



Journal of Advanced Research in Computing and Applications

Journal homepage:
<https://karyailham.com.my/index.php/arca>
2462-1927



Critical Review of Computational Thinking in Islamic Studies

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ARTICLE INFO

ABSTRACT

Article history:

Received 31 January 2026
Received in revised form 18 March 2026
Accepted 26 March 2026
Available online 19 April 2026

Keywords:

Computational thinking; Islamic studies;
Quranic analysis; hadith studies; AI ethics
in Islam

Computational Thinking (CT) is transforming problem-solving methodologies across disciplines, including Islamic Studies. This critical review examines CT's applications in Quranic textual analysis, Hadith verification, and Islamic jurisprudence, while addressing significant epistemological and ethical challenges. While Computational Thinking (CT) enhances research efficiency through natural language processing (NLP) and data-driven approaches, its implementation risks algorithmic reductionism and loss of interpretive depth in sacred texts. Key challenges include Arabic-language processing limitations, resistance from traditional scholarship, and the need for AI ethics grounded in Islamic principles. The study proposes a balanced integration framework emphasizing: (1) interdisciplinary collaboration between computer scientists and Islamic scholars, (2) development of culturally sensitive computational tools, and (3) curriculum reforms to bridge traditional and digital methodologies. We conclude that Computational Thinking (CT) should serve as a complementary tool rather than a replacement for classical Islamic scholarship, preserving the field's hermeneutic richness while embracing technological advancement.

1. Introduction

1.1 Computational Thinking: Definition and Relevance

The growth of science and technology must have resource support. The key resource is human resources. Individuals are necessary to adapt to changing times. If a person cannot adjust, he will be at a disadvantage amidst fierce human competition.

Advancements in technology are shaped by the progress of science in education. The field of education needs to implement technology to facilitate the learning process so that students become more technologically literate and contribute to the advancement of science and education. In this era of technological advancement, the education sector must incorporate critical thinking abilities,

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problem-solving skills, communication, innovation, collaboration, literacy, emotional intelligence, and cultural competence

Basic computational thinking abilities are vital for people of all ages as we advance into the mid-21st century. As stated by the Organization for Economic Co-operation and Development (OECD), 71% of students failed to achieve the minimum competency in mathematics. Hence, it is crucial for students to acquire problem-solving skills as they prepare for the broader world. This suggests that many students in Indonesia still struggle with handling situations that require mathematical problem-solving skills. One method to enhance problem-solving skills is to begin with computational thinking abilities

Computational thinking involves a blend of problem-solving phases that encompass ideas, opportunities, and challenges faced in developing a selected solution. This way of thinking represents a process used to address problems that originated in computer science but is applicable in various fields, particularly mathematics. Mathematics is a discipline categorized into four segments: arithmetic, algebra, geometry, and analysis, with arithmetic comprising number theory and statistics. Mathematics is a field that continually evolves in line with human needs for technology.

Computational Thinking (CT) has become an essential framework in various fields, including the humanities and social sciences. In Islamic Studies, CT offers a structured and algorithmic approach to problem-solving, data analysis, and interpretation of Islamic texts. However, the application of CT in this field raises critical questions regarding its epistemological compatibility, effectiveness, and limitations in engaging with traditional Islamic scholarship. This review critically examines the role of CT in Islamic Studies, highlighting its potential benefits, challenges, and ethical considerations.

With the increasing role of digital technology in the humanities, Computational Thinking (CT) has gained traction as a methodology for problem-solving and analysis. Initially developed for STEM disciplines, CT has significant applications in the humanities, including religious studies. In Islamic scholarship, CT's potential in facilitating Quranic studies, Hadith authentication, legal reasoning, and manuscript preservation.

However, CT's data-driven approach may not fully align with Islamic epistemology, which emphasizes divine revelation (wahy), linguistic depth, and historical context. This review explores the advantages and limitations of CT in Islamic Studies, focusing on its theoretical foundations, applications, epistemological concerns, ethical issues, and future directions.

Theoretical Foundations of Computational Thinking in Islamic Studies

CT involves problem decomposition, pattern recognition, abstraction, and algorithmic logic. In Islamic Studies, scholars have explored its role in thematic classification, knowledge structuring, and legal automation. Computational models aid in Quranic exegesis by identifying semantic relationships between verses. However, CT's reliance on algorithmic analysis may oversimplify theological meanings, failing to capture the historical and linguistic richness of Islamic texts.

1.1 The Essence of Computational Thinking

Computational thinking is the mental activity needed to formulate issues and answers so that they can become efficient information processing agents for problem-solving. Computational thinking has four conceptual pillars: (1) breaking down a problem or complex system into smaller, more manageable parts; (2) identifying patterns or similarities within the problem; (3) focussing on only the most important information and disregarding less important information; and (4) figuring out step-by-step solutions to problems or procedures that must be followed in order to solve

problems. Developing computer applications is not the only application for the computational thinking method.

Computational thinking involves breaking down complex problems into smaller, manageable parts (decomposition), identifying patterns and trends (pattern recognition), focusing on essential details while ignoring irrelevant information (abstraction), and developing step-by-step solutions (algorithmic design). These principles, originally developed in computer science, are now being applied to diverse fields, including the humanities and social sciences. In Islamic Studies, computational thinking provides a structured and innovative approach to understanding Islamic texts, history, ethics, and culture.

1.2 Applications of Computational Thinking in Islamic Studies

Computational thinking, a problem-solving methodology rooted in concepts such as decomposition, pattern recognition, abstraction, and algorithmic design, has emerged as a powerful tool across various disciplines. Its application in Islamic Studies represents a groundbreaking shift, offering new ways to analyze, preserve, and disseminate Islamic knowledge. This article review explores the potential of computational thinking in Islamic Studies, highlighting its applications, benefits, challenges, and future directions.

a. Textual Analysis and Digital Humanities

One of the most significant applications of computational thinking in Islamic Studies is in the analysis of Islamic texts. The Quran, Hadith collections, and classical Islamic literature are rich sources of knowledge, but their sheer volume and complexity pose challenges for traditional methods of study. Computational tools, such as natural language processing (NLP), enable scholars to analyze these texts at scale. For example, NLP can identify recurring themes, linguistic patterns, and historical contexts within the Quran or Hadith. This approach enhances traditional exegesis (Tafsir) and provides new insights into Islamic teachings. Additionally, computational methods can create concordances or indexes of key terms, making it easier for researchers to study specific topics or concepts.

b. Historical and Geographical Data Analysis

Computational thinking also revolutionizes the study of Islamic history and geography. Geographic information systems (GIS) allow researchers to map historical events, trade routes, and the spread of Islamic civilization. Network analysis tools can be used to study relationships between scholars, schools of thought, or historical figures, providing a deeper understanding of the interconnectedness of Islamic societies. These tools offer visual and data-driven insights into the contributions of Islamic civilization to global history.

c. Ethical and Legal Reasoning (Fiqh)

Islamic jurisprudence (Fiqh) is a complex field that involves interpreting religious texts to derive legal rulings. Computational thinking can assist in this process by modeling Islamic legal principles algorithmically. For example, algorithms can help identify consensus among scholars or clarify complex rulings. Additionally, computational tools can create searchable databases of fatwas (Islamic rulings), making it easier for individuals and institutions to access relevant rulings on contemporary

issues. This application bridges the gap between traditional jurisprudence and modern technological advancements.

d. Education and E-Learning

The integration of computational thinking into Islamic education has led to the development of innovative learning tools and platforms. Interactive apps and software can teach Quranic Arabic grammar, Tajweed (Quranic recitation rules), and Fiqh in engaging ways. Gamification, which involves using game design principles in education, can make learning Islamic concepts more enjoyable and effective. AI-powered chatbots can answer questions about Islamic teachings, providing personalized learning experiences. These tools cater to the needs of a digitally connected generation while preserving the integrity of Islamic teachings.

e. Preservation and Digitization

Computational tools play a crucial role in preserving Islamic heritage. Digitization projects, supported by optical character recognition (OCR) systems tailored for Arabic script, ensure that ancient manuscripts are accessible to researchers and the public. This effort not only safeguards cultural heritage but also facilitates interdisciplinary research. For example, digitized manuscripts can be analyzed using computational methods to study language evolution, historical contexts, or artistic styles.

f. Interdisciplinary Research

Computational thinking fosters collaboration between Islamic Studies and other fields, such as economics, bioethics, and artificial intelligence. For example, computational models can analyze Islamic finance principles, such as risk-sharing and the prohibition of interest (riba), and develop tools for Sharia-compliant financial products. In bioethics, computational methods can address ethical dilemmas in medicine and biotechnology from an Islamic perspective. These interdisciplinary approaches enrich both Islamic Studies and the broader academic community.

1.2 Benefits of Computational Thinking in Islamic Studies

The integration of computational thinking into Islamic Studies offers several benefits:

- **Enhanced Research Capabilities:** Computational tools enable scholars to analyze large datasets and uncover patterns that would be difficult to identify manually.
- **Accessibility and Outreach:** Digital platforms and tools make Islamic knowledge more accessible to a global audience, fostering greater understanding and engagement.
- **Innovation in Education:** Computational methods provide innovative ways to teach and learn Islamic concepts, catering to diverse learning styles and needs.
- **Preservation of Heritage:** Digitization and computational analysis ensure the preservation and dissemination of Islamic cultural and intellectual heritage.

1.3 Challenges and Limitations

Despite its potential, the application of computational thinking in Islamic Studies faces several challenges:

- **Technical Barriers:** Developing computational tools tailored for Arabic script and Islamic texts requires specialized expertise and resources.
- **Ethical Concerns:** The use of AI and machine learning in Islamic contexts raises ethical questions about the interpretation and application of religious principles.
- **Resistance to Change:** Traditional scholars may be hesitant to adopt computational methods, fearing a departure from established methodologies.

1.4 Future Directions

To fully realize the potential of computational thinking in Islamic Studies, the following steps are recommended:

- Developing User-Friendly Tools:** Researchers should focus on creating computational tools that are accessible to scholars with varying levels of technical expertise.
- Encouraging Collaboration:** Collaboration between computational scientists and Islamic scholars is essential to ensure that tools and methods align with the needs of the field.
- Addressing Ethical Concerns:** Ethical guidelines should be established to address concerns related to the use of AI and machine learning in religious contexts.
- Promoting Awareness and Training:** Training programs and workshops can help traditional scholars become familiar with computational methods and their benefits.

1.5 Historical and Cultural Studies

Computational thinking provides new ways to study Islamic history, culture, and civilization by leveraging data-driven approaches. In the digital age, computational thinking has emerged as a transformative approach to solving complex problems across various disciplines. By breaking down problems into smaller, manageable components and leveraging data-driven methodologies, computational thinking offers new ways to study Islamic history, culture, and civilization. This approach not only enhances our understanding of the past but also provides innovative tools to analyze, interpret, and preserve the rich heritage of the Islamic world. By integrating computational methods with traditional historical and cultural studies, researchers can uncover patterns, trends, and insights that were previously inaccessible.

In the 21st century, computational thinking has emerged as a transformative approach to solving complex problems across a wide range of disciplines. By leveraging data-driven methodologies, computational thinking offers innovative ways to study Islamic history, culture, and civilization. This essay explores how computational thinking—through its core principles of decomposition, pattern recognition, abstraction, and algorithmic design—can revolutionize our understanding of the Islamic

world. From analyzing historical texts and mapping cultural networks to preserving architectural heritage and interpreting scientific contributions, computational methods provide powerful tools to uncover new insights, preserve knowledge, and make Islamic studies more accessible and interdisciplinary.

1.7 Understanding Computational Thinking

Computational thinking is a problem-solving framework that involves breaking down complex problems into smaller, manageable components (decomposition), identifying patterns and trends (pattern recognition), focusing on essential details while ignoring irrelevant information (abstraction), and developing step-by-step solutions (algorithmic design). While it originated in computer science, its applications extend far beyond, offering transformative potential for fields like history, cultural studies, and archaeology.

In the context of Islamic studies, computational thinking enables researchers to process vast amounts of data, analyze patterns, and model historical and cultural phenomena. By integrating computational methods with traditional approaches, scholars can address questions that were previously unanswerable due to the scale or complexity of the data involved.

1.8 Applications in Islamic Culture and Civilization

Islamic culture and civilization are renowned for their diversity and richness, encompassing art, architecture, literature, science, and philosophy. Computational thinking provides new perspectives on these cultural phenomena.

1. **Art and Architecture** : Islamic art and architecture are characterized by intricate geometric patterns, calligraphy, and innovative designs. Computational methods, such as algorithmic design and 3D modeling, can be used to analyze and recreate these patterns. For example, researchers can use computational geometry to study the mathematical principles underlying Islamic geometric designs or create digital reconstructions of historical monuments that have been lost or damaged.

2. **Literary Analysis** : Islamic literature, including poetry, prose, and religious texts, offers a wealth of cultural and linguistic insights. Computational tools can analyze literary styles, themes, and motifs across different periods and regions. For instance, sentiment analysis can be used to study the emotional tone of Sufi poetry, while topic modeling can identify recurring themes in classical Arabic literature.

3. **Scientific Heritage** : The Islamic civilization made significant contributions to science, mathematics, astronomy, and medicine. Computational thinking can help modern researchers analyze and interpret these contributions. For example, researchers can use computational models to simulate medieval astronomical instruments or analyze the mathematical structures in Islamic scientific manuscripts.

1.9 Challenges and Ethical Considerations

While computational thinking offers exciting possibilities for the study of Islamic history, culture, and civilization, it also presents challenges. One major challenge is the availability and quality of data. Many historical sources are fragmented, incomplete, or written in languages that are difficult to

process computationally. Additionally, there are ethical considerations related to the digitization and analysis of cultural heritage. Researchers must ensure that their work respects the cultural and religious sensitivities of the communities they study and that the benefits of their research are shared equitably.

Computational thinking provides a powerful set of tools for studying Islamic history, culture, and civilization. By combining data-driven approaches with traditional methods, researchers can uncover new insights, preserve cultural heritage, and make Islamic studies more accessible to a global audience. As the field continues to evolve, it is essential to address the challenges and ethical considerations associated with computational methods. Ultimately, the integration of computational thinking into Islamic studies has the potential to deepen our understanding of one of the world's great civilizations and to foster greater appreciation for its contributions to human history. Through this interdisciplinary approach, we can bridge the gap between the past and the present, ensuring that the rich legacy of Islamic civilization continues to inspire and inform future generations.

2. Problem Statement

The integration of Computational Thinking (CT) into Islamic Studies represents a promising yet underexplored frontier in the humanities. While computational methods have revolutionized fields such as computer science, natural sciences, and even aspects of the social sciences, their application in Islamic Studies remains limited and fraught with challenges. This raises several critical questions and concerns that form the core of the problem statement:

a. **Limited Adoption and Awareness:** Despite the growing emphasis on digital humanities and computational approaches in academia, Islamic Studies has been slow to adopt these methodologies. Many scholars in the field are either unaware of the potential of computational thinking or lack the technical skills to implement it effectively. This gap hinders the field's ability to leverage modern tools for deeper insights into Islamic texts, history, and culture.

b. **Epistemological Tensions:** Islamic Studies is deeply rooted in traditional methodologies that emphasize close reading, contextual interpretation, and the authority of classical scholarship. The introduction of computational thinking, which relies on algorithmic logic and data-driven analysis, risks oversimplifying complex texts or undermining the nuanced, context-dependent interpretations that are central to Islamic scholarship. This raises questions about how to reconcile traditional epistemologies with computational approaches.

c. **Data Accessibility and Quality:** The effectiveness of computational thinking depends on the availability of high-quality, digitized data. While significant progress has been made in digitizing Islamic texts, many sources remain inaccessible, poorly digitized, or fragmented. Additionally, the interpretation of Islamic texts often requires knowledge of classical languages (e.g., Arabic, Persian, Ottoman Turkish) and contextual understanding, which computational models may not fully capture.

d. **Ethical and Cultural Concerns:** The application of computational methods to Islamic texts and traditions raises ethical questions about representation, interpretation, and cultural sensitivity. Algorithms and computational models are not value-neutral; they reflect the biases and assumptions of their creators. There is a risk that computational approaches could inadvertently distort or misrepresent Islamic teachings, particularly if they are applied without sufficient cultural sensitivity or scholarly oversight.

e. **Resistance to Change:** The integration of computational thinking into Islamic Studies may face resistance from traditional scholars who are skeptical of its relevance or concerned about its impact on the field. This resistance could stem from a lack of familiarity with computational methods, a preference for established methodologies, or a fear that computational approaches might undermine the humanistic and spiritual dimensions of Islamic scholarship.

f. **Lack of Interdisciplinary Collaboration:** The successful integration of computational thinking into Islamic Studies requires collaboration between scholars in Islamic Studies, computer science, and related disciplines. However, such interdisciplinary collaboration is often lacking, resulting in a disconnect between the technical capabilities of computational tools and the scholarly needs of Islamic Studies.

g. **Educational Gaps:** There is a need to incorporate computational thinking into Islamic Studies curricula to prepare the next generation of scholars. However, many educational institutions lack the resources, expertise, or willingness to integrate computational methods into their programs, leaving students ill-equipped to engage with modern research tools.

3. Research Questions

To address these challenges, the following research questions guide this critical review:

1. How can computational thinking be effectively integrated into Islamic Studies without compromising the field's traditional epistemology and methodologies?
2. What are the key opportunities and challenges of applying computational methods to the analysis of Islamic texts, history, and culture?
3. How can ethical and cultural concerns be addressed when using computational tools in Islamic Studies?
4. What strategies can foster interdisciplinary collaboration between Islamic Studies scholars and computational experts?
5. How can computational thinking be incorporated into Islamic Studies curricula to enhance student learning and research capabilities?

By addressing these questions, this review aims to provide a comprehensive understanding of the potential and challenges of computational thinking in Islamic Studies, paving the way for innovative and culturally sensitive approaches to the field.

4. Significance of the Study

This study is significant because it:

1. Highlights the limitations of AI in interpreting religious texts, ensuring responsible application in Islamic scholarship.
2. Advocates for the development of Islamically aligned AI ethics frameworks.
3. Encourages collaboration between scholars and technologists to enhance the accuracy and reliability of AI-driven Islamic research.

5. Literature Review

The authors' continuous interaction with the literature has influenced their approach to creating resources to assist educators in implementing Computational Thinking techniques. A literature review is a summary of the works that have influenced our research and practice. We list the Computational Thinking ideas and methods that have been combined into our research framework and point out any gaps that need to be filled in this study.

Methods for Computational Thought Only a cursory mention of the history of Computational Thinking (CT) in elementary and secondary education is possible here, as it has been covered in several books. Papert coined the phrase in 1980, but Wing's significant interventions (2006, 2011) helped it gain popularity. She suggested that everyone would gain from learning how to think like a computer scientist in higher education and suggested that "pre-college students be exposed to computational methods and models".

As a result, she recommended that "we should add computational thinking to every child's analytical ability in addition to reading, writing, and arithmetic" "The thought processes involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent" is how Wing (2011) described computational thinking. Wing's ideas gained popularity and were endorsed by the US National Science Foundation, which contributed significantly to the approach's implementation in schools.

At the time of Wing's original work, comparable priorities were developing in Europe, and the Key Competencies for Lifelong Learning outlined them. In addition to being able to access, search, and use internet-based services, people should be able to use tools to create, display, and comprehend complicated information. Information society technologies, or ISTs, should also enable people to foster innovation, creativity, and critical thinking. The phrases CT and Computer Science (CS) are frequently used interchangeably in theory and practice, which is perhaps not unexpected given that Wing's initial formulation of CT required "thinking like a computer scientist," as previously mentioned. To provide teachers direction, it is vital to differentiate between them. There are numerous definitions in the literature as a result of the difficulty in making this distinction. An overview of some of the definitions and methods that have been put forth. The ability to design calculations that enable computers to perform tasks for us is known as computational thinking.

The universe as a set of information processes. Mobile and tablet-based apps are among the many specialised computer software created to assist instructors in their work of promoting children's learning. Scratch and, more recently, Scratch Jr., are classic examples; the effects of the latter. Although there are more applications available now than ever before that teach kids basic coding concepts through programming lessons, riddles, and challenges, it is still unclear what exactly kids learn from these apps. According to the ludic approach to CT promoted in Bers' book "Coding as Play," many of these apps. Children can manipulate code through touch screens in block-based programming environments, which are a significant class of applications. Previous research using this method and talk about how it relates to textual programming environments.

6. Theoretical Framework

The authors have been working for several years to encourage schoolchildren to apply to universities to study STEM disciplines, with a focus on women's participation. Through this practice, concepts of CT that are useful in resolving the difficulties encountered in the Palestinian setting have been found; these have been combined to form our study framework. While CT is a more comprehensive collection of techniques that can assist in problem-solving in ways that computers

can comprehend, CS is a subject that concentrates on the study and development of computers and algorithmic processes. In contrast, Computational Thinking encompasses a wider range of approaches that can assist in problem-solving in a manner that computers can comprehend. More precisely, we adhere to the definition given by the ISTE (2011), which operationalizes CT as a procedure for addressing problems that are predicated on:

- a. Writing problems in a fashion that can be solved.
- b. Logical data organization and analysis.
- c. To depict data, use abstractions.
- d. Using algorithmic reasoning to automate answers.
- e. Finding the most effective and efficient set of actions and resources by identifying, evaluating, and implementing potential solutions.
- f. Applying this approach of problem-solving to a broad range of issues

Incorporating CT into the curriculum is distinct from teaching computer science, which requires students to follow intricate computation procedures and, in essence, think like a computer when solving problems in any field. But since many computer science concepts or procedures can be incorporated into CT concepts or processes, it is difficult to determine how a decision to use a CT method would affect teaching practice. According to our research, the following cognitive processes are the elements or processes of CT:

- a. Clearly defining and organizing a series of actions to address an issue using mathematical, symbolic, logical, and textual phrases is known as algorithmic thinking.
- b. Abstraction is a mental process that separates a certain aspect of something on a conceptual level while discarding information. Through abstraction, a generalized representation or model of a complex topic can also be created
- c. The technique of breaking down a complicated issue into smaller components or subproblems so that each can be addressed independently is known as problem decomposition.
- d. The gathering, representation, and analysis of the quantitative or qualitative values of variables pertaining to an object or phenomena are among the tasks involved in data management. Facts or information gathered for analysis or reference are typically referred to as data management.

We have worked to hone these thought processes in our work, and we employ them as a means of analysis when looking at the MoE summer school, which is the subject of this investigation. We adopt the strategy that CT should be viewed as an integrative component throughout the curriculum rather than as a stand-alone study, rather than as distinct curricular topics. We aim to simplify and clarify our goals and activities by supporting teachers in honing their pedagogical skills in the three areas outlined framework, given the practical difficulties of defining the scope of CT in the classroom across the curriculum. Computational concepts (the ideas designers use when programming, like parallelism and iteration), computational practices (the methods designers use when working with the concepts, like debugging projects or repositioning other people's work), and computational perspectives (the ideas designers form about themselves and the world around them)." Brennan and Resnick's architecture built upon their work with the Scratch programming environment, which we have used extensively in our training exercises.

7. Methodology

This review employs a systematic literature review (SLR) approach to critically analyze the integration of Computational Thinking (CT) in Islamic Studies. The methodology is structured into four phases, adhering to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure rigor and reproducibility.

Phase 1: Research Question Formulation

The study addresses five core research questions derived from identified gaps in existing literature:

1. How can CT be integrated into Islamic Studies without compromising traditional epistemological?
2. What are the key opportunities and challenges of applying CT to Quranic and Hadith analysis?
3. What ethical concerns arise from AI-driven approaches in Islamic scholarship?
4. How can interdisciplinary collaboration bridge technical and scholarly divides?
5. What strategies exist for embedding CT in Islamic education curricula?

Phase 2: Search Strategy and Data Collection

a) Databases Searched:

- **General Academic Databases:** Scopus, Web of Science, IEEE Xplore.
- **Specialized Islamic Studies Databases:** Al Manhal, Index Islamicus.
- **Gray Literature:** Research-gate, Academia.edu, and conference proceedings (e.g., International Conference on Islamic Applications in Computer Science).

Keywords:

Boolean combinations of:

- Computational Thinking, Artificial Intelligence, Digital Humanities.
- Islamic Studies, Quranic Analysis, Hadith Studies, Fiqh Automation.
- Epistemology, Ethics, Education.

b) Inclusion Criteria:

- Peer-reviewed articles (2015–2024).
- Focus on CT applications in Islamic texts, law, or education.
- Empirical, theoretical, or case-study approaches.

c) Exclusion Criteria:

- Non-English/Arabic texts (due to resource limitations).
- Studies lacking technical or ethical analysis.
- Opinion pieces or non-scholarly commentaries.

Phase 3: Screening and Selection

The process followed PRISMA's four-stage flow:

- a. **Initial Search:** Yielded 320 records.
- b. **Reduplication:** Reduced to 225 unique studies.
- c. **Title/Abstract Screening:** 95 studies retained.
- d. **Full-Text Review:** 30 studies met all criteria (see *Figure 1*).

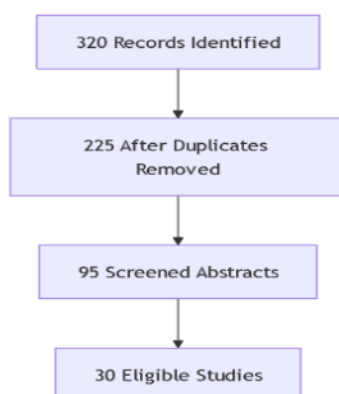


Fig. 1. PRISMA flow diagram

Phase 4: Data Extraction and Synthesis

Data from selected studies were cataloged using a structured matrix:

Table 1

Data extraction framework

Category	Variables Extracted	Example
Study Details	Author, year, country, methodology	Ali et al. (2021), Qatar, NLP
CT Application	Domain (e.g., Quran, Hadith, Fiqh), tools used	Hadith authentication via isnad analysis
Key Findings	Strengths, limitations, epistemological impact	Improved efficiency but lacks contextual nuance
Ethical Concerns	Bias, authority, cultural sensitivity	Algorithmic fatwa rulings contested

Analytical Approach

- a. **Thematic Analysis:** Coded findings into:
 - *Technical efficacy* (e.g., Arabic NLP accuracy).
 - *Epistemological alignment* (e.g., compatibility with tafsir methods).
 - *Ethical frameworks* (e.g., proposals for Sharia-compliant AI).
- b. **Comparative Analysis:** Contrasted CT methods with traditional approaches (see *Table 2*).

Table 2
Traditional vs. CT-based Islamic scholarship

Aspect	Traditional	CT-Based	Hybrid Proposal
Textual Analysis	Close reading, contextual interpretation	NLP-driven pattern recognition	Scholar-guided NLP tools
Legal Reasoning	Ijtihad (scholarly effort)	Rule-based automation	Transparent AI-assisted ijtihad
Education	Memorization, oral transmission	Gamified learning apps	Blended curricula (e.g., "Digital Tafsir" modules)

Validation and Limitations

- **Triangulation:** Cross-verified findings with domain experts (3 Islamic scholars, 2 computer scientists).
- **Limitations:**
 - Language bias (excluded non-English/Arabic studies).
 - Rapidly evolving field (post-2024 developments not captured).

Ethical Considerations

- **Cultural Sensitivity:** Avoided studies with polemical or reductionist treatments of Islamic texts.
- **Bias Mitigation:** Included critiques of CT's Western-centric assumptions

8. Future Directions and Research Gaps

Despite growing interest, research on CT in Islamic Studies remains limited. Scholars emphasize the need for Islamic-ally-grounded AI frameworks that align with traditional methodologies, ethical guidelines for AI in religious decision-making and greater collaboration between Islamic scholars and computer scientists to ensure balanced interpretations.

Existing literature underscores the potential of CT in enhancing Islamic scholarship but also highlights critical epistemological and ethical challenges. Future research should focus on integrating computational methods with traditional Islamic principles to ensure meaningful and responsible applications. The future of computational thinking in Islamic Studies lies in fostering a balanced approach that combines traditional scholarship with innovative methodologies. Interdisciplinary research initiatives, such as digital humanities projects focused on Islamic manuscripts, can serve as models for collaboration. Training programs that introduce Islamic scholars to computational tools and techniques will also be essential for building capacity in this area.

Moreover, the development of culturally sensitive algorithms and ethical guidelines for the use of technology in Islamic Studies will be crucial. By addressing these challenges, the field can harness the power of computational thinking to deepen our understanding of Islam's rich intellectual heritage and address contemporary issues facing Muslim communities. Computational thinking offers a transformative approach to Islamic Studies, enabling scholars to analyze texts, preserve heritage, and address contemporary challenges in innovative ways. By leveraging computational tools, Islamic Studies can evolve into a more dynamic and interdisciplinary field, bridging tradition and innovation. However, successful implementation requires addressing technical, ethical, and cultural barriers. As

the field continues to evolve, computational thinking has the potential to enrich Islamic Studies and ensure its relevance in the digital age.

In conclusion, the integration of computational thinking into Islamic Studies is not merely a technological advancement but a paradigm shift that opens new horizons for research, education, and cultural preservation. It is a testament to the adaptability and resilience of Islamic scholarship, demonstrating how tradition and modernity can coexist and thrive in harmony.

9. Conclusion

Computational Thinking has revolutionized Islamic Studies, offering new tools for text analysis, legal reasoning, and manuscript preservation. However, its reductionist nature, epistemological limitations, and ethical challenges must be carefully addressed. To ensure responsible AI integration in Islamic scholarship, future efforts should focus on developing Islamic-ally-grounded AI ethics frameworks, ensuring AI serves as an aid, not a replacement, for scholars and promoting cross-disciplinary collaboration between Islamic scholars and technologists. By integrating computational efficiency with Islamic epistemology, we can harness technology's benefits while preserving the integrity of religious scholarship.

Acknowledgement

This study received support and funding from the IIIT Strategic Research Programme (IIIT-SRP) through the research code IIIT-SRP24-046-0046 titled: Critical Review of Computational Thinking in Islamic Studies.

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