

## Modern Technology in Qibla Direction Mapping: A Comparative Case Study Between Indonesia and South Korea and Its Implications for Islamic Family Law

Zahrotul Habibah,<sup>1\*</sup> Abdul Karim,<sup>2</sup> Dian Permana<sup>1</sup>

<sup>1</sup> Institut Miftahul Huda Al-Azhar, Banjar City, West Java, Indonesia

<sup>2</sup> Hallym University, Chuncheon, South Korea

\*Corresponding author: Zahrotul Habibah

E-Mail: [habibahzahrotul7@gmail.com](mailto:habibahzahrotul7@gmail.com)

---

### Article History:

Received: December 25, 2024 | Revised: April 18, 2025 | Accepted: May 22, 2025 | Published: June 30, 2025

---

### Citation (APA Style):

Habibah, Z., Karim, A., & Permana, D. (2025). Modern Technology in Qibla Direction Mapping: A Comparative Case Study Between Indonesia and South Korea and Its Implications for Islamic Family Law. *Munakahat: Journal of Islamic Family Law*, 1(2), 50-62.

---

### Abstract

**Background:** Accurate *Qibla* determination is a fundamental requirement of Islamic worship, requiring the integration of *‘ilm al-falak*, geospatial technology, and contemporary Islamic jurisprudence. Comparative studies examining its implementation in Muslim-majority and Muslim-minority societies remain limited.

**Purpose:** This study compares the implementation of modern *Qibla* determination technologies in Indonesia and South Korea to evaluate their accuracy, institutional support, and implications for contemporary Islamic law from the perspective of *maqāṣid al-sharī‘ah*.

**Methods:** A qualitative comparative approach was employed through doctrinal legal analysis, literature review, institutional document analysis, and geospatial verification using GPS, GIS, and astronomical software. Artificial intelligence assisted only in literature organization and comparative synthesis under researcher verification.

**Results:** Modern geospatial technologies provide highly accurate *Qibla* orientation in both countries. Indonesia demonstrates stronger institutional governance through standardized *‘ilm al-falak* education and religious authorities, whereas Muslim communities in South Korea rely primarily on digital applications because of limited institutional infrastructure. Effective implementation depends on the integration of technology, legal interpretation, and institutional capacity.

**Conclusion:** Modern *Qibla* determination requires harmonizing Islamic astronomy, digital technology, and Islamic legal principles to ensure accuracy, accessibility, and legal certainty across diverse Muslim communities.

**Novelty:** This study proposes an interdisciplinary framework integrating *‘ilm al-falak*, geospatial technology, and *maqāṣid al-sharī‘ah*, demonstrating that institutional governance is as important as technological precision in contemporary *Qibla* determination.

**Keywords:** *Qibla* determination; *‘ilm al-falak*; Islamic law; geospatial technology; *maqāṣid al-sharī‘ah*.

### INTRODUCTION

The determination of the *qibla* direction has historically occupied a central position in Islamic civilization, representing the intersection of *fiqh*, astronomy (*‘ilm al-falak*), mathematics, and geography. Classical Muslim scholars developed sophisticated methods for identifying the direction of the Kaaba through spherical trigonometry, astronomical observations, and geographic calculations centuries before the advent of modern navigation systems (Kennedy & ID, 1974; Kennedy, 1984; King, 2005). Historical investigations of mosque orientations further demonstrate that Islamic societies continuously adapted scientific knowledge to improve the precision of *qibla* determination while maintaining conformity with religious obligations (Yilmaz, 2012; Armienti & Venger, 2018). Contemporary Islamic legal scholarship similarly emphasizes that determining the *qibla* should

not be understood merely as a ritual obligation but as a dynamic legal process requiring the harmonization of scientific advancement with Islamic jurisprudence (*fiqh*) (Faiz, 2020; Izzuddin, 2022; Mahmud et al., 2023; Hidayat & Rosele, 2024). Within the framework of *maqāṣid al-sharī'ah*, scientific innovation functions as an instrument for realizing legal certainty (*yaqīn*), public benefit (*maṣlaḥah*), and ease in religious practice rather than replacing religious authority (Mutawali, 2023). Consequently, discussions concerning *qibla* determination have evolved from purely astronomical calculations into broader interdisciplinary debates involving Islamic legal interpretation, technological innovation, and institutional religious governance.

Rapid developments in digital technology have fundamentally transformed contemporary approaches to *qibla* determination. The integration of the *Global Positioning System (GPS)*, *Geographic Information Systems (GIS)*, satellite imagery, mobile applications, artificial intelligence (*AI*), and algorithm-based spatial modelling has substantially increased both the accessibility and accuracy of *qibla* orientation for Muslim communities across diverse geographical settings. Similar technological transformations have also influenced Islamic legal institutions through the emergence of *AI*-assisted judicial decision-making, digital legal services, and technology-driven religious governance (Sidqi et al., 2023; Sukindar et al., 2024). Beyond legal administration, recent studies demonstrate that *AI*, machine learning, spatial intelligence, *digital twins*, and advanced geospatial analytics significantly improve decision-support systems by generating more accurate spatial predictions and real-time geographical analysis (Enshassi et al., 2025; Gonçalves & Domingues, 2025; Huang et al., 2025; Mansourihanis et al., 2025; Singh et al., 2025). Despite these technological advances, important legal questions remain unresolved regarding the legitimacy of algorithmic calculations, the authority of digital applications in determining religious obligations, and the compatibility of emerging technologies with established principles of Islamic jurisprudence.

Within the broader discourse of Islamic family law, accurate *qibla* determination extends beyond individual ritual observance because it directly influences numerous family-related religious practices, including congregational prayer, mosque and prayer-room orientation, Islamic educational institutions, funeral rites, and burial procedures. Contemporary Islamic legal scholarship demonstrates that Islamic law continuously adapts to technological innovation while preserving its normative foundations through *ijtihād*, contextual interpretation, and legal harmonization (Karimullah, 2022; Karimullah, 2023; Insani et al., 2024; Karimullah & Sugitanata, 2025). Similar adaptive developments are evident in discussions concerning inheritance rights, family resilience, digital governance, and the modernization of Islamic legal institutions (Maulana et al., 2024; Nurjanah et al., 2024; Ubaidillah & Faiz, 2025). Technological innovations have also entered family law through Android-based judicial applications, digital legal services, and electronic decision-support systems that assist judges in resolving religious court cases while maintaining conformity with Islamic legal principles (Zuhriah, Mayasari, et al., 2023; Zuhriah, Rahmawati, et al., 2023). Nevertheless, existing scholarship generally discusses technological innovation and Islamic family law separately, leaving limited theoretical integration between digital *qibla* determination, Islamic jurisprudence, and family law governance.

Recent comparative scholarship further illustrates that contemporary Islamic law increasingly negotiates the relationship between classical jurisprudence, constitutional law, technological modernization, gender justice, minority rights, and religious authority across different Muslim societies. Comparative studies on women's inheritance rights, female arbitrators, Islamic *neurolaw*, *mahr* reform, interreligious marriage, and legal pluralism reveal the diversity of juristic responses to contemporary legal challenges while reaffirming the adaptability of Islamic legal reasoning (Hidayah, 2024; Petoft et al., 2024; Al-Shibli, 2025; Okumuş & Gümüş, 2025; Parvizi & Ghodrati, 2025; Tilahun et al., 2025). At the same time, broader discussions concerning Islamic moderation, religious authority, Muslim-friendly public institutions, Islamic higher education reform, and the interaction between religion and state policies indicate that Islamic law increasingly operates within complex technological and socio-political environments (Jati et al., 2022; Hamdy & Eid, 2024; Haruna et al., 2024; Jati, 2024; Muthohirin, 2025; Toyibah & Riyani, 2025). These developments demonstrate that technological transformation should no longer be viewed merely as an external instrument but rather as an integral component of contemporary Islamic legal discourse requiring renewed *ijtihād* grounded in both legal doctrine and scientific advancement.

Although previous studies have significantly contributed to the literature on *qibla* determination, Islamic jurisprudence, digital legal technology, and Islamic family law, they remain fragmented in both theoretical orientation and analytical scope. Existing research predominantly focuses either on astronomical precision, technological applications, or doctrinal legal analysis without constructing an integrated framework that systematically examines digital *qibla* determination through the combined perspectives of *'ilm al-falak*, Islamic

family law, contemporary *fiqh*, *maqāṣid al-sharī'ah*, and emerging digital technologies. This theoretical fragmentation constitutes the principal research gap addressed by the present study. Accordingly, this research develops a comparative legal framework integrating classical Islamic scholarship, contemporary *fiqh*, AI-based spatial technologies, GIS/GPS-supported navigation, and *maqāṣid al-sharī'ah*-oriented legal reasoning to evaluate the legitimacy, accuracy, and legal implications of digital *qibla* determination within contemporary Islamic family law. By bridging these previously disconnected fields, the study contributes a comprehensive interdisciplinary model for understanding how technological innovation can strengthen—not replace—the normative objectives of Islamic law while supporting adaptive legal development in the digital era.

## LITERATURE REVIEW

The scholarly discourse on *qibla* determination has evolved from classical mathematical astronomy into an interdisciplinary field integrating *Islamic jurisprudence*, geodesy, cartography, and digital spatial sciences. Classical Muslim astronomers developed sophisticated mathematical methods for calculating the shortest great-circle distance between a location and the Kaaba, laying the scientific foundation for accurate *qibla* orientation. Early works demonstrated how spherical trigonometry and astronomical observation became indispensable instruments for Islamic ritual practice (Kennedy & ID, 1974; Kennedy, 1984). This scientific tradition was further systematized through the concept of the sacred geography of Islam, where geographical knowledge functioned not merely as technical information but also as a religious instrument for ensuring ritual correctness (King, 2005). Historical investigations of mosque orientations in Anatolia confirmed that Muslim societies continuously refined *qibla* calculations according to the scientific capabilities available in each historical period (Yılmaz, 2012). Likewise, medieval navigation studies reveal that *qibla* determination influenced Islamic cartographic traditions and maritime navigation through geometrically sophisticated mapping techniques (Armienti & Venger, 2018). Contemporary Islamic legal scholarship subsequently reframed these classical astronomical achievements by emphasizing that *fiqh* accommodates scientific advancement without abandoning normative principles. Rather than treating astronomy and religion as competing epistemologies, modern scholars argue that *fiqh* encourages scientific precision while maintaining legal flexibility whenever absolute certainty cannot be achieved (Faiz, 2020; Izzuddin, 2022; Mahmud et al., 2023; Hidayat & Rosele, 2024).

The second major body of literature emphasizes that contemporary *Islamic family law* increasingly responds to complex social transformation by balancing classical legal doctrines with contextual legal reasoning. Early discussions focused on harmonizing Islamic law with national legal systems and local socio-cultural values, particularly in Indonesia, where legal pluralism necessitates continuous legal adaptation (Karimullah, 2022; Insani et al., 2024). Subsequent scholarship broadened this discussion toward protecting minority rights, promoting *Islamic moderation*, and integrating *maqāṣid al-sharī'ah* into legal interpretation (Karimullah, 2023; Mutawali, 2023; Jati, 2024). Within family law specifically, recent studies examine diverse contemporary issues including inheritance rights of children born outside legal marriage, digital family governance, childfree discourse, marriage dispensation, women's legal empowerment, and the evolving role of religious authority in responding to state regulation (Zuhriah, Mayasari, et al., 2023; Zuhriah, Rahmawati, et al., 2023; Maulana et al., 2024; Nurjanah et al., 2024; Hidayah, 2024; Al-Shibli, 2025; Okumuş & Gümüş, 2025; Parvizi & Ghodrati, 2025; Tilahun et al., 2025; Toyibah & Riyani, 2025). Collectively, these studies demonstrate that *Islamic jurisprudence* increasingly operates through contextual interpretation rather than rigid textualism, thereby strengthening the role of *maqāṣid al-sharī'ah* as an interpretive framework capable of responding to evolving legal realities.

Another significant strand of literature concerns the accelerating integration of digital technology into Islamic legal institutions and judicial decision-making. Initial studies mainly discussed digital applications designed to assist judges in handling family law cases, such as Android-based systems supporting marriage dispensation decisions (Zuhriah, Mayasari, et al., 2023). Subsequent research expanded toward artificial intelligence as an emerging instrument for legal reasoning, judicial administration, and dispute resolution within religious courts (Sidqi et al., 2023; Sukindar et al., 2024). Beyond judicial administration, scholars have examined broader digital transformation affecting Muslim societies, including digital governance for family resilience, legal harmonization, and institutional modernization (Nurjanah et al., 2024; Karimullah & Sugitanata, 2025; Ubaidillah & Faiz, 2025). Parallel developments within computer science reveal rapid advances in *Artificial Intelligence*, *Geographic Information Systems (GIS)*, digital twins, spatial analytics, and machine learning capable of improving decision-support systems through highly accurate geospatial modelling and predictive analytics (Enshassi et al., 2025; Gonçalves & Domingues, 2025; Huang et al., 2025; Mansourihanis et al., 2025; Singh et al., 2025). Nevertheless, most technological studies remain largely disconnected from Islamic legal methodologies, indicating that digital

innovation has primarily emphasized computational efficiency while paying comparatively limited attention to jurisprudential legitimacy.

The literature further indicates that *maqāṣid al-sharī'ah* provides an increasingly influential normative framework for integrating scientific innovation, legal reform, and public welfare. Studies on Islamic moderation argue that legal adaptation should preserve essential objectives including religion, life, intellect, lineage, and property while simultaneously responding to contemporary societal challenges (Jati et al., 2022; Karimullah, 2023; Mutawali, 2023; Karimullah & Sugitanata, 2025; Ubaidillah & Faiz, 2025). Similar perspectives emerge in research addressing Muslim minorities, interreligious marriage, inheritance reform, women's rights, and Islamic legal pluralism, all of which emphasize balancing legal certainty with social justice (Haruna et al., 2024; Hamdy & Eid, 2024; Muthohirin, 2025; Okumuş & Gümüş, 2025; Tilahun et al., 2025). Even emerging fields such as *Islamic neurolaw* illustrate the need to reinterpret classical legal principles when confronted with technological and neuroscientific developments affecting legal responsibility and moral accountability (Petoft et al., 2024). Consequently, contemporary scholarship increasingly recognizes *maqāṣid al-sharī'ah* not merely as a doctrinal theory but as a dynamic methodology capable of guiding legal responses toward technological transformation.

Despite substantial progress across these four research streams, important theoretical and methodological gaps remain. Existing studies on *qibla* determination primarily emphasize astronomical precision and historical methodology, whereas research in *Islamic family law* predominantly addresses normative legal reform without systematically incorporating geospatial technologies. Similarly, studies concerning artificial intelligence, *GIS*, and digital innovation generally prioritize technological performance while providing limited engagement with Islamic legal theory and *maqāṣid al-sharī'ah*. Conversely, discussions on Islamic legal reform rarely examine how emerging spatial technologies can strengthen legal certainty in determining *qibla* direction within contemporary family and religious legal practices. Therefore, an integrated conceptual framework connecting *Islamic astronomy*, *Islamic jurisprudence*, *Artificial Intelligence*, *GIS*, and *maqāṣid al-sharī'ah* remains underdeveloped. Addressing this gap constitutes the principal contribution of the present study by proposing an interdisciplinary model in which technological innovation functions not only as a tool for improving computational accuracy but also as an instrument for realizing the higher objectives of Islamic law through scientifically reliable, legally legitimate, and socially beneficial *qibla* determination.

## METHODS

This study employed a qualitative doctrinal research design using an interdisciplinary normative approach that integrates *Islamic jurisprudence*, *Ilmu Falak*, legal theory, digital technology, and *maqāṣid al-sharī'ah*. The selection of this approach is grounded in the assumption that contemporary *qibla* determination cannot be adequately understood through either astronomical calculation or legal interpretation alone, but instead requires an integrated analytical framework capable of reconciling scientific accuracy with normative legitimacy. Classical scholarship demonstrates that *qibla* determination has historically combined mathematical astronomy, spherical trigonometry, and sacred geography (Kennedy & ID, 1974; Kennedy, 1984; King, 2005; Yilmaz, 2012; Armienti & Venger, 2018), while contemporary Islamic legal studies emphasize adaptive *fiqh* reasoning that accommodates scientific development without compromising Islamic legal principles (Faiz, 2020; Izzuddin, 2022; Mahmud et al., 2023; Hidayat & Rosele, 2024). Likewise, recent developments in *Islamic family law* indicate that legal interpretation increasingly adopts contextual and interdisciplinary reasoning to address emerging technological and social challenges (Karimullah, 2022, 2023; Insani et al., 2024; Jati, 2024; Karimullah & Sugitanata, 2025). Therefore, this study adopts doctrinal qualitative analysis because it enables systematic interpretation of legal texts, scientific literature, and technological developments within a unified conceptual framework oriented toward achieving legal certainty, scientific reliability, and public benefit.

Data were collected through comprehensive library research involving classical and contemporary scholarly publications relevant to four interconnected domains: *qibla* determination and *Islamic astronomy*; *Islamic family law* and *Islamic jurisprudence*; *Artificial Intelligence*, *Geographic Information Systems (GIS)*, and digital technologies; and *maqāṣid al-sharī'ah* alongside Muslim minority studies. The analytical corpus consisted of thirty-nine peer-reviewed publications published between 1974 and 2025, ensuring both historical continuity and contemporary relevance. These publications were purposively selected because they collectively represent the theoretical evolution from classical astronomical methodologies toward modern legal and technological innovations. The analysis proceeded through thematic coding, conceptual categorization, and comparative synthesis. Initially, studies concerning *qibla* calculation were examined to identify the evolution of scientific



methodologies from traditional astronomical observation to modern computational systems (Kennedy & ID, 1974; Kennedy, 1984; King, 2005; Yilmaz, 2012; Armienti & Venger, 2018; Faiz, 2020; Izzuddin, 2022; Mahmud et al., 2023). Subsequently, literature addressing legal modernization, family law reform, *maqāṣid al-sharī'ah*, legal pluralism, women's rights, inheritance, and Muslim minority issues was comparatively synthesized to identify contemporary jurisprudential principles (Jati et al., 2022; Karimullah, 2022, 2023; Mutawali, 2023; Zuhriah, Mayasari, et al., 2023; Zuhriah, Rahmawati, et al., 2023; Hidayah, 2024; Maulana et al., 2024; Nurjanah et al., 2024; Al-Shibli, 2025; Okumuş & Gümüş, 2025; Parvizi & Ghodrati, 2025; Tilahun et al., 2025; Toyibah & Riyani, 2025). Finally, studies concerning AI, GIS, digital twins, spatial intelligence, and legal technologies were analyzed to evaluate their applicability for supporting Islamic legal decision-making (Sidqi et al., 2023; Sukindar et al., 2024; Enshassi et al., 2025; Gonçalves & Domingues, 2025; Huang et al., 2025; Mansourihanis et al., 2025; Singh et al., 2025).

The analytical procedure followed three sequential stages. First, descriptive analysis was employed to map the evolution of theoretical perspectives across the four knowledge domains. Second, comparative legal analysis was conducted to identify convergences and divergences between classical *fiqh*, contemporary *Islamic jurisprudence*, and emerging digital technologies. Third, an integrative synthesis was undertaken using *maqāṣid al-sharī'ah* as the principal analytical lens for evaluating whether technological innovation contributes to the realization of legal certainty (*hiḍḍ al-dīn*), protection of intellect (*hiḍḍ al-'aql*), preservation of social welfare (*maṣlaḥah*), and equitable legal outcomes. This interpretive framework also enabled critical assessment of broader legal transformations involving religious authority, legal modernization, Islamic moderation, digital governance, and institutional adaptation in Muslim societies (Jati et al., 2022; Karimullah, 2023; Hamdy & Eid, 2024; Haruna et al., 2024; Petoft et al., 2024; Muthohirin, 2025; Ubaidillah & Faiz, 2025). Rather than evaluating technological capability solely from an engineering perspective, this study examines digital innovation as a jurisprudential instrument whose legitimacy depends upon its consistency with Islamic legal objectives. Through this interdisciplinary methodological framework, the study develops a comprehensive conceptual model that connects *Ilmu Falak*, *Artificial Intelligence*, *GIS*, and *Islamic jurisprudence* in supporting scientifically accurate, legally legitimate, and *maqāṣid*-oriented *qibla* determination for contemporary Muslim societies.

## RESULT AND DISCUSSION

### Reconstructing the Integration of *Fiqh al-Qibla*, Islamic Family Law, and *Maqāṣid al-Sharī'ah* in Determining Qibla Direction for Muslim Minority Families

The determination of the *qibla* has historically evolved from a purely astronomical endeavor into an interdisciplinary discourse involving Islamic jurisprudence, legal reasoning, geographical science, and more recently digital technology. Classical Muslim scholars relied on mathematical astronomy, spherical geometry, and celestial observations to establish the direction of the Kaaba with remarkable precision. Early scientific works by al-Bīrūnī and Abū al-Wafā' demonstrated that determining the *qibla* required rigorous mathematical calculations rather than simple estimation (Kennedy & ID, 1974; Kennedy, 1984). This scientific tradition was further refined through the concept of the sacred geography of Islam, which positioned the Kaaba as the central spatial reference for Muslim worship across different geographical regions (King, 2005). Historical studies likewise reveal that mosque orientations across Anatolia and medieval maritime navigation reflected continuous efforts to reconcile religious obligations with astronomical knowledge despite technological limitations (Yilmaz, 2012; Armienti & Venger, 2018). Contemporary scholarship has reaffirmed that *fiqh al-qibla* should not merely preserve historical calculation techniques but also embrace scientific development while maintaining legal certainty and flexibility. The principle of *ijtihād* remains central because determining the *qibla* is fundamentally an exercise in maximizing certainty (*ghalabat al-zann*) rather than demanding absolute mathematical perfection (Faiz, 2020; Izzuddin, 2022; Mahmud et al., 2023). Consequently, reconstruction of *fiqh al-qibla* requires integrating classical astronomical heritage with modern scientific instruments without abandoning the normative objectives of Islamic law.

Beyond astronomical precision, determining the *qibla* also possesses significant implications for Islamic family law because family worship constitutes the primary context in which Muslims continuously practice religious obligations. Families living in Muslim-majority societies usually benefit from standardized mosque orientations and institutional religious guidance, whereas Muslim minority communities frequently encounter uncertainty arising from geographical limitations, limited religious infrastructure, and differing legal environments. In this context, *fiqh al-qibla* extends beyond technical measurement into the broader domain of legal protection for religious practice within the family. Indonesian scholarship has emphasized that Islamic law continuously adapts to changing social realities through harmonization between religious norms and national legal systems

(Karimullah, 2022). Such adaptation also includes recognizing local wisdom and contextual legal interpretation as legitimate sources supporting Islamic legal implementation (Insani et al., 2024). Likewise, modernization of *fiqh* encourages scholars to reinterpret classical doctrines without compromising fundamental Islamic principles (Hidayat & Rosele, 2024). The implications become particularly evident in protecting the rights of religious minorities, where Islamic jurisprudence increasingly emphasizes inclusiveness, legal harmony, and recognition of diverse socio-cultural contexts (Karimullah, 2023). More recent developments further demonstrate that nationalist *fiqh* seeks to integrate Islamic values with civic responsibilities to address contemporary social challenges while preserving religious authenticity (Karimullah & Sugitanata, 2025). Therefore, the legal reconstruction of *qibla* determination should be understood as part of broader Islamic family law that safeguards the continuity of worship for Muslim families regardless of demographic or political circumstances.

The reconstruction proposed in this study is further strengthened through the perspective of *maqāṣid al-sharī'ah*, which provides normative justification for integrating scientific innovation into religious practice. The preservation of religion (*hifẓ al-dīn*) cannot be separated from protecting family integrity (*hifẓ al-nasl*), intellectual development (*hifẓ al-'aql*), and public welfare (*maṣlahah*). Consequently, employing modern astronomical instruments or digital technologies does not contradict Islamic law but rather facilitates the realization of these higher objectives. Contemporary scholarship identifies *maqāṣid al-sharī'ah* as an effective philosophical foundation for strengthening Islamic moderation and preventing rigid legal formalism (Mutawali, 2023). Similar perspectives are reflected in studies emphasizing Islamic moderation as a dynamic process of balancing textual fidelity with contextual realities (Jati et al., 2022). Architectural and educational reforms within Islamic institutions likewise illustrate how moderation enables religious values to remain relevant amid social transformation (Ubaidillah & Faiz, 2025). Accordingly, the determination of the *qibla* should not be viewed solely as compliance with ritual obligations but as part of a broader legal framework aimed at ensuring accessible, accurate, and equitable religious practice. This perspective is particularly important for Muslim minority families who often require practical legal guidance capable of accommodating geographical diversity while maintaining conformity with Islamic jurisprudence.

The rapid development of digital technology further expands opportunities for reconstructing *fiqh al-qibla*. Artificial intelligence, digital legal systems, and mobile-based applications have significantly transformed the administration of Islamic law, particularly within religious courts and family law institutions. Recent studies indicate that artificial intelligence possesses considerable potential to support legal reasoning, improve consistency in judicial decision-making, and accelerate legal services without replacing human judicial authority (Sidqi et al., 2023; Sukindar et al., 2024). Digital innovations have similarly been introduced into marriage dispensation systems and broader family law administration, demonstrating that technological adoption can enhance legal accessibility while preserving procedural legitimacy (Zuhriah, Mayasari, et al., 2023). The digital era also presents new legal debates surrounding family ethics, reproductive choices, and evolving religious authority, thereby requiring Islamic jurisprudence to respond adaptively to emerging societal issues (Zuhriah, Rahmawati, et al., 2023). Moreover, collaborative governance between state institutions and religious organizations has become increasingly important in maintaining family harmony amid digital transformation (Nurjanah et al., 2024). Rather than replacing traditional *ijtihād*, digital technology should therefore be understood as an instrument supporting more accurate legal implementation, particularly when integrated with established astronomical methods for *qibla* determination.

Based on these developments, this study argues that reconstructing *fiqh al-qibla* requires a multidimensional framework integrating classical astronomy, Islamic family law, and *maqāṣid al-sharī'ah* within the context of contemporary technological advancement. Earlier scholarship has predominantly examined these dimensions separately, focusing either on astronomical calculations, family law, or legal modernization. Consequently, limited attention has been given to developing an integrated model capable of addressing the practical challenges encountered by Muslim minority families in determining the *qibla*. This study therefore proposes that accurate *qibla* determination should be understood not merely as a technical issue but as a comprehensive legal process involving scientific validity, jurisprudential legitimacy, family protection, and realization of public welfare. Such an integrative reconstruction contributes theoretically by bridging the historical legacy of Islamic astronomy with contemporary legal theory and contributes practically by providing a conceptual foundation for digital *qibla* governance that remains faithful to the objectives of Islamic law while responding to the realities of increasingly pluralistic societies.

**Table 1. Evolution of *Qibla* Determination and Its Juridical Reconstruction**

| Historical Phase           | Primary Approach                            | Juridical Orientation                                | Main Limitation                                | Proposed Reconstruction                                                              |
|----------------------------|---------------------------------------------|------------------------------------------------------|------------------------------------------------|--------------------------------------------------------------------------------------|
| <b>Classical period</b>    | Naked-eye astronomy, spherical trigonometry | <i>Ijtihād</i> based on celestial observation        | Limited measurement precision                  | Integration with digital astronomical verification                                   |
| <b>Medieval period</b>     | Mathematical geography and navigation       | Expansion of <i>fiqh al-qibla</i> across regions     | Regional methodological variation              | Harmonization through standardized spatial analysis                                  |
| <b>Contemporary period</b> | GPS, GIS, AI-assisted computation           | <i>Maqāsid al-sharī'ah</i> -oriented legal reasoning | Fragmented legal and technological integration | Integrated framework combining astronomy, Islamic family law, and digital technology |

Source: Authors' analysis (2025).

### Artificial Intelligence, GIS, and Digital Legal Technology for Contemporary *Qibla* Verification

The rapid advancement of digital technology has fundamentally transformed how religious legal issues are addressed, including the determination of the *qibla*. While classical Islamic astronomy relied heavily on manual observations, trigonometric calculations, and geographical estimation, contemporary digital ecosystems enable the integration of *Global Positioning System* (GPS), *Geographic Information Systems* (GIS), *Artificial Intelligence* (AI), remote sensing, and spatial analytics into a unified decision-support framework. These technological developments do not replace Islamic jurisprudence but instead strengthen the scientific reliability of *ijtihad* by providing increasingly precise geographical information. Within the context of *fiqh al-qibla*, digital transformation should therefore be understood as an extension of the long-standing Islamic scientific tradition that continuously integrates new knowledge to facilitate the fulfillment of religious obligations. This perspective is consistent with earlier studies demonstrating that Islamic legal reasoning has historically accommodated scientific development whenever such innovation contributes to greater legal certainty and public benefit (Faiz, 2020; Hidayat & Rosele, 2024; Mahmud et al., 2023). Accordingly, the integration of AI and GIS into *qibla* verification represents not a departure from classical jurisprudence but rather its contemporary continuation under the principles of *maqāsid al-sharī'ah*.

Recent developments in legal technology further demonstrate that artificial intelligence has begun reshaping various dimensions of Islamic legal administration. Studies on Religious Courts indicate that AI can support legal analysis, organize evidence, improve procedural efficiency, and assist judges in processing increasingly complex legal disputes while maintaining human authority over final decisions (Sidqi et al., 2023; Sukindar et al., 2024). Similar digital innovations have also emerged through Android-based legal applications assisting judges in marriage dispensation cases, illustrating how algorithmic systems may enhance legal consistency without undermining judicial discretion (Zuhriah, Mayasari, et al., 2023). Beyond judicial administration, digital technologies have stimulated broader discussions concerning family law, including childfree discourse, reproductive ethics, and the evolution of religious authority within online environments (Zuhriah, Rahmawati, et al., 2023). Collaborative governance between governmental institutions and religious organizations likewise illustrates that digital transformation has become an integral component of maintaining family harmony in contemporary Muslim societies (Nurjanah et al., 2024). Consequently, extending similar technological innovations into *qibla* verification constitutes a logical progression because both domains seek to improve legal certainty while preserving the normative authority of Islamic jurisprudence.

From a technological perspective, AI, GIS, and spatial computing provide complementary capabilities that substantially improve the accuracy and transparency of *qibla* determination. AI contributes by processing large datasets, recognizing spatial patterns, and optimizing computational models that estimate directional accuracy under varying geographical conditions. GIS strengthens this process by integrating geographical coordinates, satellite imagery, digital elevation models, and spatial databases to visualize precise *qibla* orientation in real time. Recent studies demonstrate that *Generative Spatial Artificial Intelligence* significantly enhances spatial decision-making by combining large-scale geographical information with intelligent analytical models capable of supporting sustainable urban management (Huang et al., 2025). Similarly, GIS has evolved into one of the most powerful analytical instruments for spatial verification because it enables comprehensive visualization, mapping accuracy, and multi-layer geographical analysis (Mansourihanis et al., 2025). Advances in AI-supported data

management further strengthen analytical reliability by integrating *machine learning*, intelligent databases, and *digital twin* technologies capable of simulating complex spatial environments with high computational efficiency (Singh et al., 2025). Although these technologies were initially developed for urban governance and infrastructure management, their analytical principles can be adapted effectively for Islamic astronomical applications, including *qibla* verification and mosque orientation planning.

The integration of AI into Islamic legal governance must nevertheless remain guided by ethical principles rather than technological determinism. Evidence from studies on AI adoption indicates that organizational readiness, institutional trust, technological literacy, and regulatory support significantly influence successful implementation of intelligent systems (Enshassi et al., 2025). Likewise, research on AI-driven intelligent logistics emphasizes that artificial intelligence functions most effectively as a decision-support instrument instead of an autonomous decision-maker, particularly in domains requiring ethical judgment and contextual interpretation (Gonçalves & Domingues, 2025). These findings are highly relevant to *fiqh al-qibla* because determining the direction of prayer ultimately remains a juridical exercise rooted in *ijtihad*. AI may accelerate calculations, automate geographical analysis, and reduce human error; however, legal legitimacy continues to depend upon scholarly interpretation grounded in Islamic jurisprudence. Therefore, digital technology should complement—not replace—the interpretative role of Islamic scholars, *muftis*, and *fatwa* experts. Such an approach preserves the balance between technological innovation and religious authority while preventing overreliance on algorithmic outputs that may neglect contextual legal considerations.

The synthesis of these findings demonstrates that contemporary *qibla* verification requires an integrated digital ecosystem combining AI, GIS, GPS, and Islamic legal reasoning within a *maqāṣid al-sharī'ah* framework. Rather than viewing technology merely as an instrument for improving computational precision, this study argues that digital innovation should be conceptualized as a mechanism for strengthening accessibility, transparency, legal certainty, and inclusiveness for Muslim communities, particularly those living as religious minorities. Through intelligent spatial analysis, automated verification, and interactive digital applications, Muslim families may obtain more reliable *qibla* information regardless of geographical constraints. Simultaneously, maintaining scholarly supervision ensures that technological outputs remain consistent with the principles of Islamic jurisprudence. Accordingly, the proposed integration represents a new paradigm of digital *fiqh al-qibla* in which classical astronomical knowledge, contemporary spatial technologies, and normative Islamic legal values operate synergistically to achieve greater public benefit (*maṣlaḥah*) while preserving the integrity of religious practice.

**Table 2. Comparative Contribution of Digital Technologies to Contemporary *Qibla* Verification**

| Technology                                 | Primary Function                       | Main Strength                             | Potential Limitation                  | Juridical Contribution                                   |
|--------------------------------------------|----------------------------------------|-------------------------------------------|---------------------------------------|----------------------------------------------------------|
| GPS                                        | Coordinate positioning                 | High positional accuracy                  | Signal dependency                     | Improves certainty of observation location               |
| GIS                                        | Spatial mapping and visualization      | Multi-layer spatial analysis              | Requires reliable geospatial database | Verifies <i>qibla</i> orientation geographically         |
| Artificial Intelligence                    | Intelligent computation and prediction | Automated analysis and error reduction    | Requires ethical supervision          | Supports <i>ijtihad</i> through decision-support systems |
| <i>Machine Learning &amp; Digital Twin</i> | Simulation and optimization            | Scenario modeling and continuous learning | High computational resources          | Assists policy simulation and institutional planning     |

Source: Authors' analysis (2025).

### **Toward a *Maqāṣid al-Sharī'ah*-Based Framework for *Qibla* Determination among Muslim Minority Communities**

The increasingly diverse socio-religious landscape of contemporary society requires a more adaptive approach to *qibla* determination, particularly for Muslim minority communities that frequently encounter legal, geographical, and institutional constraints. Unlike Muslim-majority countries, where standardized mosque orientations, official fatwas, and religious institutions provide clear guidance, Muslims living as minorities often rely on limited resources, digital applications, or individual *ijtihad* when determining the direction of prayer. Consequently, *qibla* determination should no longer be perceived solely as a technical astronomical calculation but rather as a



multidimensional legal issue involving religious freedom, family resilience, social inclusion, and public welfare. Studies on Islamic moderation indicate that contemporary Islamic jurisprudence increasingly emphasizes contextual legal reasoning capable of responding to pluralistic societies without compromising fundamental religious principles (Jati et al., 2022). Likewise, critical analyses of Islamic populism demonstrate that legal authority within Muslim societies continues to evolve alongside changing political and social realities, making contextual *ijtihad* increasingly essential in addressing practical religious challenges (Jati, 2024). These developments suggest that *fiqh al-qibla* should likewise evolve beyond conventional astronomical discourse toward a more inclusive legal framework capable of accommodating demographic diversity while maintaining doctrinal legitimacy.

The relevance of this reconstruction becomes more evident when examined through contemporary developments in Islamic family law and comparative jurisprudence. Muslim minority families frequently navigate complex legal environments characterized by interactions between Islamic law, state regulations, customary practices, and multicultural social norms. Research from Aceh illustrates that Islamic legal practice often develops through continuous negotiation between religious doctrine, local customs, and national legislation rather than through rigid legal formalism (Hidayah, 2024). Similar patterns emerge in studies examining Muslim-friendly social environments, where institutional support significantly influences the confidence of Muslims in practicing their religious obligations within non-Muslim settings (Hamdy & Eid, 2024). Evidence from Cameroon likewise demonstrates that legal certainty and institutional trust substantially affect Muslim communities' willingness to adopt Islamic legal and financial institutions outside Muslim-majority jurisdictions (Haruna et al., 2024). These findings collectively indicate that the effectiveness of *qibla* determination cannot be separated from broader institutional ecosystems that provide accessible legal guidance, educational resources, and reliable technological infrastructure. Therefore, developing a comprehensive *maqāsid*-based framework requires integrating legal certainty with institutional accessibility so that Muslim minority families may consistently fulfill religious obligations regardless of geographical circumstances.

A *maqāsid al-sharī'ah* perspective provides the normative foundation for this integration by emphasizing that Islamic law seeks to preserve essential human interests through flexible yet principled legal reasoning. In the context of *qibla* determination, protecting religion (*ḥifẓ al-dīn*) extends beyond ensuring directional accuracy to facilitating sustainable religious practice within diverse social environments. Simultaneously, preserving family (*ḥifẓ al-nasl*) requires ensuring that households possess reliable access to accurate worship guidance, particularly where formal religious institutions remain limited. The preservation of intellect (*ḥifẓ al-'aql*) encourages the responsible adoption of scientific knowledge and digital innovation as legitimate instruments for strengthening religious understanding rather than replacing scholarly authority. Furthermore, the realization of *maṣlaḥah* supports technological solutions that reduce uncertainty, improve legal accessibility, and enhance public confidence in religious practice. Comparative studies concerning women's legal empowerment, reproductive jurisprudence, and family law reforms further illustrate that Islamic jurisprudence has consistently demonstrated adaptive capacity when addressing contemporary social challenges (Okumuş & Gümüş, 2025; Parvizi & Ghodrati, 2025). Likewise, studies on *Islamic neurolaw* reveal that emerging technologies and modern scientific knowledge increasingly require Islamic legal theory to formulate more contextual and interdisciplinary responses without abandoning its normative foundations (Petoft et al., 2024). These developments reinforce the argument that integrating AI, GIS, and digital legal technologies into *qibla* determination represents a continuation of Islamic legal dynamism rather than a departure from classical jurisprudence.

The proposed framework also acknowledges that Muslim minority communities experience unique socio-cultural realities requiring inclusive legal governance. Interreligious interactions, multicultural family structures, and varying state policies frequently shape how Islamic legal norms are implemented in everyday life. Research on interreligious marriage in Ethiopia demonstrates that Muslim communities often develop pragmatic legal adaptations enabling religious continuity within pluralistic societies (Tilahun et al., 2025). Similarly, debates surrounding religious authority in Indonesia indicate that contemporary legal governance increasingly requires collaboration among religious institutions, governmental agencies, and civil society organizations to address emerging social issues effectively (Toyibah & Riyani, 2025). Educational transformation within Islamic universities further illustrates the necessity of revitalizing Islamic studies through interdisciplinary approaches that combine classical scholarship with technological literacy and social responsiveness (Muthohirin, 2025). Parallel developments in comparative Islamic law, including discussions regarding female arbitrators and constitutional reforms in Muslim countries, confirm that Islamic jurisprudence continues expanding its

interpretative scope while remaining anchored in the objectives of *maqāṣid al-sharī'ah* (Al-Shibli, 2025). Collectively, these findings support the conclusion that future *fiqh al-qibla* should be embedded within a collaborative legal ecosystem involving astronomers, Islamic jurists, GIS specialists, AI developers, policymakers, and community organizations rather than relying exclusively on traditional astronomical expertise.

Based on the synthesis of classical Islamic astronomy, contemporary family law, digital technology, and *maqāṣid al-sharī'ah*, this study proposes a conceptual framework for *qibla* determination that is simultaneously scientifically accurate, legally legitimate, technologically adaptive, and socially inclusive. Unlike previous approaches that primarily emphasized astronomical precision, the proposed model positions *qibla* determination as an integrated legal process supporting religious freedom, family resilience, educational development, and public welfare. AI and GIS function as intelligent analytical instruments that enhance measurement accuracy, while Islamic jurisprudence provides ethical supervision ensuring that technological outputs remain consistent with the objectives of Islamic law. Within this framework, *maqāṣid al-sharī'ah* serves as the normative bridge connecting scientific innovation with religious legitimacy, thereby enabling Muslim minority families to practice Islam confidently despite geographical and institutional limitations. Consequently, the proposed framework contributes theoretically by expanding the interdisciplinary discourse on *fiqh al-qibla* and contributes practically by offering policy guidance for Islamic religious authorities, *falak* institutions, developers of digital *qibla* applications, and governments seeking to strengthen inclusive religious services in increasingly pluralistic societies.

**Table 3. Proposed *Maqāṣid al-Sharī'ah*-Based Framework for Contemporary *Qibla* Determination**

| Framework Dimension      | <i>Maqāṣid al-Sharī'ah</i> Principle | Supporting Technology                   | Expected Legal Outcome                                     |
|--------------------------|--------------------------------------|-----------------------------------------|------------------------------------------------------------|
| Religious Protection     | <i>Hifẓ al-Dīn</i>                   | AI, GPS, GIS                            | Accurate and reliable <i>qibla</i> determination           |
| Family Protection        | <i>Hifẓ al-Nasl</i>                  | Mobile <i>qibla</i> applications        | Strengthened family worship practices                      |
| Intellectual Development | <i>Hifẓ al-'Aql</i>                  | Digital education, AI-assisted learning | Improved legal and astronomical literacy                   |
| Public Welfare           | <i>Maṣlaḥah</i>                      | Integrated digital legal platforms      | Accessible and inclusive religious services                |
| Legal Governance         | Contextual <i>Ijtihād</i>            | AI-supported decision support systems   | Harmonization between technology and Islamic jurisprudence |

Source: Authors' analysis (2025).

## CONCLUSION

This study demonstrates that contemporary *qibla* determination should no longer be understood solely as an issue of astronomical calculation but rather as an interdisciplinary legal framework integrating *fiqh al-qibla*, *Islamic family law*, digital technology, and *maqāṣid al-sharī'ah*. Addressing the first research objective, the findings reveal that the historical evolution of *qibla* determination—from classical Islamic astronomy based on spherical trigonometry and celestial observation to modern digital computation—provides a strong foundation for reconstructing Islamic legal reasoning that remains faithful to both scientific accuracy and jurisprudential legitimacy. Rather than treating astronomy and Islamic law as separate disciplines, this study confirms that *ijtihād* concerning *qibla* determination should operate through a dynamic interaction between empirical evidence and normative legal principles. Such an integrative approach strengthens legal certainty while simultaneously protecting the continuity of worship for Muslim families, particularly those living in minority contexts where institutional religious support and standardized *qibla* infrastructure are often limited.

The second and third research objectives are addressed through the development of an integrated framework combining *Artificial Intelligence* (AI), *Geographic Information Systems* (GIS), GPS technology, and *maqāṣid al-sharī'ah*-oriented legal reasoning. The findings indicate that AI and spatial technologies should function as decision-support instruments rather than substitutes for scholarly *ijtihād*, enabling more accurate, transparent, and accessible *qibla* verification while preserving the ethical authority of Islamic jurisprudence. From this perspective, *maqāṣid al-sharī'ah* provides the normative bridge connecting scientific innovation with religious legitimacy through the protection of religion (*hifẓ al-dīn*), family (*hifẓ al-nasl*), intellect (*hifẓ al-'aql*), and public welfare (*maṣlaḥah*). The principal novelty of this research therefore lies in proposing an integrated *maqāṣid al-sharī'ah*-

based framework that synthesizes Islamic astronomy, *fiqh al-qibla*, *Islamic family law*, and AI-GIS technologies into a unified conceptual model specifically designed for Muslim minority communities. This framework extends previous studies that generally examined these dimensions independently by offering a comprehensive interdisciplinary model capable of guiding future legal policy, digital religious services, and the development of intelligent *qibla* verification systems. Accordingly, this study contributes theoretically by enriching the discourse on Islamic legal reconstruction in the digital era and contributes practically by providing policy recommendations for religious authorities, *falak* institutions, software developers, and governments seeking to strengthen inclusive religious services through responsible technological innovation.

Despite these contributions, this study has several limitations. The proposed framework remains conceptual and is primarily derived from qualitative doctrinal analysis and interdisciplinary literature synthesis without empirical validation through field implementation or experimental testing of AI- and GIS-based *qibla* verification systems. Consequently, the practical effectiveness of the framework across different geographical, cultural, and legal environments has not yet been systematically evaluated. Future studies should therefore employ mixed-method or quantitative approaches by integrating real-time geospatial data, AI-assisted simulation models, and comparative field studies involving Muslim minority communities across different countries. Such empirical investigations would enable further refinement of the proposed framework while assessing its legal, technological, and social effectiveness in supporting accurate, inclusive, and *maqāṣid*-oriented *qibla* determination within increasingly diverse global Muslim societies.

## REFERENCES

- Al-Shibli, F. S. (2025). The appointment of female arbitrators—What do *Islamic law* and the constitutions of Arab Muslim countries really say? *Women's Studies International Forum*, 110, 103096. <https://doi.org/10.1016/j.wsif.2025.103096>
- Armienti, P., & Venger, A. M. (2018). A Middle Age Qibla finder and the secret code of Portolan maps. *Journal of Cultural Heritage*, 29, 137–144. <https://doi.org/10.1016/j.culher.2017.07.001>
- Enshassi, M., Nathan, R. J., Soekmawati, & Ismail, H. (2025). Unveiling barriers and drivers of AI adoption for digital marketing in Malaysian SMEs. *Journal of Open Innovation: Technology, Market, and Complexity*, 11(2), 100519. <https://doi.org/10.1016/j.joitmc.2025.100519>
- Faiz, A. K. (2020). *Fiqh* moderation on *Qibla* direction determination: Flexible accuracy (Moderasi *Fiqh* pada Penentuan Arah Kiblat: Akurasi yang Fleksibel). *Journal of Islamic Law*, 1(1). <https://doi.org/10.24260/jil.v1i1.23>
- Gonçalves, R., & Domingues, L. (2025). Artificial intelligence driving intelligent logistics: Benefits, challenges, and drawbacks. *Procedia Computer Science*, 256, 665–672. <https://doi.org/10.1016/j.procs.2025.02.165>
- Hamdy, A., & Eid, R. (2024). Muslim-friendly tourist destination image in the travel and hospitality industry: Conceptualization and scale development. *International Journal of Intercultural Relations*, 102, 102043. <https://doi.org/10.1016/j.ijintrel.2024.102043>
- Haruna, A., Oumbé, H. T., & Kountchou, A. M. (2024). What determines the adoption of Islamic finance products in a non-Islamic country? Empirical evidence from Cameroonian small- and medium-sized enterprises. *Journal of Islamic Marketing*, 15(5), 1253–1279. <https://doi.org/10.1108/JIMA-08-2023-0234>
- Hidayah, S. (2024). From unity in diversity to culture wars? Aceh women's mastery over *adat*, Islam, and the state inheritance laws. *Women's Studies International Forum*, 103, 102881. <https://doi.org/10.1016/j.wsif.2024.102881>
- Hidayat, M., & Rosele, M. I. (2024). Modernization of *fiqh* in the contemporary era: A study of Yusuf al-Qardhawi's *fiqh* thought. *MIQOT: Jurnal Ilmu-ilmu Keislaman*, 48(1). <https://doi.org/10.30821/miqot.v48i1.1124>
- Huang, J., Bibri, S. E., & Keel, P. (2025). Generative spatial artificial intelligence for sustainable smart cities: A pioneering large flow model for urban digital twin. *Environmental Science and Ecotechnology*, 24, 100526. <https://doi.org/10.1016/j.es.2025.100526>
- Insani, N., B, S., Karimullah, S. S., Gönan, Y., & Sulastri, S. (2024). Islamic law and local wisdom: Exploring legal scientific potential in integrating local cultural values. *Kanun Jurnal Ilmu Hukum*, 26(1). <https://doi.org/10.24815/kanun.v26i1.32930>
- Izzuddin, A. (2022). The problems of the relationship between science and religion in *Qibla* direction calibration at the Great Mosque of Demak and Baiturrahman Mosque in Semarang, Indonesia. *Journal of Islamic Law*, 3(2). <https://doi.org/10.24260/jil.v3i2.823>

- Jati, W. R. (2024). Critical analysis of Islamic populism: Insights from Indonesian perspectives. *Journal of Indonesian Islam*, 18(1). <https://doi.org/10.15642/JIIS.2024.18.1.27-48>
- Jati, W. R., Halimatusa'diah, H., Syamsurijal, S., Aji, G. B., Nurkhoiron, M., & Tirtosudarmo, R. (2022). From intellectual to advocacy movement: Islamic moderation, the conservatives, and the shift of interfaith dialogue campaign in Indonesia. *Ulumuna*, 26(2). <https://doi.org/10.20414/ujis.v26i2.572>
- Karimullah, S. S. (2022). Pursuing legal harmony: Indonesianization of Islamic law concept and its impact on national law. *Mazahib*, 21(2). <https://doi.org/10.21093/mj.v21i2.4800>
- Karimullah, S. S. (2023). The implications of Islamic law on the rights of religious minorities in Muslim-majority countries. *MILRev: Metro Islamic Law Review*, 2(2). <https://doi.org/10.32332/milrev.v2i2.7847>
- Karimullah, S. S., & Sugitanata, A. (2025). Masnun Tahir's nationalist *fiqh*: The integration of Islam and nationalism in addressing social challenges in Indonesia. *Addin*, 18(2). <https://doi.org/10.21043/addin.v18i2.20218>
- Kennedy, E. S. (1984). Applied mathematics in the tenth century: Abu al-Wafā' calculates the distance between Baghdad and Mecca. *Historia Mathematica*, 11(2), 193–206. [https://doi.org/10.1016/S0315-0860\(84\)80008-7](https://doi.org/10.1016/S0315-0860(84)80008-7)
- Kennedy, E. S., & ID, Y. (1974). A letter of al-Bīrūnī: Ḥabash al-Ḥāsib's analemma for the *Qibla*. *Historia Mathematica*, 1(1), 3–11. [https://doi.org/10.1016/0315-0860\(74\)90161-X](https://doi.org/10.1016/0315-0860(74)90161-X)
- King, D. A. (2005). The sacred geography of Islam. In T. Koetsier & L. Bergmans (Eds.), *Mathematics and the divine* (pp. 161–178). Elsevier. <https://doi.org/10.1016/B978-044450328-2/50010-2>
- Mahmud, H., Bahran, B., Ipansyah, N., Faridah, S., & Ruslan, R. (2023). Understanding *Qibla* orientation through the *Nagara* artificial compass: A *falak* legal perspective. *Syariah: Jurnal Hukum dan Pemikiran*, 23(1), 78–91. <https://doi.org/10.18592/sjhp.v22i2.6492>
- Mansourihanis, O., Maghsoodi Tilaki, M. J., Armitage, R., & Zaroujtaghi, A. (2025b). Evolution and prospects of geographic information systems (GIS) applications in urban crime analysis: A review of the literature. *Remote Sensing Applications: Society and Environment*, 38, 101583. <https://doi.org/10.1016/j.rsase.2025.101583>
- Maulana, A., Akbar, Z., Habibie, R. A., Norhadi, M., & Hasuna, K. (2024). Inheritance rights of *nasabiyah* children born out of wedlock according to Islamic family law. *El-Usrah: Jurnal Hukum Keluarga*, 7(2), 444–461. <https://doi.org/10.22373/ujhk.v7i2.25072>
- Mutawali. (2023). *Maqāṣid al-Sharī'ah* as the foundation of Islamic moderation: Theo-philosophical insight against extreme religious ideology. *Ulumuna*, 27(1). <https://doi.org/10.20414/ujis.v27i1.560>
- Muthohirin, N. (2025). Revitalizing Islamic studies: A two-decade conversion in Indonesia's state Islamic universities. *Social Sciences & Humanities Open*, 12, 102153. <https://doi.org/10.1016/j.ssaho.2025.102153>
- Nurjanah, S., Ferliadi, A. S., Jafar, W. A., Firdaus, W. Y., & Hamamah, F. (2024). Mitigating the digital age impact: Collaborative strategies of state and religious institutions for family harmony in Indonesia. *El-Usrah: Jurnal Hukum Keluarga*, 7(2), 713–741. <https://doi.org/10.22373/ujhk.v7i2.25754>
- Okumuş, H. Ş., & Gümüş, M. A. (2025). Revitalizing *mahr* for Muslim women's empowerment within Türkiye's secular legal system. *Social Sciences & Humanities Open*, 12, 101644. <https://doi.org/10.1016/j.ssaho.2025.101644>
- Parvizi, S., & Ghodrati, F. (2025). A comparative approach to the legitimacy of uterine surrogacy in jurisprudence in Iran and some Muslim countries in the Middle East: A systematic review. *Current Women's Health Reviews*, 21(2). <https://doi.org/10.2174/0115734048256307231124074455>
- Petoft, A., Abbasi, M., & Zali, A. (2024). Loss of free will from the perspective of Islamic neurolaw: The Iranian criminal justice system. *Médecine & Droit*, 184, 1–10. <https://doi.org/10.1016/j.meddro.2023.08.002>
- Sidqi, I., Nisa, S. M., & Daini, H. S. (2023). Development of artificial intelligence in the dispute resolution of religious courts. *Jurnal Hukum Islam*, 21(1). <https://doi.org/10.28918/jhi.v21i1.04>
- Singh, S. K., Kumar, S., Goyal, S., Arya, V., Attar, R. W., Gupta, B. B., Alhomoud, A., & Chui, K. T. (2025). Leveraging AI and machine learning for enhanced data analytics and visualization in database management with digital twins. *Journal of Database Management*, 36(1). <https://doi.org/10.4018/JDM.388135>
- Sukindar, Kusnianto, H., Sarikun, Pasaribu, B. K., & Sahmat, M. S. (2024). Legal innovation in religious courts: The potential utilization of artificial intelligence (AI) in resolving contemporary cases. *MILRev: Metro Islamic Law Review*, 3(2). <https://doi.org/10.32332/milrev.v3i2.8199>
- Tilahun, M. A., Gatisso, M. M., & Ali, A. M. (2025). Interreligious marriage in Wollo, Ethiopia: Historical factors underpinning its development and prevalence. *Social Sciences & Humanities Open*, 11, 101611. <https://doi.org/10.1016/j.ssaho.2025.101611>





- Toyibah, D., & Riyani, I. (2025). Contesting religious authority in response to government regulations on the prevention and handling of campus sexual violence (CSV) in Indonesia. *Women's Studies International Forum*, 110, 103085. <https://doi.org/10.1016/j.wsif.2025.103085>
- Ubaidillah, & Faiz, M. F. (2025). Beyond the sacred walls: Reimagining *pesantren*'s architecture of Islamic moderation. *Uhumuna*, 29(1). <https://doi.org/10.20414/ujis.v29i1.1362>
- Yilmaz, M. (2012). Historical mosque orientation in Turkey: Central-Western Anatolia Region, 1150–1590. *Journal of Historical Geography*, 38(4), 359–371. <https://doi.org/10.1016/j.jhg.2012.06.002>
- Zuhriah, E., Mayasari, L. D., Rahmawati, E. S., Razak, A. Q. B. A., & Sukadi, I. (2023). *Dispen-Ku*: Android-based application assisting religious court judges in deciding marriage dispensation. *Al-Ihkam: Jurnal Hukum & Pranata Sosial*, 18(2). <https://doi.org/10.19105/al-lhkam.v18i2.8773>
- Zuhriah, E., Rahmawati, E. S., Aprilyanti, M., Chaidaroh, U., & Ch, M. (2023). Childfree, the digital era, and Islamic law: Views of Nahdlatul Ulama, Muhammadiyah, and gender activists in Malang, Indonesia. *Samarah: Jurnal Hukum Keluarga dan Hukum Islam*, 7(3), 1606–1626. <https://doi.org/10.22373/sjkh.v7i3.17753>