

Integrating Ilm Al-Falak and TVET: The Role of the Co-Curricular Course “Application of Falak in Worship” at Universiti Teknikal Malaysia Melaka (UTeM)

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Abstract

Ilm al-falak (Islamic astronomy) is a classical Islamic science that combines astronomical observation, mathematics and Shariah requirements to establish the validity of acts of worship, notably the direction of the qibla, the times of prayer and the Hijri calendar. As technical and vocational education and training (TVET) gains prominence in Malaysian higher education, there is a growing need to move falak from a purely theoretical framework towards practical technical competence. This article examines the importance of the co-curricular course Application of Falak in Worship at Universiti Teknikal Malaysia Melaka (UTeM) and its relevance to the university's TVET agenda. A qualitative design was used, combining document analysis, a structured review of the literature and practical observation of the course's implementation. The discussion, supported by recent empirical studies on qibla accuracy, hilal visibility, TVET policy, service-learning and micro-credentials, indicates that the course strengthens the accuracy of worship among campus members while building transferable skills in instrumentation, geospatial data processing and software development. Critical considerations, including limited seat capacity, the need for outcome-based assessment and the debate over the place of TVET within universities, are also discussed. The article closes with four recommendations: a Smart Falak and Internet of Things (IoT) curriculum, competency certification with religious agencies, a digital falak laboratory, and an outcome-based evaluation framework.

Keywords: Ilm Al-Falak, Application of Falak in Worship, Co-Curricular Course, Higher-Education Tvet, Utem, Qibla Direction, Hijri Calendar

Introduction

The golden age of Islamic civilisation never separated the core religious sciences from the technical sciences. One discipline that shows the synergy between revelation and reason

particularly well is ilm al-falak, or Islamic astronomy. In the practice of daily worship, falak acts as a determinant of validity (syarat sah): it fixes the direction of the qibla, the beginning of each prayer time and the start of the Hijri months for fasting and festivals. King (2015) traces how Muslim astronomers over many centuries developed instruments, tables and mathematical methods precisely to meet these religious needs, a tradition he describes as astronomy in the service of Islam. The question for contemporary universities is how that tradition can be taught in ways that are both faithful to the Shariah and relevant to modern technical practice.

In Malaysia, TVET has been elevated as a main driver of national human-capital development. The National TVET Policy 2030, launched in 2024, emphasises industry collaboration, quality and the instilling of national values so that young people acquire not only skills but also sound values (New Straits Times, 2024). Together with the MADANI Economic Framework, the New Industrial Master Plan 2030 and the 13th Malaysia Plan, it has placed vocational training at the centre of national development (Universiti Malaysia Pahang Al-Sultan Abdullah [UMPSA], 2025). Public interest is rising accordingly: more than half of the 2024 secondary-school leavers (53.56%) reportedly chose TVET as their first option (The Sun Malaysia, 2026). Universiti Teknikal Malaysia Melaka (UTeM), a member of the Malaysian Technical University Network (MTUN), is well positioned within this landscape because its curriculum is built on hands-on practice and the application of technology.

UTeM offers the co-curricular course Application of Falak in Worship (course code BKKM/BKKX) as a credit-bearing subject. According to the science officer of the Al-Khawarizmi Astronomy Complex in Tanjung Bidara, the complex has run a falak co-curricular course at UTeM since 2015, reaching nearly 800 students to date, with a cap of 60 students per semester; the content covers an introduction to falak syar'i and the fundamentals of falak (Kosmo!, 2024). The course is therefore a strategic attempt to realise the idea of "practical falak science", in which engineering skills, geospatial data processing and precision instrumentation are placed at the service of the community's worship.

This article analyses the importance of the course from the perspectives of worship accuracy, student character development and the integration of TVET elements, and considers its implications for the university and the wider community. It also takes a critical view, acknowledging the limitations and the policy debates that surround TVET in higher education. The article proceeds as follows: the objectives are stated in Section 2, the literature is reviewed in Section 3, the methodology is described in Section 4, the findings are discussed in Section 5, recommendations are offered in Section 6, and the article concludes in Section 7.

The significance of the study is threefold. For educators, it documents how a short co-curricular course can serve as a bridge between religious knowledge and technical competence. For policymakers and religious agencies, it identifies mechanisms such as certification and shared facilities through which universities can contribute to the accuracy of public worship practices. For researchers, it offers an integrated reading of literatures that are normally treated separately, namely qibla geodesy, hilal observation, TVET policy and service-learning.

Objectives of the Study

The article is guided by four main objectives:

1. To analyse the importance of offering the co-curricular course Application of Falak in Worship at UTeM from the perspective of strengthening worship and student character.
2. To identify the relevance and synergy between falak science and the TVET ecosystem, as well as the technical capacity of the university.
3. To evaluate the impact of modern technology (instrumentation, computational software and digital observation) on the delivery of the falak co-curricular course.
4. To propose strategic improvements that strengthen the falak co-curriculum in line with Industry 4.0/5.0 demands and the needs of religious agencies in the state of Melaka.

Literature Review

Ilm al-Falak as an Applied Science

Falak is often assumed to belong to traditional Islamic studies, yet its core methods are mathematical and instrument-based. King (2015) documents the long history of Muslim timekeeping and qibla determination, in which tables, trigonometric methods and observational instruments were developed for ritual purposes. In modern practice, the same tasks are carried out with computational algorithms. Meeus (1991) provides the widely used algorithms for computing the positions of the Sun and the Moon, and these underpin many contemporary falak calculations. Sari et al. (2023) compared the spherical trigonometry method, the Jean Meeus algorithm and Google Qibla Finder at an Islamic hospital and concluded that all three can determine the qibla accurately across locations. This body of work supports the view that falak is an applied science whose classical purpose and modern technique are fully compatible.

Qibla Determination: From Spherical Trigonometry to Geodesy

Facing the qibla is a condition for the validity of prayer, and mathematical determination of the direction is a well-established subject in Malaysian universities. Shapiee et al. (2022), for example, applied spherical trigonometry to calculate the qibla azimuth of a campus building at Universiti Sains Islam Malaysia. At a more advanced level, Saksono et al. (2018) analysed the geodetic azimuths of the qibla computed using different models of the Earth and argued that an ellipsoidal model provides the most accurate direction, placing qibla determination firmly within geodesy and surveying. Field verification remains necessary because errors are common in practice; Fatwa et al. (2020), for instance, tested the qibla direction of mosques and prayer rooms against measured values in order to identify those requiring correction. The qibla azimuth for Malaysia lies between about 291° and 293° (Mufti Wilayah Persekutuan, 2022, as cited in Ismail et al., 2024), so even a small angular error can translate into a visible lateral offset over the length of a prayer row.

Prayer Times, Hilal Observation and the Hijri Calendar

The Hijri calendar is regulated by the first appearance of the crescent, and the determination of the start of each month is therefore both a Shariah and an astronomical problem (Md Shariff et al., 2017). The classic study of crescent visibility by Odeh (2004) illustrates how empirical criteria are derived from observational records. Malaysia uses the imkanur rukyah approach, which combines astronomical calculation (hisab) with physical sighting (rukyah): calculations assess whether the crescent could be visible, and observation is carried out at designated sites to confirm it. Observers are religious officials from state mufti departments,

assisted by astronomers and technical personnel, and the Al-Khawarizmi Observatory in Melaka is among the designated locations (New Straits Times, 2026). Atmospheric conditions matter greatly. Md Shariff et al. (2017) used a Sky Quality Meter to show that sky brightness readings between 16 and 22 magnitudes per square arcsecond were associated with a high chance of seeing the hilal, whereas readings below 16 coincided with failure to see it, and they proposed sky limiting magnitude as an additional criterion. Such findings show that hilal observation is also an exercise in sensor-based data collection.

TVET in Malaysian Higher Education

Ridzuan and Abd Rahman (2022) review government policies on TVET in Malaysia and the predicaments that remain, and they stress the need for graduates to possess the employability skills required in the future. More recent policy discourse stresses balance: the Minister of Higher Education has argued that technical and academic pathways should be given balanced priority and that TVET must emphasise industry practice (Portal Rasmi TVET MADANI, 2024). At the same time, there are critical voices. Gerak (2024) cautions that universities are institutions of knowledge production and that their roles should complement, rather than become extensions of, TVET; it also warns against a narrow conception of higher education as preparation for the job market alone. Commentators have likewise argued that vocational institutions should be differentiated from academic universities (UMPSA, 2025). These debates matter for a course such as Application of Falak in Worship, which sits at the boundary between a technical skill set and a body of knowledge grounded in Islamic values.

Service-Learning, Co-Curricular Learning and Micro-Credentials

Co-curricular participation has long been associated with graduate employability. A factor analysis of data from 2013 graduates identified soft skills, co-curricular involvement and academic performance as the three factors contributing to employability (Md Yusof et al., 2014). More recently, Cheah et al. (2025) found that university students regard service-learning as an effective experiential tool that combines academic learning with community service, although its adoption across campuses is not yet extensive. Finally, micro-credentials offer a way of recognising short, assessed learning outcomes. The Malaysian Qualifications Agency (2020) defines a micro-credential as a certification of assessed learning of a smaller set of courses or learning outcomes, while the HRD Corp micro-credential initiative was launched to provide stackable certifications through short-term learning (HRD Corp, 2022). Abdul Halim et al. (2022) note, however, that there is still no consensus on how micro-credentials should be implemented in higher education institutions, which suggests that any certification scheme must be designed carefully.

Synthesis and Research Gap

Read together, the literature supports a clear technical claim but a much weaker educational one. The technical basis for accurate qibla and hilal work is well established: spherical trigonometry, ellipsoidal geodesy, surveying instruments and sensor-based measurement all have documented applications (Saksono et al., 2018; Ismail et al., 2024; Md Shariff et al., 2017). The studies do not, however, share a common view of how much precision is required. Saksono et al. (2018) argue that an ellipsoidal model gives the most accurate direction, whereas Sari et al. (2023) conclude that spherical trigonometry, the Jean Meeus algorithm and Google Qibla Finder can all determine the qibla accurately at the site they examined. These positions can be reconciled only if the acceptable tolerance is specified, yet the sources

reviewed here largely report accuracy in geodetic terms and say little about the tolerance that fiqh accepts. A deviation of about 3° in a subset of applications (Ismail et al., 2024) is therefore difficult to judge as trivial or consequential without that reference point. Many of these studies are also tested at a single institution or a limited set of venues, such as a campus building, a hospital or a sample of mosques and prayer rooms (Shapiee et al., 2022; Sari et al., 2023; Fatwa et al., 2020), which limits how far their results can be generalised to the range of prayer spaces in Melaka.

Second, the field evidence documents a problem but not a remedy. Fatwa et al. (2020) identified mosques and prayer rooms requiring correction, and Ismail et al. (2024) found that some widely used applications deviate from a surveyed reference; together these indicate a continuing need for people able to verify. Both studies, however, evaluate buildings or tools. Neither examines whether training people in instruments and calculation changes verification outcomes, so the inference that a course can help close this gap is plausible but untested. The same limitation applies to hilal work: Odeh (2004) derives visibility criteria from observational records and Md Shariff et al. (2017) add a sensor-based criterion, but these contributions concern the phenomenon and its measurement, not how observers or students acquire the competence to apply them.

Third, the educational and policy literatures differ in evidential strength and rarely address falak directly. Evidence on co-curricular learning is largely general. Md Yusof et al. (2014) rely on a factor analysis of 2013 graduates, which shows an association with employability rather than the effect of any particular course and is now more than a decade old, while Cheah et al. (2025) report a single-university case in which students perceive service-learning as effective, which is a finding about perception rather than measured competence. Majid et al. (2023) come closest to the present topic by examining co-curricular falak courses, but it is one study, concerned with soft skills, leadership and employability rather than the technical and fiqh competencies that the qibla and hilal literatures treat as central, and no comparable study was identified in the literature reviewed here. The TVET and micro-credential sources show a similar pattern. They consist mainly of policy statements, commentary, guidelines and an exploratory study (New Straits Times, 2024; Portal Rasmi TVET MADANI, 2024; Gerak, 2024; Malaysian Qualifications Agency, 2020; HRD Corp, 2022; Abdul Halim et al., 2022), apart from the policy review by Ridzuan and Abd Rahman (2022). They articulate aspirations and tensions, but they do not test how competency-based learning is best embedded in a university course.

These sources also pull in different directions on what such a course should be. National discourse stresses industry practice and values alongside skills (Portal Rasmi TVET MADANI, 2024; New Straits Times, 2024), whereas Gerak (2024) warns against a narrow, labour-market view of university education. Falak sits uneasily in both framings: presented as TVET it risks being reduced to technique, while presented as religious knowledge it risks being overlooked in technical competency reporting. The literature reviewed does not resolve how a course can retain its fiqh grounding while its outcomes are assessed as technical competence, and this tension is the main reason why a simple transfer of TVET models to falak cannot be assumed. These limitations clarify the research gap, which is better understood as three connected gaps. The first is an evidential gap: none of the studies reviewed measures whether a falak course improves students' ability to verify the qibla direction or to conduct hilal observation,

or whether that ability is retained after the course. The second is an integrative gap: the technical, TVET and pedagogical threads are developed in separate literatures with different evidentiary standards and are rarely examined in relation to one another. The third is a contextual gap: little is known about how a credit-bearing co-curricular falak course in a Malaysian technical university can combine technical competence with Shariah understanding and have that learning recognised through certification. This article responds mainly to the second and third gaps, by arguing that the falak course occupies the intersection of the three threads and by proposing the conceptual framework in Figure 1 (Section 5.2) and the evaluation approach in Section 6. It does not close the evidential gap, which requires the primary data outlined in Sections 4 and 7. Three testable propositions follow from the framework: that course participation improves the accuracy of qibla verification; that field-based service-learning activities strengthen the transfer of that skill to community settings; and that understanding of the fiqh basis for tolerance develops alongside technical skill. These are offered as hypotheses for future empirical work, not as findings.

Methodology

This study adopts a qualitative approach comprising three complementary components: document analysis, a literature review and practical observation. First, documents relating to the course, including its course information and descriptions in the UTeM academic and co-curricular handbook, were examined to identify learning content and intended outcomes. Second, peer-reviewed articles, conference proceedings, official policy statements and credible news reports published mainly between 2014 and 2026 were reviewed. Sources were selected for their relevance to qibla determination, the Hijri calendar and hilal observation, TVET policy, service-learning and micro-credentials, and were analysed thematically to identify points of convergence between falak and TVET. Third, practical observation of the course's field activities, such as qibla verification and hilal observation sessions, was used to understand how technical skills are applied in context.

The study has limitations. It does not report primary survey or test data on student learning gains, and its findings are interpretive rather than statistically generalisable. The discussion in Section 5 should therefore be read as an analytical argument informed by the literature and by observation, and future research should complement it with a tracer study and pre- and post-course competency assessment.

Findings and Discussion

Strengthening the Accuracy of Worship through Modern Shariah Application

Acts of worship such as prayer, fasting and zakat are closely tied to parameters of time and geographical space. An error in determining the qibla or the time of prayer can affect the validity of worship according to the discipline of fiqh. Through the course, students are introduced to spherical trigonometry and geographic coordinates (latitude and longitude). Rather than passively accepting a published timetable, they learn to understand the daily motion of the Sun and the Moon (sun and moon tracking) and the effect of atmospheric refraction. Nadzri et al. (2022) emphasise that a sound modern understanding of falak helps erode the habitual "zone of assumption" among young people regarding the qibla direction of homes and business premises. This is consistent with Fatwa et al. (2020), whose measurements of mosques and prayer rooms identified places where the qibla direction required follow-up correction.

The importance of verification is heightened by the spread of smartphone applications. Ismail et al. (2024) tested twenty of the most downloaded qibla applications against a reference direction obtained by surveying instruments ($292^{\circ}57'44''$) and found that most applications gave a correct value of about 292° , but that a subset consistently indicated about 295° , a deviation of roughly 3° . They also noted that compass sensors are sensitive to magnetic interference, and that religious bodies, including the Malacca State Fatwa Committee, have raised concerns about the accuracy of qibla applications. Niri et al. (2023) similarly examined a Sun Compass application computationally. For a technical university, these results are an argument for the course: students who understand the underlying mathematics and who can operate an independent benchmark instrument are able to audit the tools that the public relies on, rather than trusting them blindly.

Synergy between Ilm al-Falak and University TVET

A stereotype persists that falak is merely a traditional Islamic discipline confined to pondok institutions or faculties of Islamic studies. The current reality is that falak is an applied science that draws on TVET-type skills. Table 1 summarises how the main TVET domains are expressed in the falak course at UTeM and the literature that supports each link.

Table 1

TVET aspects and their applications in falak at UTeM

TVET aspect	Application in ilm al-falak at UTeM	Supporting literature
Instrumentation and calibration	Use of theodolite, total station, Rubu' Mujayyab and computerised telescope	Ismail et al. (2024); Baharim & Ramli (2021)
Geomatics engineering / GIS	Qibla mapping using survey-grade GPS and geographic information systems	Saksono et al. (2018); Nadzri et al. (2022)
Software development / AI	Development of falak algorithms in Python, C++ and mobile applications	Sari et al. (2023); Meeus (1991)
Materials science and optics	Care of telescope lenses, solar filters and CCD sensors; sky-brightness measurement	Md Shariff et al. (2017)

According to Zainuddin et al. (2023), integrating TVET elements into falak studies accelerates technology transfer, because students do not merely learn the theory but are trained to operate optical equipment built on precision engineering. The decision of the Melaka State Mufti Department to bring falak science into local TVET syllabi (Jabatan Mufti Negeri Melaka, 2024) indicates that UTeM is on the right track. At the national level, the same direction is visible in the policy emphasis on industry practice (Portal Rasmi TVET MADANI, 2024) and on values alongside skills (New Straits Times, 2024); falak, with its explicit Shariah grounding, is a natural vehicle for the latter. Figure 1 presents the conceptual framework of the course.

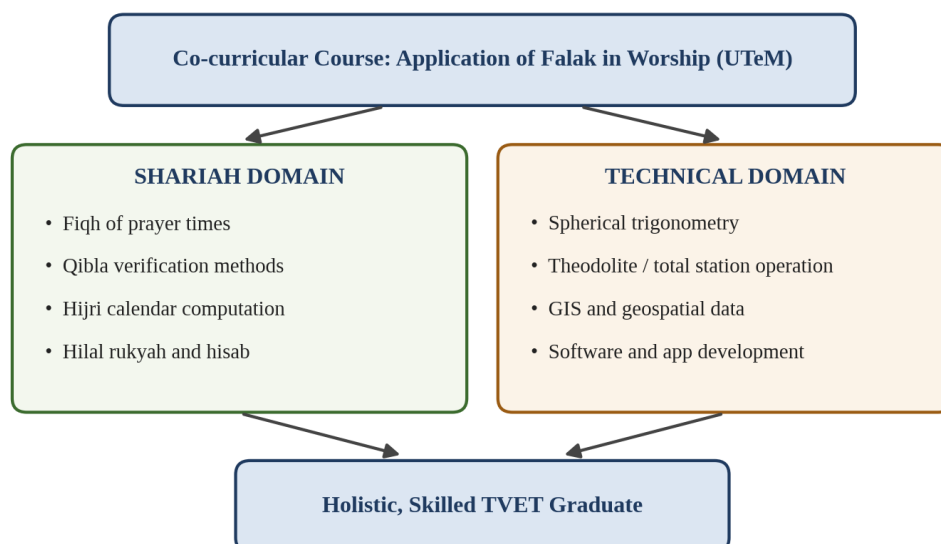


Figure 1. Conceptual framework of the falak co-curricular course at UTeM

Mastery of Instrumentation and Data Processing

In the falak co-curricular classes, students are introduced to classical instruments such as the Rubu' Mujayyab (quadrant) and to modern tools such as the digital theodolite. Determining the qibla requires students to compute the azimuth using Equation 1, in which α is the qibla azimuth, ϕ_L is the latitude of the location, ϕ_M is the latitude of Mecca and $\Delta\lambda$ is the difference in longitude between Mecca and the location (Ismail et al., 2024).

$$\tan \alpha = \frac{\sin \Delta\lambda}{\cos \phi_L \tan \phi_M - \sin \phi_L \cos \Delta\lambda} \quad (1)$$

As an illustration, using approximate coordinates for the UTeM main campus in Durian Tunggal ($\phi_L \approx 2.314^\circ\text{N}$, $\lambda_L \approx 102.320^\circ\text{E}$) and for the Kaaba ($\phi_M \approx 21.4225^\circ\text{N}$, $\lambda_M \approx 39.826^\circ\text{E}$), $\Delta\lambda$ is about -62.49° . The numerator of Equation 1 is then negative and the denominator positive, so the tangent is negative; a two-argument arctangent (or a manual quadrant check) is needed to place the bearing in the correct quadrant, giving $\alpha \approx 292.83^\circ$, or about $292^\circ 50'$ measured clockwise from true north. This falls within the 291° – 293° range reported for Malaysia and is close to the value of $292^\circ 57' 44''$ obtained by Ismail et al. (2024) for a site in Johor. The figure is illustrative only, since surveyed coordinates should be used in the field, but the exercise shows students why quadrant handling is a typical source of error in hand calculations and why it is also a natural programming exercise.

The process cultivates analytical skill and precision in technical students. They learn to calibrate instruments, to align true north using the shadow of the Sun (istiwa'), and to account for magnetic declination, which is exactly the weakness that compass-based applications suffer from (Ismail et al., 2024). Ismail et al. (2024) also show that the total station and theodolite methods, which rely on solar observation, remain the reference against which applications are judged. Baharim and Ramli (2021) state that the ability to operate measuring instruments for religious purposes builds psychomotor competence aligned with the standards of the land-survey and construction industries. Related engineering work, such as the use of a MEMS gyroscope and accelerometer as a north-finding system for bulk direction

marking (Ariffin & Arsad, 2022), shows how the same underlying problem, finding true north accurately, is being addressed by sensor technology, and suggests project ideas for students in electrical and electronic disciplines.

Hilal Observation, Digital Observation and Local Partnerships

Hilal observation extends the course from calculation to data acquisition. Because the thin crescent is low on the western horizon and sets quickly, students must understand the roles of atmospheric transparency, horizon conditions and artificial light. The work of Md Shariff et al. (2017) illustrates how a low-cost sensor can add an objective, quantitative dimension to what was traditionally a purely visual task. For UTeM, the geographical advantage is clear: the Al-Khawarizmi Astronomy Complex, which has observed the hilal for Ramadan, Syawal and Zulhijjah and positions itself as a centre for education, research and tourism (Kosmo!, 2024), lies in the same state, and its observatory is one of the official sighting sites (New Straits Times, 2026). This proximity allows students to see how classroom calculations connect with an official national process.

Community Service and Knowledge Transfer

As a higher-education institution in Melaka, UTeM has a responsibility to contribute directly to the local community. Students enrolled in the course are often involved in service-learning activities such as the following:

1. Qibla verification: helping to measure and verify the qibla direction in campus prayer rooms, residential halls, schools and community mosques around Melaka.
2. Hilal observation programmes: working with the Al-Khawarizmi Astronomy Complex, Tanjung Bidara, in hilal observation activities for the beginning of Ramadan, Syawal and Zulhijjah.
3. Modern falak camps: educating students from full boarding and vocational schools on the combination of science and religion.

This approach is in line with the findings of Majid et al. (2023), who report that service-learning in falak improves soft skills, leadership and the employability of technical graduates. It also fits the broader evidence that students perceive service-learning as an effective form of experiential learning (Cheah et al., 2025) and that co-curricular participation contributes to employability alongside academic performance (Md Yusof et al., 2014). The qibla verification activity has a further practical value: because verification work has identified prayer spaces that need correction (Fatwa et al., 2020), student teams trained with proper instruments can provide a genuine public service.

Critical Considerations and Challenges

Several considerations temper the positive picture. First, capacity is limited. With a cap of 60 students per semester (Kosmo!, 2024), the course reaches only a fraction of UTeM's student body, and the nearly 800 students served since 2015 represent a modest proportion of all graduates. Cheah et al. (2025) similarly observe that service-learning is not yet widely adopted across campuses, which suggests a need for broader implementation. Second, the course must guard against reducing falak to technique alone. The values dimension emphasised in national TVET discourse (New Straits Times, 2024) requires that students understand the fiqh reasoning behind qibla tolerance, prayer-time definitions and the imkanur rukyah approach, and not only the measurement procedures.

Third, the debate captured by Gerak (2024) and UMPSA (2025) raises the question of how far a university course should be framed as TVET. A reasonable reading is that the course need not claim to convert a university into a vocational institution; rather, it demonstrates that practical, competency-based learning can coexist with the knowledge-production role of the university. Fourth, assessment must be sound. As micro-credential practice is still maturing (Abdul Halim et al., 2022), any certificate awarded for the course should rest on clearly defined and verifiable outcomes. Finally, environmental constraints such as cloud, haze and light pollution can limit field sessions (New Straits Times, 2026; Md Shariff et al., 2017), so instructors should plan alternatives such as simulation and archived observation data.

Implications for UTeM and Its Stakeholders

The discussion above carries implications for four groups. For students, the course offers a context in which mathematics, surveying and computing skills are exercised on a task with visible religious and social meaning, and the literature suggests that such co-curricular experience contributes to employability alongside academic performance (Md Yusof et al., 2014). For the university, the course provides a concrete, locally grounded example of competency-based learning that can be reported within its TVET agenda without compromising its academic mission (Gerak, 2024; Ridzuan & Abd Rahman, 2022).

For religious agencies, trained student teams represent a pool of volunteers who can assist in routine verification work, an area in which inaccuracies are still found (Fatwa et al., 2020). For the wider community, the principal benefit is greater confidence in the tools used for worship. Because even popular applications can deviate from the reference direction (Ismail et al., 2024), a community that has access to graduates able to verify the qibla with calibrated instruments is better protected against avoidable error. These implications are summarised in the implementation matrix presented in Section 6.

Relevance to Industry 4.0/5.0 Skills

The fourth objective of this article concerns alignment with Industry 4.0/5.0. National planning documents point in the same direction: the 13th Malaysia Plan, tabled in July 2025, aims to create 700,000 manufacturing jobs and 500,000 digital-economy jobs by 2030, supported by new TVET financing schemes (UMPSA, 2025). The skills practised in the falak course are not tied to religious applications alone. Acquiring and filtering sensor data for sky brightness or solar position, writing code to compute celestial positions, processing images of the crescent, and handling geospatial coordinates are all competencies that transfer to embedded systems, data analytics and geomatics work. It is an argument of this article, rather than a finding, that framing falak projects explicitly in terms of these transferable competencies would make the course more legible to employers and to national TVET reporting, while the Shariah purpose gives students a meaningful and values-based context for practising them.

Recommendations for Strengthening the Course

To keep the course relevant and competitive, in line with UTeM's vision of leading higher-education TVET, four recommendations are proposed.

Recommendation 1: Upgrade the curriculum around “Smart Falak and IoT”.

The syllabus should be aligned with current technology trends such as the Internet of Things (IoT) and artificial intelligence (AI). Students should be encouraged to develop final projects based on automatic sensors, for example a light sensor that detects the Sun’s position for prayer times, or a digital camera that detects the hilal using image processing. Two evidence-based project themes are suggested. The first is the benchmarking of qibla applications against a theodolite or total-station reference, extending the work of Ismail et al. (2024) to prayer rooms in malls, petrol stations and hotels in Melaka, as those authors themselves recommend. The second is low-cost sky-brightness logging at the observation site, building on Md Shariff et al. (2017).

Recommendation 2: Recognise competency through certification with religious agencies.

UTeM should collaborate strategically with the Melaka State Mufti Department or the Islamic Training Institute of Malaysia (ILIM). Students who complete the course with distinction could be awarded a Qibla Verification Competency Certificate or Falak Assistant Certificate, which would add micro-credential value to the TVET graduate’s résumé. Because the national micro-credential landscape is still developing, the certificate should be mapped to the guidelines of the Malaysian Qualifications Agency (2020), exploit the stackable approach promoted by HRD Corp (2022), and be designed with explicit learning principles and assessment rubrics as advised by Abdul Halim et al. (2022).

Recommendation 3: Establish a UTeM Digital Falak Laboratory and Observation Station.

A dedicated observation corner (an Observatory Deck) equipped with geodetic falak instruments should be established on campus. It can function as an interdisciplinary laboratory used by falak co-curricular students, engineering faculties and information technology faculties for joint research. Formal links with the Al-Khawarizmi Astronomy Complex, which already hosts training facilities and observes the hilal (Kosmo!, 2024), would allow the laboratory to serve as a feeder and calibration site rather than a duplicate facility.

Recommendation 4: Adopt an outcome-based evaluation and research framework.

To address the limitations noted in Section 5.6, the course should be evaluated with pre- and post-course competency tests, rubric-based assessment of field tasks, and a tracer study of alumni. Seat capacity could be expanded through blended delivery and by training senior students as peer facilitators. The evidence generated would support publication, inform the university’s TVET reporting, and allow the course to be benchmarked against other service-learning co-curricular offerings in Malaysia (Cheah et al., 2025; Md Yusof et al., 2014).

Table 2 summarises how each recommendation could be implemented, the stakeholders involved and the indicators by which progress might be judged.

Table 2

Implementation matrix for the proposed recommendations

Recommendation	Key stakeholders	Indicative success indicators
1. Smart Falak and IoT curriculum	UTeM co-curriculum centre; engineering and IT faculties	Number of student projects benchmarked against a theodolite or total-station reference; documented error margins of student-built tools
2. Competency certification	Melaka State Mufti Department; ILIM; UTeM; accrediting bodies	Approved competency statement and assessment rubric; number of certificates issued; employer or agency feedback
3. Digital falak laboratory	UTeM; Al-Khawarizmi Astronomy Complex; research groups	Instruments commissioned and calibrated; joint research outputs; number of cross-faculty users
4. Outcome-based evaluation	UTeM co-curriculum centre; instructors; alumni	Pre- and post-course gains; tracer-study results; seat capacity beyond the current cap

Conclusion

The implementation of the co-curricular course Application of Falak in Worship at Universiti Teknikal Malaysia Melaka does more than satisfy co-curricular credit requirements. It is a manifestation of strengthening the TVET MADANI ecosystem on the foundation of values and scientific precision. The literature reviewed shows that qibla determination, prayer-time computation and hilal observation draw on spherical trigonometry, geodesy, sensor technology and software, all of which are core TVET competencies, and that the accuracy of tools used by the public cannot be taken for granted. Through the course, UTeM can produce technical graduates who are not only proficient in engineering and technology but also firm in their understanding of the Shariah and capable of serving the community.

At the same time, the discussion highlights that the course's potential will be realised only if its limited capacity, its balance between technique and fiqh understanding, and its assessment and certification are addressed. The four recommendations offered, namely a Smart Falak and IoT curriculum, certification with religious agencies, a digital falak laboratory and an outcome-based evaluation framework, provide a practical pathway. Future research should gather primary data from students, alumni and community partners to measure the course's impact empirically.

Future research can build on this conceptual analysis in several ways. A tracer study of the nearly 800 alumni of the course would show whether the skills are retained and used. A comparative study across the MTUN universities could identify good practices in teaching practical falak. A benchmarking experiment, in which student-built tools are evaluated against a theodolite or total-station reference as in Ismail et al. (2024), would provide quantitative evidence of learning outcomes. Mixed-methods designs combining such measurements with interviews with religious officers and community leaders would give the fullest picture of the course's contribution.

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