and then increasing more sharply in the 42-44 interval to reach 8. The curve further rises to 11 in the 45-47 interval and reaches its maximum at the 48-50 interval with a value of 30, which represents the total number of respondents. Meanwhile, the greater-than cumulative frequency curve shows an opposite pattern, beginning at 30 in the highest interval (48-50) and decreasing steadily to 19, 11, 8, 5, 3, and finally reaching 0 in the lowest interval (30-32). This systematic decline indicates

that most of the data are concentrated in the higher score intervals, reflecting a predominance of respondents within the good to very good comprehension categories.

When both curves are combined, the ogive forms a complementary pattern. The less-than cumulative frequency curve illustrates an upward trend toward higher values, while the greater-than cumulative frequency curve depicts a downward trend from the highest to the lowest values. This visualization clearly shows that the data distribution is skewed toward higher scores, meaning that the majority of students achieved scores classified as high. Therefore, the combined ogive reinforces the finding that hilal observation activities are effective in enhancing students' understanding of the determination of the beginning of the Hijri month. The dominance of scores in the upper intervals indicates the success of the activity in providing a deeper understanding of Islamic astronomical concepts.

Table 2.

Data Value	*f*i	Xi	*f*iXi	Fi
30-32	2	31	62	2
33-35	1	34	34	3
36-38	2	37	74	5
39-41	3	40	120	8
42-44	3	43	129	11
45-47	10	46	460	21
48-50	9	49	441	30
JUMLAH	30	280	1320	

1. MEAN (Rata-rata)

Rumus:

$$\bar{X} = \frac{\sum f_i X_i}{\sum f_i}$$

Diketahui:

$\sum f_i X_i - 1320, \sum f_i - 30$

Maka:

$$\bar{X} = \frac{1320}{30} = 44$$

Mean = 44

2. MEDIAN (Me)

Menggunakan rumus median data berkelompok:

$$Me = B_{me} + p\left(\frac{\frac{n}{2} - F_{me}}{f_{me}}\right)$$

Maka:

$$Me = 44{,}5 + 3\left(\frac{\frac{30}{2} - 11}{10}\right) = 45{,}7$$

Median = 45,7

3. **MODUS (Mo)**
   Menggunakan rumus modus data berkelompok:

$$Mo = B_{mo} + p\left(\frac{b_1}{b_1 + b_2}\right)$$

Maka:

$$Mo = 44{,}5 + 3\left(\frac{7}{7+1}\right) = 47{,}12$$

Modus = 47,12

Based on the results of the questionnaire data analysis on the Effectiveness of Hilal Observation Activities in Enhancing Students' Understanding of the Determination of the Beginning of the Hijri Month, measures of central tendency namely the mean, median, and mode were calculated to identify the general tendency of respondents' scores.

First, the mean value was obtained by dividing the total sum of the products of frequency and class midpoints by the total number of respondents. The calculation resulted in a mean score of 44. This value indicates that, on average, students' level of understanding of hilal observation activities falls within the high category. This average is further supported by the dominance of scores in the 45-47 and 48-50 intervals, which have the highest frequencies.

Next, the median value was calculated to determine the midpoint of the data distribution. The median was found in the 45-47 class interval, with a calculated value of 45.7. This result indicates that 50% of students scored below 45.7, while the remaining 50% scored above it. Therefore, the median located in the high-score interval confirms that the majority of students achieved a good level of understanding after participating in the hilal observation activities.

The mode, which represents the most frequently occurring value in the data distribution, was also found in the 45-47 interval, with a calculated value of 47.12. This mode indicates that the most dominant group consists of students with a very good level of understanding. This finding is consistent with the high number of respondents in this interval, totaling 10 students.

Overall, all three measures of central tendency mean, median, and mode consistently indicate a tendency toward high scores. This suggests that hilal observation activities contribute positively to enhancing students' understanding of the process of determining the beginning of the Hijri month. The upward tendency of the data further strengthens the conclusion that these activities are effective as a learning medium in Islamic astronomy.

Table 3.

Xi	*fi*	Xi - 44	$(Xi - 44)^2$	$fi \times (Xi - 44)^2$
31	2	-13	169	338
34	1	-10	100	100
37	2	-7	49	98
40	3	-4	16	48

43	3	-1	1	3
46	10	2	4	40
49	9	5	25	225
Jumlah	**30**			**852**

Perhitungan menggunakan rumus simpangan baku data berkelompok untuk sampel:

$$S = \sqrt{\frac{\sum f_i (X_i - \bar{X})^2}{f_i - 1}}$$

$$S = \sqrt{\frac{852}{30-1}} = 5{,}41$$

Perhitungan menggunakan rumus variansi data berkelompok untuk sampel:

$$S^2 = \frac{\sum f_i (X_i - \bar{X})^2}{f_i - 1}$$

$$S^2 = \frac{852}{30-1} = 29{,}3$$

To determine the level of dispersion of students' questionnaire scores regarding the effectiveness of hilal observation activities, the standard deviation was calculated. Based on the results, the standard deviation was found to be 5.41. This value indicates that the data dispersion falls within the low to moderate category, meaning that the differences in scores among respondents are not far from the mean value (mean = 44). This relatively small standard deviation suggests that most students provided consistent assessments of the hilal observation activities. In other words, students' understanding of the determination of the beginning of the Hijri month after participating in the hilal observation activities tends to be uniform and stable. This finding reinforces the previous results indicating that hilal observation activities offer an effective learning experience for the majority of respondents.

In addition to the standard deviation, the analysis also included the calculation of variance as another measure of data dispersion. Based on the previous calculation, the variance value was 29.3. This variance reflects the degree of variability in respondents' questionnaire scores regarding the effectiveness of hilal observation activities. A relatively small variance indicates that the scores given by students are not widely spread from the mean value. In other words, students tend to provide relatively similar evaluations of the effectiveness of hilal observation activities. This consistency further strengthens the conclusion that hilal observation activities have a uniform and positive impact on improving students' understanding of the determination of the beginning of the Hijri month.

Conclusion

Based on the results of the statistical analysis of the questionnaire data titled *"The Effectiveness of Hilal Observation Activities in Improving Students' Understanding of the Determination of the Beginning of the Hijri Month,"* it can be concluded that hilal observation activities have a significant influence on improving students' understanding. This is indicated by the mean value of 44, which shows that most respondents provided assessments within the good to very good categories. The standard deviation of 5.41 and the variance of 29.3 indicate that the data dispersion is relatively low, suggesting that students' assessments tend to be consistent and do not differ greatly from one respondent to another. The concentration of scores in the high category strengthens the conclusion that hilal observation activities contribute positively to enhancing students' knowledge of Islamic astronomy concepts, particularly in the determination of the beginning of the Hijri month. In other words, these observation activities not only provide direct experience in observing celestial objects but also improve students' ability to understand both the theoretical and practical aspects of *hisab* and *rukyat* more deeply. Overall, hilal observation activities can be considered effective, as evidenced by the tendency toward high scores, the consistency of students' assessments, and the stable data distribution. These findings indicate that observation-based learning methods are highly relevant to be applied in the educational process of Islamic Astronomy (*Ilmu Falak*).

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