Al-Hilal: Journal of Islamic Astronomy
Vol. 08, No. 02, October 2026: 151-170
DOI: 10.21580/al-hilal.2026.8.2.32865
ISSN: 2775-1236 (printed); 2775-2119 (online)

Understanding the Unified Global Hijri Calendar: Conceptual Knowledge and Astronomical Criteria among Islamic Studies Students

Abu Yazid Raisal[1*], Muhammad Hidayat[2], Oktrigana Wirian[3], Marataon Ritonga[4], Ahmad Hariz Bely[5]

[1, 2, 3, 4] Universitas Muhammadiyah Sumatera Utara, Indonesia
[5] Universiti Sultan Zainal Abidin, Malaysia
* Corresponding Author, Email: abuyazidraisal@umsu.ac.id

Submitted: 19-06-2026 | *Revised: 30-09-2026* | *Accepted: 01-10-2026* | *Published: 25-10-2026*

Abstract

The Unified Global Hijri Calendar (Kalender Hijriah Global Tunggal/KHGT) proposes a framework to unify the global Islamic calendar and requires understanding its principles, implementation requirements, and astronomical criteria. This study maps students' baseline knowledge of the KHGT and compares their performance across these three domains. A descriptive quantitative design involved all 54 sixth-semester students in the Faculty of Islamic Studies at Universitas Muhammadiyah Sumatera Utara, Indonesia. We collected data on April 4-6, 2026, before formal classroom instruction, using a 15-item true/false KHGT instrument. The overall mean correct-response rate was 69.01%. Performance was highest in principles (75.56%), followed by requirements (72.96%), while astronomical criteria received the lowest score (58.52%). The difference between the principles and astronomical criteria scores was 17.04 percentage points. These findings indicate uneven baseline knowledge across KHGT domains, particularly regarding astronomical criteria. However, given the binary response format and the low reliability of some subscales, the results should be interpreted as an initial descriptive assessment rather than definitive evidence of a conceptual–technical knowledge gap.

Keywords: KHGT, astronomical criteria, university students, educational assessment

***

Kalender Hijriah Global Tunggal (KHGT) menawarkan kerangka penyatuan kalender Islam secara global yang menuntut pemahaman tentang prinsip, ketentuan penerapan, dan kriteria astronomis. Penelitian ini bertujuan memetakan pengetahuan awal mahasiswa mengenai KHGT dan membandingkan pemahaman mereka pada ketiga domain tersebut. Penelitian ini menggunakan pendekatan kuantitatif deskriptif dengan melibatkan seluruh 54 mahasiswa semester enam Fakultas Agama Islam Universitas Muhammadiyah Sumatera Utara. Data dikumpulkan pada 4–6 April 2026, sebelum pembelajaran formal khusus mengenai KHGT, menggunakan instrumen benar-salah sebanyak 15 butir. Hasil menunjukkan rata-rata jawaban benar sebesar 69,01%. Skor tertinggi terdapat pada domain prinsip (75,56%), diikuti ketentuan (72,96%), sedangkan kriteria astronomis memperoleh skor terendah (58,52%). Selisih antara skor prinsip dan kriteria astronomis mencapai 17,04 poin persentase. Temuan ini menunjukkan bahwa pengetahuan awal mahasiswa belum merata di seluruh domain KHGT, terutama terkait kriteria astronomis. Namun, karena instrumen menggunakan format benar-salah dan beberapa subskala memiliki reliabilitas rendah, hasil ini perlu dipahami sebagai pemetaan deskriptif awal, bukan sebagai bukti definitif adanya kesenjangan pengetahuan konseptual dan teknis.

Kata Kunci: KHGT, kriteria astronomis, mahasiswa, asesmen pendidikan

Copyright © 2026 Al-Hilal: Journal of Islamic Astronomy

To cite this article (Chicago Manual of Style 17th Edition Full-Note):
Abu Yazid Raisal, et al., "Understanding the Unified Global Hijri Calendar: Conceptual Knowledge and Astronomical Criteria among Islamic Studies Students", *Al-Hilal: Journal of Islamic Astronomy*, Vol. 8, No. 2 (2026): 151-170.

A. Introduction

The Hijri calendar plays a central role in Muslim religious life, providing the temporal framework for determining important occasions such as Ramadan, Eid al-Fitr, and Eid al-Adha. Nevertheless, Muslim communities and authorities still debate the start of Hijri months. Differences in astronomical calculation (*ḥisāb*), crescent observation (*ru'yah*), and the criteria used to establish the beginning of a month have led to divergent calendar practices. These differences raise a broader question: can a unified Hijri calendar be established and applied across national boundaries? A unified calendar is not merely an astronomical undertaking; it also involves religious interpretation, technical decision-making, and institutional coordination. The challenge, therefore, concerns not only the formulation of a calendar system but also the understanding of the principles and astronomical rules on which that system is based.[1]

One prominent initiative in this regard is the Unified Global Hijri Calendar (Kalender Hijriah Global Tunggal, KHGT), which seeks to establish a common calendar for Muslims worldwide. The initiative stems from the International Hijri Calendar Unity Congress held in Istanbul in 2016 and has since become a key reference in Muhammadiyah's efforts to promote calendar unification.[2] The KHGT combines overarching principles, operational requirements, and astronomical criteria intended to determine the beginning of a new Hijri month and support the calendar's global application. Its implementation therefore requires more than general awareness of the idea of calendar unification. A meaningful understanding also requires distinguishing the calendar's underlying principles from the requirements governing its global application and the astronomical parameters used to determine the beginning of a month. Although these dimensions are interconnected, they involve different forms of knowledge.[3] This distinction raises an important educational question: to what extent do students understand both the conceptual foundations and the specific astronomical provisions of the KHGT?

---

[1] Arwin Juli Rakhmadi and Muhammad Hidayat, "The Issues and Prospects of the Global Islamic Calendar," in *Proceedings of the International Conference on Community Development (ICCD 2020)* (Paris, France: Atlantis Press, 2020), 109–12, https://doi.org/10.2991/assehr.k.201017.025; Abdul Mufid, "Unification of Global Hijrah Calendar In Indonesia: An Effort To Preserve The Maqasid Sunnah of The Prophet (SAW)," *Journal of Islamic Thought and Civilization* 10, no. 2 (November 25, 2020): 18–36, https://doi.org/10.32350/jitc.102.02; Marwadi Marwadi, "Renewing the Thoughts of the Hijri Calendar of Muhammadiyah, Nahdlatul Ulama and Persatuan Islam and Its Implications for Realization of National Hijri Calendar," *Al-Manahij: Jurnal Kajian Hukum Islam* 15, no. 1 (June 14, 2021): 19–36, https://doi.org/10.24090/mnh.v15i1.4870; Ahmad Adib Rofiuddin, Mahsun Mahsun, and Arifana Nur Kholiq, "State Authority and Religious Contestation: Resistance to Governmental Decisions on Islamic Calendar Determination in Indonesia," *Fikri : Jurnal Kajian Agama, Sosial Dan Budaya* 10, no. 1 (July 3, 2025): 250–63, https://doi.org/10.25217/jf.v10i1.5159.

[2] Muhammad Qorib and Arwin Juli Rakhmadi, "Tolerance and Moderation in the Formulation of A Global Islamic Calendar," *Al-Fikru: Jurnal Ilmiah* 17, no. 2 (December 30, 2023): 343–57, https://doi.org/10.51672/alfikru.v17i2.291; Susiknan Azhari, "Global Islamic Calendar Challenge in Era Industrial Revolution 4.0," *Jurnal Fiqh* 18, no. 1 (June 24, 2021): 117–34, https://doi.org/10.22452/fiqh.vol18no1.4.

[3] Muhammad Hidayat et al., "Problem and Solutions for Accepting a Single Global Islamic Calendar," *Journal of Law and Governance* 7, no. 1 (2024): 63–72; Suara Muhammadiyah, "Muhammadiyah Resmi Luncurkan KHGT, Jalan Menuju Kesatuan Umat," suaramuhammadiyah.id, 2025, https://www.suaramuhammadiyah.id/read/muhammadiyah-resmi-luncurkan-khgt-jalan-menuju-kesatuan-umat; Muhammad Hidayat et al., "Peningkatan Pemahaman Kalender Hijriah Global Tunggal Kepada Warga Muhammadiyah Cabang Medan Helvetia," *Ihsan: Jurnal Pengabdian Masyarakat* 6, no. 1 (April 9, 2024): 86–92, https://doi.org/10.30596/ihsan.v6i1.19118.

Islamic Studies students are a relevant group for examining this question because their academic backgrounds connect religious interpretation to Islamic legal and institutional practices. This study focuses on sixth-semester students in the Faculty of Islamic Studies at Universitas Muhammadiyah Sumatera Utara (UMSU), an institution within the Muhammadiyah educational environment. This setting makes the KHGT a relevant subject of investigation, and the students' academic stage offers an opportunity to assess their existing knowledge before they receive formal instruction specifically on the calendar. Establishing this baseline is important because familiarity with the general goal of calendar unification does not necessarily mean students understand its operational provisions accurately. They may recognize the calendar's broad principles but have difficulty interpreting its requirements or applying its astronomical criteria. Assessing their responses across these dimensions can help identify areas of relative strength and weakness in their existing knowledge. However, the assessment should be understood as an examination of students' responses, not as a direct measure of educational effectiveness or an explanation of the causes of any difficulties identified.

Previous research on the KHGT has examined its normative and astronomical foundations, institutional adoption, and implications for calendar unification.[4] Empirical research has also investigated public awareness, understanding, acceptance, and readiness to adopt the KHGT. For example, Fikri and Anas (2025) surveyed 300 respondents and found generally high levels of awareness, understanding, acceptance, and readiness, although their sample was dominated by Muhammadiyah respondents.[5] Educational outreach research has also explored efforts to improve understanding of the KHGT among Muhammadiyah communities.[6] In the broader field of astronomy education, researchers have used diagnostic instruments to identify misconceptions and difficulties in understanding astronomical concepts.[7] These studies provide useful foundations for investigating knowledge of the KHGT, but their primary emphases differ from the present study. In particular, further evidence is needed on how students in Islamic higher education respond to the distinct components of the KHGT before receiving formal instruction specifically focused on the calendar. An item-level assessment of its principles, requirements, and astronomical criteria can provide a more differentiated picture of students' knowledge than a general measure of awareness, acceptance, or readiness. Accordingly, the research gap addressed here is not the absence of empirical research on public understanding of the KHGT, but the need for a more focused assessment of students' knowledge across these three domains.

---

[4] Qorib and Rakhmadi, "Tolerance and Moderation in the Formulation of A Global Islamic Calendar"; Azhari, "Global Islamic Calendar Challenge in Era Industrial Revolution 4.0"; Samia Loucif et al., "Toward a Globally Lunar Calendar: A Machine Learning-Driven Approach for Crescent Moon Visibility Prediction," *Journal of Big Data* 11, no. 1 (August 12, 2024): 114, https://doi.org/10.1186/s40537-024-00979-6.

[5] Mursyid Fikri and Muh Fauzi Anas, "From Awareness to Acceptance: Quantitative Evidence on the Public Readiness Toward the Global Unified Hijri Calendar," *Hikmatuna : Journal for Integrative Islamic Studies* 11, no. 2 (December 2, 2025): 118–46, https://doi.org/10.28918/hikmatuna.v11i2.12259.

[6] Hidayat et al., "Problem and Solutions for Accepting a Single Global Islamic Calendar."

[7] Uygar Kanli, "A Study on Identifying the Misconceptions of Pre-Service and In-Service Teachers about Basic Astronomy Concepts," *Eurasia: Journal of Mathematics, Science and Technology Education* 10, no. 5 (December 15, 2014): 471–79, https://doi.org/10.12973/eurasia.2014.1120a; Winny Liliawati, "Identification Of Astronomic Misconceptions In Students With Confidence Discrimination Quotient Analysis Techniques," *Jurnal Pengajaran Matematika Dan Ilmu Pengetahuan Alam* 26, no. 2 (October 29, 2021): 1–7, https://doi.org/10.18269/jpmipa.v26i2.48784; Loucif et al., "Toward a Globally Lunar Calendar: A Machine Learning-Driven Approach for Crescent Moon Visibility Prediction."

Accordingly, this study assesses KHGT knowledge among 54 sixth-semester Islamic Studies students at UMSU before formal instruction, with a focus on the calendar. Using a 15-item true-or-false questionnaire, it examines three domains: KHGT principles, requirements, and astronomical criteria. The analysis considers overall response patterns, domain-level performance, and item-level differences to identify which aspects appear relatively well understood and which warrant further clarification. By comparing performance across the three domains, the study provides an exploratory account of students' existing knowledge and identifies specific provisions that may require greater attention in teaching and learning. Its contribution lies in offering a differentiated, pre-instruction assessment of KHGT knowledge within a particular Islamic higher education context. The findings are not intended to establish causal explanations for students' responses, demonstrate a validated distinction between conceptual and technical knowledge, or represent all Islamic Studies students. Rather, they provide an empirical starting point for developing more focused educational interventions and for informing subsequent research using larger samples, more comprehensive diagnostic instruments, and designs capable of examining changes in knowledge over time.

B. Method

This study employed a descriptive quantitative design to assess students' knowledge of the Unified Global Hijri Calendar (KHGT). The participants were 54 sixth-semester students from the Faculty of Islamic Studies at Universitas Muhammadiyah Sumatera Utara (UMSU). The study used a census approach because all students in the cohort participated. The assessment was conducted before formal instruction and addressed the KHGT, providing a baseline description of students' existing knowledge rather than measuring learning outcomes after instruction.

Data were collected using a 15-item true-or-false questionnaire covering three domains: KHGT principles, requirements, and astronomical criteria, with five items assigned to each domain. The items were developed by the research team based on KHGT provisions. To assess content validity, two lecturers specializing in Islamic astronomy reviewed the items using a binary judgment format (1 = appropriate; 0 = not appropriate). Both reviewers judged all 15 items to be appropriate, and their suggested revisions were incorporated into the questionnaire. Although the reviewers agreed on the suitability of all items, this process represents expert-based content review rather than comprehensive validation of the instrument's construct validity. The internal consistency of the dichotomously scored instrument was evaluated using the Kuder–Richardson Formula 20 (KR-20), an appropriate coefficient for assessing the internal consistency of tests with binary-scored items.[8] The overall KR-20 coefficient was 0.71, while the coefficients for the principles, requirements, and criteria subscales were 0.31, 0.56, and 0.27, respectively. These relatively low subscale coefficients indicate that domain-level results require cautious interpretation.

Data collection took place on April 4-6, 2026, and included explaining the study to participants, administering the questionnaire, and compiling responses. Participants were

[8] Pasquale Anselmi, Daiana Colledani, and Egidio Robusto, "A Comparison of Classical and Modern Measures of Internal Consistency," *Frontiers in Psychology* 10 (December 4, 2019): 1–12, https://doi.org/10.3389/fpsyg.2019.02714.

informed about the study and agreed to participate. Each correct answer was scored 1, and each incorrect answer was scored 0. The percentage of correct responses was calculated by dividing the number of correct answers by the total number of responses and multiplying by 100. Overall, domain-level, and item-level results were summarized using descriptive statistics, including the mean, median, standard deviation, minimum and maximum scores, and percentages of correct responses. Overall scores were also classified into five categories: very high (85–100%), high (70–less than 85%), sufficient (55–less than 70%), low (40–less than 55%), and very low (below 40%).

A guessing-corrected score was calculated as a supplementary analysis to examine how random responses might affect the results. Following the formula-scoring approach discussed by Frary (1988), we calculated the corrected score as (S=R-W/(k-1)), where (R) is the number of correct answers, (W) the number of incorrect answers, and (k) the number of response options per item.[9] Because the questionnaire used two response options and all items were answered, the corrected score was calculated as the number of correct answers minus the number of incorrect answers. Corrected scores were treated as supplementary estimates rather than definitive measures of knowledge because formula scoring relies on assumptions about respondents' guessing behavior.

The analysis was intended to describe response patterns and identify specific KHGT provisions that may warrant further educational attention. Given the descriptive design, the single-institution sample, and the relatively low internal consistency of the domain-level scores, the findings were not interpreted as evidence of causal relationships or as validation of separate conceptual and technical knowledge constructs. No institutional ethics approval or formal ethics exemption was obtained for this study.

C. Result and Discussion

1. Overall Knowledge of the KHGT: A Baseline Assessment

The assessment of 54 sixth-semester students at the Faculty of Islamic Studies, Universitas Muhammadiyah Sumatera Utara (UMSU), provides a baseline overview of their knowledge of the Unified Global Hijri Calendar (KHGT) before formal instruction on this calendar system. The students obtained a mean score of 69.01%, with a median of 70.00% and a standard deviation of 19.56 percentage points. Individual scores ranged from 26.67% to 93.33%, indicating substantial variation in performance within the cohort. Although the mean score was close to the high-category threshold, the wide range suggests students did not enter the assessment with a uniform level of knowledge. These results describe performance on the instrument used in this study and should not be interpreted as a comprehensive measure of students' mastery of the KHGT.

The distribution of students across the five score categories provides a more detailed picture of this variation. As shown in Table 1, 18 students (33.33%) were classified in the very high category, while nine (16.67%) fell into the high category. Together, these groups comprised 27 students, or 50% of the cohort. The remaining 27 students (50%) were classified as having

[9] Robert B. Frary, "Formula Scoring of Multiple-Choice Tests (Correction for Guessing)," *Educational Measurement: Issues and Practice* 7, no. 2 (June 25, 1988): 33–38, https://doi.org/10.1111/j.1745-3992.1988.tb00434.x.

sufficient, low, or very low scores. Within this group, 13 students (24.07%) were in the sufficient category, nine (16.67%) in the low category, and five (9.26%) in the very low category. Thus, while half of the participants achieved scores in the high or very high categories, approximately one-quarter (25.93%) were in the low or very low categories. The distribution points to differences in students' demonstrated knowledge that are not fully captured by the mean score alone.

Table 1. Distribution of students by overall KHGT knowledge score

Score Category	Score Range (%)	Number of Students	Percentage (%)
Very High	85 - 100	18	33.33
High	70 ≤ 85	9	16.67
Sufficient	55 ≤70	13	24.07
Low	40 ≤ 55	9	16.67
Very Low	< 40	5	9.26
Total		54	100

Source: Authors' analysis of questionnaire data.

The overall results require cautious interpretation because the instrument consisted of 15 true-or-false items. With only two response options per item, a correct response may reflect either knowledge or a successful guess. To examine this limitation, the study also calculated a guessing-corrected score using the formula-scoring approach described by Frary (1988).[10] The mean raw score of 69.01% corresponded to a mean guessing-corrected score of 38.02%. This difference shows how accounting for random responses changes the numerical interpretation of performance. However, the corrected score should not be treated as a definitive estimate of students' actual knowledge, because formula scoring depends on assumptions about guessing behavior and does not identify whether an individual answer resulted from knowledge or chance.

Taken together, the raw scores provide an initial description of students' performance, while the score distribution and guessing-corrected results highlight the need to avoid interpreting the overall mean as evidence of uniformly strong understanding of the KHGT. The findings are best regarded as a baseline assessment of performance among one cohort at one institution. They do not establish why students obtained particular scores, whether their responses reflect stable misconceptions, or how their knowledge might change following instruction. To understand the specific pattern underlying the overall results, the following subsection compares performance across the three assessed domains: KHGT principles, requirements, and astronomical criteria.

2. Differences across KHGT Knowledge Domains: Principles, Requirements, and Astronomical Criteria

The overall score provides a general picture of students' performance but does not indicate whether their knowledge was evenly distributed across the components of the Unified Global Hijri Calendar (KHGT). As shown in Table 2 below, mean scores varied across the three assessed

[10] Frary.

domains. Students achieved the highest mean in KHGT principles (75.56%), followed by requirements (72.96%), with astronomical criteria receiving the lowest mean (58.52%). The difference between principles and criteria was 17.04 percentage points, whereas the difference between requirements and criteria was 14.44 percentage points. By comparison, the difference between principles and requirements was only 2.60 percentage points. This pattern indicates that performance on the criteria items was lower than on the other two domains. However, because each domain consisted of only five true-or-false items, these differences should be interpreted as descriptive patterns in the responses rather than definitive evidence of distinct levels of conceptual and technical competence.

Table 2. Descriptive statistics of students' scores across KHGT knowledge domains (N = 54)

Statistic	Principles	Requirements	Astronomical Criteria
Mumber of items	5	5	5
Mean (%)	75.56	72.96	58.52
Median (%)	80	80	60
Standard deviation	20.80	26.40	24.22
Minimum (%)	40.00	0.00	0.00
Maximum (%)	100	100	100
Guessing-corrected mean (%)	51.11	45.93	17.04

Source: Authors' analysis of questionnaire data.

The relatively higher score for KHGT principles suggests that students answered the items addressing the calendar's foundational provisions more successfully than those addressing its astronomical criteria. These principles include using *ḥisāb* to determine the beginning of the month and applying a unified calendar worldwide. Nevertheless, the mean score of 75.56% should not be interpreted as evidence that students had mastered all the principles. The standard deviation of 20.80 percentage points and the score range of 40–100% indicate variation in individual performance. Moreover, a domain mean can conceal differences between specific items: a high proportion of correct answers on one principle does not necessarily imply equally strong understanding of every other principle. The item-level findings discussed in the following subsection are therefore necessary to identify which provisions were more readily understood and which remained challenging.

The requirements domain produced a mean score of 72.96%, only 2.60 percentage points below the principles domain. Its median was also 80%, suggesting similar central tendencies in these two domains. However, the requirements domain had the largest standard deviation (26.40 percentage points) and included scores ranging from 0 to 100%. This dispersion indicates considerable heterogeneity in students' performance on the five items concerning the conditions that an Islamic calendar must satisfy. Consequently, the relatively high mean should not obscure the fact that some students answered few or none of the items correctly, while others answered all five correctly. The results provide a descriptive indication of students' responses to the KHGT requirements, but they do not establish whether the variation arose from differences in prior learning, interpretation of the statements, or other factors not measured in this study.

The lowest mean score was observed in the astronomical criteria domain, at 58.52%. Its median was 60%, and its standard deviation was 24.22 percentage points. The score range extended from 0 to 100%, demonstrating that performance varied substantially even in the domain with the lowest average. The items in this domain addressed operational provisions, including the minimum elongation and crescent altitude thresholds and the special conditions associated with the 24:00 Universal Time boundary. These provisions require respondents to distinguish between general calendar principles and the specific conditions governing when a new month begins. The lower mean is consistent with the possibility that these items were more challenging for the participants. Nevertheless, the test did not directly assess the reasoning processes used to answer them; therefore, the results cannot establish that astronomical complexity itself caused the lower scores.

The guessing-corrected results offer an additional perspective on the differences among domains. After applying the correction procedure described in the Method section, the mean scores were 51.11% for principles, 45.93% for requirements, and 17.04% for astronomical criteria. The ordering remained unchanged, with criteria still producing the lowest score. The correction therefore indicates that the observed ranking was not altered by this particular scoring adjustment. However, these corrected values should be interpreted cautiously: they depend on assumptions about guessing in a binary-response test and are not direct measures of students' underlying knowledge. They are most useful here as supplementary evidence that the domain-level pattern warrants further investigation rather than as replacement estimates of actual competence.

The reliability results also limit the strength of conclusions that can be drawn from the domain comparisons. Although the overall instrument had a KR-20 coefficient of 0.71, the coefficients for principles, requirements, and astronomical criteria were 0.31, 0.56, and 0.27, respectively. These low domain-level coefficients indicate limited internal consistency within the respective five-item subscales. This is particularly important because each item represents a substantial proportion of its domain score, meaning that performance on a single item can noticeably affect the average. The domain means remain useful for describing the responses obtained in this cohort, but they should not be treated as highly reliable, independently validated measures of three distinct knowledge constructs. Future research would benefit from a larger number of items per domain and additional assessment formats capable of examining students' reasoning.

Overall, the domain-level results show a consistent descriptive pattern: students performed better on the principles and requirements items than on the astronomical criteria items, and this ordering remained after the guessing correction. The findings identify astronomical criteria as an area warranting closer examination, but they do not by themselves explain why the pattern occurred or establish a general conceptual–technical knowledge gap. The next subsection therefore examines the item-level response patterns to identify the specific KHGT provisions associated with higher and lower percentages of correct answers.

3. Item-Level Patterns: Students' Understanding of Specific KHGT Provisions

The domain-level comparison identifies differences in students' performance, but item-level analysis offers a more detailed view of which KHGT provisions students answered correctly and which were more difficult. Across the 15 statements, the percentages of correct responses varied considerably. This variation suggests that students' performance was not uniform across individual provisions, even within the same domain. The following analysis examines response patterns in relation to the substantive content of KHGT, while recognizing that a true-or-false test can identify response accuracy but cannot independently establish the reasoning behind each answer.

In the principles domain, the percentage of correct responses ranged from 54% to 94% (Table 3). The highest proportion of correct answers was recorded for the statement that astronomical calculation (ḥisāb) is valid for determining the beginning of the month (94%). The statement that the results of crescent observation or the possibility of crescent visibility at one location may apply globally also received a high percentage of correct answers (89%). These results indicate that most participants selected the correct responses to statements concerning the legitimacy of *ḥisāb* and the global application of calendar parameters. However, percentages were lower for statements about dividing the world into several calendar zones (74%) and using Coordinated Universal Time (UTC) as a reference (67%). The lowest percentage in this domain was for the statement that a new month may begin without *imkān al-ru'yah* being fulfilled anywhere on Earth (54%). Under the KHGT framework described in this study, that statement is false: using *ḥisāb* does not mean disregarding the astronomical criteria related to crescent visibility. The contrast between the 94% result for the validity of *ḥisāb* and the 54% result for the visibility-related statement may indicate that students understand these provisions differently. Nevertheless, without data on students' reasoning, it remains uncertain why they responded differently to these two statements.

Table 3. Percentage of correct responses to KHGT principles items

Statement	Correct Responses (%)
Astronomical calculations (*ḥisāb*) are considered valid for determining the start of the month	94
KHGT does not use Coordinated Universal Time (UTC) as the reference for the day	67
KHGT divides the world into several calendar zones	74
The new month may begin without the possibility of sighting (*imkān al-ru'yah*) anywhere	54
The results of crescent sighting or the possibility of crescent visibility at one location may apply to the entire world	89

Source: Authors' analysis of questionnaire data.

The requirements domain showed a narrower range of correct responses, from 61% to 81% (Table 4). The highest percentage (81%) was recorded for the statement that KHGT permits

postponing the beginning of the month even when the crescent has already been sighted; the statement is false under the answer key used in the study. The items concerning the requirement that a single day carry the same date worldwide and the possibility of beginning the month before conjunction each received 78% correct responses. Meanwhile, 67% answered correctly that a lunar month may last fewer than 29 days. The lowest result (61%) concerned whether KHGT permits the beginning of a new month before *imkān al-ru'yah* is fulfilled. This pattern indicates that the response accuracy varied across the requirements items, with the lowest percentage again involving the relationship between the calendar's rules and the possibility of crescent visibility. It is possible that the distinction between conjunction (*ijtimā'*) and *imkān al-ru'yah* contributed to the difficulty, but the present data cannot confirm that interpretation. The item results should therefore be treated as indicators of which provisions merit closer examination rather than as direct evidence of a specific misconception.

Table 4. Percentage of correct responses to KHGT requirements items

Statement	Correct Responses (%)
The duration of a lunar month may be less than 29 days	67
A single day must have the same date worldwide	78
KHGT allows the new month to begin before conjunction (*ijtimā'*)	78
KHGT permits the start of the new month before the possibility of sighting (*imkān al-ru'yah*)	61
KHGT permits postponing the start of the month if the crescent has already been sighted	81

Source: Authors' analysis of questionnaire data.

The criteria domain produced the widest substantive concern because it included the lowest item-level result in the entire instrument. Correct responses ranged from 41% to 74% (Table 5). The highest percentage (74%) was recorded for the statement concerning the role of the American continent under the special conditions for determining the beginning of the month. The item on the minimum crescent altitude of 5° received 67% correct responses, while 59% answered correctly on the statement that the beginning of the month may vary by region worldwide. Only 52% correctly responded to the statement that the new month still begins when the criteria are met after 24:00 UT without additional conditions. The lowest result, 41%, concerned the statement that the minimum elongation criterion in KHGT is 6.4°. This statement is false under the KHGT criteria applied in this study, which specify a minimum elongation of 8° and a minimum lunar altitude of 5°. The result therefore identifies the elongation threshold as a specific item for which fewer than half of the participants selected the correct answer. It does not, however, establish whether incorrect responses arose from confusion with another visibility criterion, limited familiarity with the numerical threshold, or another reason.

Table 5. Percentage of correct responses to KHGT astronomical criteria items

Statement	Correct Responses (%)
The start of the month in KHGT may vary by region worldwide	59
The minimum elongation criterion in KHGT is 6.4°	41
The minimum crescent altitude in KHGT is 5°	67
The Americas play a role under special conditions for determining the start of the month	74
The new month still begins if the criteria are met after 24:00 UT without additional conditions	52

Source: Authors' analysis of questionnaire data.

The responses to the two items concerning elongation and the 24:00 UT condition warrant particular attention because both involve specific operational provisions rather than general statements about calendar unification. Under the KHGT framework described in the manuscript, the principal criteria require elongation of at least 8° and lunar altitude of at least 5°. When the relevant criteria are met only after 24:00 UT, the calendar provision adds conditions, including conjunction before dawn in New Zealand and meeting the visibility criteria on the American continent. Accordingly, the statement that the new month begins after 24:00 UT without additional conditions is false. The 41% correct response rate for the elongation item and the 52% rate for the 24:00 UT item indicate that these statements were answered correctly by fewer participants than the item concerning the 5° altitude threshold. One possible interpretation is that recognizing an individual numerical threshold may differ from understanding how multiple conditions operate together. However, the questionnaire did not directly test students' ability to perform astronomical calculations or explain the conditional rule, so this interpretation remains provisional.

Taken together, the item-level findings show that correct-response rates differed not only between the three domains but also among provisions within each domain. The relatively high percentages for the validity of *ḥisāb* and the global application of calendar parameters contrast with the lower percentages for the *imkān al-ru'yah* provision, the 8° elongation threshold, and the conditional rule after 24:00 UT. These patterns identify specific content areas that may deserve further assessment and instructional attention. They do not, by themselves, demonstrate that students hold stable misconceptions or explain the sources of their responses. Since the instrument used binary-response items and each domain contained only five statements, further studies using items that require explanations, astronomical problem-solving, or follow-up interviews would be needed to determine whether incorrect answers reflect conceptual confusion, uncertainty about particular provisions, or guessing. This item-level analysis thus provides a more precise basis for the educational implications discussed in the following subsection.

4. Educational and Theoretical Implications: From KHGT Awareness to Astronomical Understanding

This study offers an exploratory baseline for understanding how Islamic studies students respond to the principles, requirements, and astronomical criteria of the Unified Global Hijri Calendar (KHGT) before formal instruction. Differences in mean scores across the three domains suggest that students' performance varies by the specific content assessed. Although the principles and requirements domains produced higher scores than the astronomical criteria domain, this pattern should not be taken as conclusive evidence of a conceptual–technical knowledge gap, as the instrument did not independently validate these as separate constructs. Instead, the findings underscore the importance of distinguishing between familiarity with the general objectives of calendar unification and the ability to interpret its operational provisions. This distinction matters for scholarship on global Islamic calendar proposals, which examines the relationship among astronomical calculation, jurisprudential considerations, and the aspiration to establish a single date worldwide.[11] Research on KHGT dissemination and public readiness further highlights the value of examining how knowledge of calendar unification is communicated and understood beyond specialist communities.[12] The present study contributes to this discussion by examining students' responses to specific KHGT propositions. However, it does not establish why particular items were answered correctly or incorrectly. Its principal contribution is to identify patterns that merit further investigation and to encourage a more differentiated assessment of KHGT knowledge in Islamic higher education.

From an educational perspective, the results suggest that teaching Islamic astronomy should link conceptual explanations to the astronomical relationships that underlie calendrical rules. Students need to understand not only the definitions of conjunction (*ijtimā'*), elongation, and crescent altitude but also how these parameters relate to the conditions used to determine the beginning of a Hijri month. Research in astronomy education has documented persistent challenges in learners' understanding of lunar phenomena and related astronomical concepts.[13] Studies examining instruction on lunar phases and eclipses likewise underscore the importance of addressing learners' existing conceptions and providing opportunities to reconstruct their understanding.[14] Broader reviews of conceptual change research have identified instructional

[11] Azhari, "Global Islamic Calendar Challenge in Era Industrial Revolution 4.0"; Anisah Budiwati, "Telaah Awal Kalender Hijriah Global Tunggal Jamaluddin 'Abd Al-Razik," *Jurnal Bimas Islam* 10, no. 3 (2017): 407–30, https://doi.org/https://doi.org/10.37302/jbi.v10i3.29; Abdul Aziz Abdul Halim and Ahmed Ahmed Kamil, "A Unified Islamic Calendar Proposal for the World," *Middle-East Journal of Scientific Research* 22, no. 1 (2014): 115–20, https://doi.org/https://doi.org/10.5829/idosi.mejsr.2014.22.01.21831; Qorib and Rakhmadi, "Tolerance and Moderation in the Formulation of A Global Islamic Calendar."

[12] Hidayat et al., "Problem and Solutions for Accepting a Single Global Islamic Calendar"; Fikri and Anas, "From Awareness to Acceptance: Quantitative Evidence on the Public Readiness Toward the Global Unified Hijri Calendar."

[13] Anthony Lelliott and Marissa Rollnick, "Big Ideas: A Review of Astronomy Education Research 1974–2008," *International Journal of Science Education* 32, no. 13 (September 13, 2010): 1771–99, https://doi.org/10.1080/09500690903214546; Kanli, "A Study on Identifying the Misconceptions of Pre-Service and In-Service Teachers about Basic Astronomy Concepts."

[14] Kathy Cabe Trundle, Ronald K. Atwood, and John E. Christopher, "Preservice Elementary Teachers' Conceptions of Moon Phases Before and After Instruction," *Journal of Research in Science Teaching* 39, no. 7 (September 9, 2002): 633–58, https://doi.org/10.1002/tea.10039; Randy L. Bell and Kathy Cabe Trundle, "The Use of a Computer Simulation to Promote Scientific Conceptions of Moon Phases," *Journal of Research in Science Teaching* 45, no. 3 (March 13, 2008): 346–72, https://doi.org/10.1002/tea.20227; Naomi Madaiton et

approaches that can support the development of scientific understanding, while emphasizing the importance of considering learner characteristics and the methods used to assess change.[15] Şensoy and Yeşil (2025), for example, investigated conceptual-change texts in astronomy education,[16] while Cardinot and McCauley (2024) examined non-digital educational games as a means of supporting conceptual change in astronomy.[17] These studies provide pedagogical precedents rather than direct explanations of the present findings, since their participants, instructional contexts, and learning outcomes differ from those of the current study. Nevertheless, they suggest possible directions for KHGT teaching, including visual representations of lunar geometry, worked examples, comparative exercises, and questions that prompt students to explain the reasoning behind their answers. Such strategies should be evaluated in future research before claims are made about their effectiveness in improving KHGT understanding.

The item-level findings also underscore the need to distinguish the numerical criteria across calendrical systems. In the present instrument, the statement that the minimum elongation criterion is 6.4° was incorrect within the KHGT framework examined in this study. KHGT specifies a minimum elongation of 8° and a minimum geocentric crescent altitude of 5° at sunset. By contrast, the new MABIMS criterion uses a minimum altitude of 3° and an elongation of 6.4°.[18] This comparison shows why numerical thresholds should always be interpreted in relation to the specific calendar system to which they belong. Research on crescent visibility has examined the historical development of criteria, the statistical modeling of observational data, and the performance of competing models.[19] More recent research has evaluated modern crescent-visibility criteria against extensive observational datasets, underscoring the continued importance of empirical evidence in assessing these models' performance.[20] These studies help situate KHGT within the broader technical discussion of crescent visibility, although their objectives and criteria

al., "Conceptual Change Framework of Instruction (CCFI): An Instructional Model in Teaching Eclipses," *Journal of Turkish Science Education* 19, no. 2 (June 30, 2022), https://doi.org/10.36681/tused.2022.141.

[15] Ananda Hafizhah Putri, Achmad Samsudin, and Andi Suhandi, "Exhaustive Studies Before Covid-19 Pandemic Attack Of Students' Conceptual Change In Science Education: A Literature Review," *Journal of Turkish Science Education* 19, no. 3 (October 1, 2022): 808–29, https://doi.org/10.36681/tused.2022.151; Cagatay Pacaci, Ulas Ustun, and Omer Faruk Ozdemir, "Effectiveness Of Conceptual Change Strategies In Science Education: A Meta-Analysis," *Journal of Research in Science Teaching* 61, no. 6 (August 8, 2024): 1263–1325, https://doi.org/10.1002/tea.21887.

[16] Önder Şensoy and Yaprak Yeşil, "The Effect of Conceptual Change Texts on Pre-Service Science Teachers' Achievement Levels Towards Astronomy," *Participatory Educational Research* 12, no. 3 (May 1, 2025): 102–22, https://doi.org/10.17275/per.25.36.12.3.

[17] Adriana Cardinot and Veronica McCauley, "Non-Digital Educational Games To Support Conceptual Change In Astronomy Education," *Astronomy Education Journal*, August 14, 2024, https://doi.org/10.32374/AEJ.AECON.2023.111aept.

[18] Maskufa Maskufa et al., "Implementation of the New MABIMS Crescent Visibility Criteria: Efforts to Unite the Hijriyah Calendar in the Southeast Asian Region," *Ahkam: Jurnal Ilmu Syariah* 22, no. 1 (June 30, 2022): 209–35, https://doi.org/10.15408/ajis.v22i1.22275.

[19] Nazhatulshima Ahmad et al., "A New Crescent Moon Visibility Criteria Using Circular Regression Model: A Case Study of Teluk Kemang, Malaysia," *Sains Malaysiana* 49, no. 4 (April 30, 2020): 859–70, https://doi.org/10.17576/jsm-2020-4904-15; Muhamad Syazwan Faid et al., "Development of Qibla Direction Determinant Using Sun Shadow," *Online Journal of Research in Islamic Studies (RIS)* 9, no. 1 (2022): 89–102, https://doi.org/10.22452/ris.vol9no1.7; Mohammed Y. Taher and Fouad M. Abdulla, "Evaluating the Development of the Crescent Visibility Criteria," *Iraqi Journal of Science*, January 30, 2024, 555–66, https://doi.org/10.24996/ijs.2024.65.1.43.

[20] Mohd Saiful Anwar Mohd Nawawi et al., "Hijri Month Determination in Southeast Asia: An Illustration Between Religion, Science, and Cultural Background," *Heliyon* 10, no. 20 (October 2024): e38668, https://doi.org/10.1016/j.heliyon.2024.e38668; Loucif et al., "Toward a Globally Lunar Calendar: A Machine Learning-Driven Approach for Crescent Moon Visibility Prediction."

are not necessarily identical to those of KHGT. The relatively low percentage of correct responses to the 6.4° item indicates a topic that may warrant further attention in instruction. It does not, however, demonstrate that students confused KHGT with MABIMS or another system, because the test did not collect explanations for incorrect answers. Future studies should investigate whether such responses reflect uncertainty about numerical thresholds, confusion between systems, or other factors.

The findings also raise questions about how knowledge of KHGT develops through formal education and broader public communication. Because the instrument was administered before formal instruction on KHGT, the results represent a baseline assessment rather than evidence of learning gains. Previous research has examined educational outreach on KHGT and public awareness and readiness for calendar unification.[21] Scholarship on global calendar proposals also shows that calendar unification involves more than astronomical calculation; it raises questions about the interpretation of universal dates, institutional coordination, and the practical implementation of a common calendar.[22] These discussions make it relevant to investigate how students encounter KHGT through university courses, religious organizations, public lectures, and digital communication. However, the present study did not measure students' prior exposure to these sources, nor did it examine the relationship between information sources and test performance. It would therefore be premature to claim that public communication transmits general principles more effectively than technical criteria. That proposition remains a hypothesis for further investigation. Future research could combine knowledge assessments with questions about students' prior exposure to KHGT, interviews about their interpretations of specific provisions, and pretest–posttest designs to evaluate changes following formal instruction. This would help establish a clearer relationship between students' learning experiences, their explanations of KHGT provisions, and their performance on domain-specific assessments.

Methodologically, the study highlights the need for assessment instruments that can distinguish between correct responses and the reasoning behind them. The 15-item true-or-false instrument offers an economical way to assess responses to selected propositions, but each item has a 50% chance of being answered correctly by guessing. Research on objective testing has discussed the limitations of interpreting true-or-false and multiple-choice scores without accounting for guessing, reliability, and scoring assumptions.[23] Although the overall KR-20 coefficient in the present study was 0.71, the lower reliability coefficients for the three five-item domains mean that comparisons between domain scores should be interpreted cautiously. The

[21] Hidayat et al., "Peningkatan Pemahaman Kalender Hijriah Global Tunggal Kepada Warga Muhammadiyah Cabang Medan Helvetia"; Fikri and Anas, "From Awareness to Acceptance: Quantitative Evidence on the Public Readiness Toward the Global Unified Hijri Calendar."

[22] Anisah Budiwati et al., "Indonesian Muslims' Intention to Adopt the Global Islamic Calendar," *Cogent Arts & Humanities* 13, no. 1 (December 31, 2026), https://doi.org/10.1080/23311983.2026.2625583; Qorib and Rakhmadi, "Tolerance and Moderation in the Formulation of A Global Islamic Calendar"; Halim and Kamil, "A Unified Islamic Calendar Proposal for the World."

[23] Richard F. Burton, "Multiple-Choice And True/False Tests: Myths And Misapprehensions," *Assessment & Evaluation in Higher Education* 30, no. 1 (February 14, 2005): 65–72, https://doi.org/10.1080/0260293042003243904; Richard F. Burton, "Multiple Choice And True/False Tests: Reliability Measures And Some Implications Of Negative Marking," *Assessment & Evaluation in Higher Education* 29, no. 5 (October 2004): 585–95, https://doi.org/10.1080/02602930410001689153; Richard F. Burton and David J. Miller, "Statistical Modelling Of Multiple-Choice And True/False Tests: Ways Of Considering, And Of Reducing, The Uncertainties Attributable To Guessing," *Assessment & Evaluation in Higher Education* 24, no. 4 (December 28, 1999): 399–411, https://doi.org/10.1080/0260293990240404.

short subscales may not adequately represent the full range of knowledge within each domain. Future research should therefore expand the item pool, establish a more detailed content blueprint, and obtain additional evidence of content validity and reliability. Two-tier items, in which respondents select an answer and then provide a justification, could help researchers investigate the reasoning underlying their responses. Confidence ratings could provide complementary information, provided they are interpreted alongside response accuracy rather than as direct evidence of knowledge. Diagnostic approaches such as the Certainty of Response Index have been used to investigate misconceptions in science education, including astronomy-related topics.[24] The broader literature on conceptual change likewise emphasizes the importance of examining how understanding develops and how it is assessed.[25] These approaches could be adapted to KHGT research, but their validity would need to be established for the specific content and student population under investigation.

Taken together, the study offers an initial account of students' responses to KHGT principles, requirements, and astronomical criteria before formal instruction. Its contribution is not to establish the causes of students' responses or to demonstrate that one domain constitutes a distinct cognitive construct, but to identify performance differences that warrant further investigation. The results suggest that Islamic astronomy education could benefit from integrating the conceptual aims of calendar unification with the astronomical parameters and conditional rules used in calendrical applications. They also underscore the importance of distinguishing KHGT from other systems, such as MABIMS, and of developing assessment methods that probe reasoning rather than relying exclusively on correct-response percentages. Future studies could extend this work through multi-institutional sampling, validated diagnostic instruments, interviews, and pretest–posttest designs. Research on crescent visibility can provide the technical context for these assessments, while research in astronomy education and conceptual change can inform the design of learning activities and evaluation methods. By combining these perspectives, subsequent studies can more precisely investigate how students interpret KHGT provisions, which elements require further clarification, and how their understanding develops through formal instruction. The present findings should nevertheless be interpreted within their limitations, particularly the single-institution sample, the short instrument, and the absence of direct evidence about students' prior information sources and reasoning processes.

D. Conclusion

This study assessed the baseline knowledge of the Unified Global Hijri Calendar (KHGT) among 54 sixth-semester students at the Faculty of Islamic Studies, Universitas Muhammadiyah Sumatera Utara, before formal instruction specifically addressing KHGT. The mean score was 69.01%, with substantial variation among participants. Performance was highest in the principal domain (75.56%), followed by requirements (72.96%), and lowest in astronomical criteria

[24] Sekar Rachmawati, Hadi Susanto, and Fianti Fianti, "Penggunaan Metode CRI (Certainty Of Response Index) Berbantuan Soal PISA (Programme Of International Student Assesment) Untuk Mengidentifikasi Miskonsepsi IPA Materi Tata Surya," *UPEJ: Unnes Physics Education Journal* 6, no. 3 (2017): 26–31, https://doi.org/https://doi.org/10.15294/UPEJ.V6I3.19310.

[25] Putri, Samsudin, and Suhandi, "Exhaustive Studies Before Covid-19 Pandemic Attack Of Students' Conceptual Change In Science Education: A Literature Review"; Pacaci, Ustun, and Ozdemir, "Effectiveness Of Conceptual Change Strategies In Science Education: A Meta-Analysis."

(58.52%). At the item level, the lowest correct-response rates concerned the 8% elongation threshold and the conditional provisions that apply when the criteria are fulfilled after 24:00 UT. These results indicate uneven student performance across the assessed KHGT provisions. However, given the binary-response instrument and the low internal consistency of the domain-level scores, the findings should be interpreted as a descriptive baseline rather than definitive evidence of a validated conceptual–technical knowledge gap.

The findings complement previous research on KHGT, which has primarily examined its normative and jurisprudential foundations, astronomical criteria, institutional dissemination, and public awareness or acceptance. For example, Hidayat et al. examined Muhammadiyah members' understanding of KHGT in Medan Helvetia within a community outreach program, while research on young people has explored familiarity with and support for the global calendar. Research in astronomy education, including work by Kanli, has also documented difficulties in understanding basic astronomical concepts. Building on these strands, the present study contributes an item-level assessment of students' responses, organized by KHGT's principles, requirements, and astronomical criteria. It therefore provides a more nuanced picture of students' performance than measures of general awareness or acceptance alone and identifies specific provisions that warrant further investigation.

Future research should develop a more comprehensive instrument with additional items per domain and diagnostic formats, such as questions requiring explanations or two-tier and three-tier tests, to distinguish correct knowledge from guessing and to investigate the reasoning behind incorrect responses. Studies involving multiple institutions and diverse student populations would help establish whether the observed response patterns extend beyond this cohort. Further research should also examine students' prior learning experiences and sources of KHGT information rather than assume their influence. Finally, pre-test and post-test studies, including appropriately designed quasi-experimental research, could evaluate whether instructional approaches that integrate calendar principles, astronomical calculations, and simulations improve students' understanding of the technical provisions of KHGT.

E. Acknowledgement

This research is supported and funded by Majelis Pendidikan Tinggi Penelitian dan Pengembangan Pimpinan Pusat Muhammadiyah through the Muhammadiyah National Research Grant Batch IX, Year 2025.

BIBLIOGRAPHY

Ahmad Adib Rofiuddin, Mahsun Mahsun, and Arifana Nur Kholiq. "State Authority and Religious Contestation: Resistance to Governmental Decisions on Islamic Calendar Determination in Indonesia." *Fikri : Jurnal Kajian Agama, Sosial Dan Budaya* 10, no. 1 (July 3, 2025): 250–63. https://doi.org/10.25217/jf.v10i1.5159.

Ahmad, Nazhatulshima, Mohd Saiful Anwar Mohd Nawawi, Mohd Zambri Zainuddin, Zuhaili Mohd Nasir, Rossita Mohamad Yunus, and Ibrahim Mohamed. "A New Crescent Moon Visibility Criteria Using Circular Regression Model: A Case Study of Teluk Kemang, Malaysia." *Sains Malaysiana* 49, no. 4 (April 30, 2020): 859–70. https://doi.org/10.17576/jsm-2020-4904-15.

Anselmi, Pasquale, Daiana Colledani, and Egidio Robusto. "A Comparison of Classical and Modern Measures of Internal Consistency." *Frontiers in Psychology* 10 (December 4, 2019): 1–12. https://doi.org/10.3389/fpsyg.2019.02714.

Azhari, Susiknan. "Global Islamic Calendar Challenge in Era Industrial Revolution 4.0." *Jurnal Fiqh* 18, no. 1 (June 24, 2021): 117–34. https://doi.org/10.22452/fiqh.vol18no1.4.

Bell, Randy L., and Kathy Cabe Trundle. "The Use of a Computer Simulation to Promote Scientific Conceptions of Moon Phases." *Journal of Research in Science Teaching* 45, no. 3 (March 13, 2008): 346–72. https://doi.org/10.1002/tea.20227.

Budiwati, Anisah. "Telaah Awal Kalender Hijriah Global Tunggal Jamaluddin 'Abd Al-Razik." *Jurnal Bimas Islam* 10, no. 3 (2017): 407–30. https://doi.org/https://doi.org/10.37302/jbi.v10i3.29.

Budiwati, Anisah, Krismono Krismono, Saiful Aziz, Muhammad Arafat, and Danny Setiawan. "Indonesian Muslims' Intention to Adopt the Global Islamic Calendar." *Cogent Arts & Humanities* 13, no. 1 (December 31, 2026). https://doi.org/10.1080/23311983.2026.2625583.

Burton, Richard F. "Multiple-Choice And True/False Tests: Myths And Misapprehensions." *Assessment & Evaluation in Higher Education* 30, no. 1 (February 14, 2005): 65–72. https://doi.org/10.1080/0260293042003243904.

———. "Multiple Choice And True/False Tests: Reliability Measures And Some Implications Of Negative Marking." *Assessment & Evaluation in Higher Education* 29, no. 5 (October 2004): 585–95. https://doi.org/10.1080/02602930410001689153.

Burton, Richard F., and David J. Miller. "Statistical Modelling Of Multiple-Choice And True/False Tests: Ways Of Considering, And Of Reducing, The Uncertainties Attributable To Guessing." *Assessment & Evaluation in Higher Education* 24, no. 4 (December 28, 1999): 399–411. https://doi.org/10.1080/0260293990240404.

Cardinot, Adriana, and Veronica McCauley. "Non-Digital Educational Games To Support Conceptual Change In Astronomy Education." *Astronomy Education Journal*, August

14, 2024. https://doi.org/10.32374/AEJ.AECON.2023.111aept.

Faid, Muhamad Syazwan, Muhammad Syaoqi Nahwandi, Mohd Saiful Anwar Bin Mohd Nawawi, Nurulhuda Binti Ahmad Zaki, and Mohd Hafiz Mohd Saadon. "Development of Qibla Direction Determinant Using Sun Shadow." *Online Journal of Research in Islamic Studies (RIS)* 9, no. 1 (2022): 89–102. https://doi.org/10.22452/ris.vol9no1.7.

Fikri, Mursyid, and Muh Fauzi Anas. "From Awareness to Acceptance: Quantitative Evidence on the Public Readiness Toward the Global Unified Hijri Calendar." *Hikmatuna : Journal for Integrative Islamic Studies* 11, no. 2 (December 2, 2025): 118–46. https://doi.org/10.28918/hikmatuna.v11i2.12259.

Frary, Robert B. "Formula Scoring of Multiple-Choice Tests (Correction for Guessing)." *Educational Measurement: Issues and Practice* 7, no. 2 (June 25, 1988): 33–38. https://doi.org/10.1111/j.1745-3992.1988.tb00434.x.

Halim, Abdul Aziz Abdul, and Ahmed Ahmed Kamil. "A Unified Islamic Calendar Proposal for the World." *Middle-East Journal of Scientific Research* 22, no. 1 (2014): 115–20. https://doi.org/https://doi.org/10.5829/idosi.mejsr.2014.22.01.21831.

Hidayat, Muhammad, Abu Yazid Raisal, Marataon Ritonga, and Syahrul Amsari. "Problem and Solutions for Accepting a Single Global Islamic Calendar." *Journal of Law and Governance* 7, no. 1 (2024): 63–72.

Hidayat, Muhammad, Arwin Juli Rakhmadi, Abu Yazid Raisal, and Alfath Khair. "Peningkatan Pemahaman Kalender Hijriah Global Tunggal Kepada Warga Muhammadiyah Cabang Medan Helvetia." *Ihsan: Jurnal Pengabdian Masyarakat* 6, no. 1 (April 9, 2024): 86–92. https://doi.org/10.30596/ihsan.v6i1.19118.

Kanli, Uygar. "A Study on Identifying the Misconceptions of Pre-Service and In-Service Teachers about Basic Astronomy Concepts." *Eurasia: Journal of Mathematics, Science and Technology Education* 10, no. 5 (December 15, 2014): 471–79. https://doi.org/10.12973/eurasia.2014.1120a.

Lelliott, Anthony, and Marissa Rollnick. "Big Ideas: A Review of Astronomy Education Research 1974–2008." *International Journal of Science Education* 32, no. 13 (September 13, 2010): 1771–99. https://doi.org/10.1080/09500690903214546.

Liliawati, Winny. "Identification Of Astronomic Misconceptions In Students With Confidence Discrimination Quotient Analysis Techniques." *Jurnal Pengajaran Matematika Dan Ilmu Pengetahuan Alam* 26, no. 2 (October 29, 2021): 1–7. https://doi.org/10.18269/jpmipa.v26i2.48784.

Loucif, Samia, Murad Al-Rajab, Raed Abu Zitar, and Mahmoud Rezk. "Toward a Globally Lunar Calendar: A Machine Learning-Driven Approach for Crescent Moon Visibility Prediction." *Journal of Big Data* 11, no. 1 (August 12, 2024): 114. https://doi.org/10.1186/s40537-024-00979-6.

Madaiton, Naomi, Maria Eloiza Tomaquin, Eric Jhay Visitacion, Jenny Rhea Villaver, Jea Marie Malingin, Sherwin Nacua, Dharel Acut, and Marchee Picardal. "Conceptual

Change Framework of Instruction (CCFI): An Instructional Model in Teaching Eclipses." *Journal of Turkish Science Education* 19, no. 2 (June 30, 2022). https://doi.org/10.36681/tused.2022.141.

Marwadi, Marwadi. "Renewing the Thoughts of the Hijri Calendar of Muhammadiyah, Nahdlatul Ulama and Persatuan Islam and Its Implications for Realization of National Hijri Calendar." *Al-Manahij: Jurnal Kajian Hukum Islam* 15, no. 1 (June 14, 2021): 19–36. https://doi.org/10.24090/mnh.v15i1.4870.

Maskufa, Maskufa, Sopa Sopa, Sri Hidayati, and Adi Damanhuri. "Implementation of the New MABIMS Crescent Visibility Criteria: Efforts to Unite the Hijriyah Calendar in the Southeast Asian Region." *Ahkam: Jurnal Ilmu Syariah* 22, no. 1 (June 30, 2022): 209–35. https://doi.org/10.15408/ajis.v22i1.22275.

Mohd Nawawi, Mohd Saiful Anwar, Muhamad Syazwan Faid, Mohd Hafiz Mohd Saadon, Raihana Abdul Wahab, and Nazhatulshima Ahmad. "Hijri Month Determination in Southeast Asia: An Illustration Between Religion, Science, and Cultural Background." *Heliyon* 10, no. 20 (October 2024): e38668. https://doi.org/10.1016/j.heliyon.2024.e38668.

Mufid, Abdul. "Unification of Global Hijrah Calendar In Indonesia: An Effort To Preserve The Maqasid Sunnah of The Prophet (SAW)." *Journal of Islamic Thought and Civilization* 10, no. 2 (November 25, 2020): 18–36. https://doi.org/10.32350/jitc.102.02.

Muhammadiyah, Suara. "Muhammadiyah Resmi Luncurkan KHGT, Jalan Menuju Kesatuan Umat." suaramuhammadiyah.id, 2025. https://www.suaramuhammadiyah.id/read/muhammadiyah-resmi-luncurkan-khgt-jalan-menuju-kesatuan-umat.

Pacaci, Cagatay, Ulas Ustun, and Omer Faruk Ozdemir. "Effectiveness Of Conceptual Change Strategies In Science Education: A Meta-Analysis." *Journal of Research in Science Teaching* 61, no. 6 (August 8, 2024): 1263–1325. https://doi.org/10.1002/tea.21887.

Putri, Ananda Hafizhah, Achmad Samsudin, and Andi Suhandi. "Exhaustive Studies Before Covid-19 Pandemic Attack Of Students' Conceptual Change In Science Education: A Literature Review." *Journal of Turkish Science Education* 19, no. 3 (October 1, 2022): 808–29. https://doi.org/10.36681/tused.2022.151.

Qorib, Muhammad, and Arwin Juli Rakhmadi. "Tolerance and Moderation in the Formulation of A Global Islamic Calendar." *Al-Fikru: Jurnal Ilmiah* 17, no. 2 (December 30, 2023): 343–57. https://doi.org/10.51672/alfikru.v17i2.291.

Rachmawati, Sekar, Hadi Susanto, and Fianti Fianti. "Penggunaan Metode CRI (Certainty Of Response Index) Berbantuan Soal PISA (Programme Of International Student Assesment) Untuk Mengidentifikasi Miskonsepsi IPA Materi Tata Surya." *UPEJ: Unnes Physics Education Journal* 6, no. 3 (2017): 26–31. https://doi.org/https://doi.org/10.15294/UPEJ.V6I3.19310.

Rakhmadi, Arwin Juli, and Muhammad Hidayat. "The Issues and Prospects of the Global

Islamic Calendar." In *Proceedings of the International Conference on Community Development (ICCD 2020)*, 109–12. Paris, France: Atlantis Press, 2020. https://doi.org/10.2991/assehr.k.201017.025.

Şensoy, Önder, and Yaprak Yeşil. "The Effect of Conceptual Change Texts on Pre-Service Science Teachers' Achievement Levels Towards Astronomy." *Participatory Educational Research* 12, no. 3 (May 1, 2025): 102–22. https://doi.org/10.17275/per.25.36.12.3.

Taher, Mohammed Y., and Fouad M. Abdulla. "Evaluating the Development of the Crescent Visibility Criteria." *Iraqi Journal of Science*, January 30, 2024, 555–66. https://doi.org/10.24996/ijs.2024.65.1.43.

Trundle, Kathy Cabe, Ronald K. Atwood, and John E. Christopher. "Preservice Elementary Teachers' Conceptions of Moon Phases Before and After Instruction." *Journal of Research in Science Teaching* 39, no. 7 (September 9, 2002): 633–58. https://doi.org/10.1002/tea.10039.