



Integrating Computational Thinking and Islamic Values in Geometry Learning: Effects on Pre-Service Primary Teachers' Conceptual Understanding

Lilis Marina Angraini^{1*}, Dianne Amor Kusuma², Reni Wahyuni¹, Muchamad Subali Noto³, Astri Wahyuni¹,
Putri Wahyuni¹

¹Universitas Islam Riau, Indonesia

²Universitas Padjajaran, Indonesia

³Universitas Swadaya Gunung Jati, Indonesia

Correspondence: E-mail: lilismarina@edu.uir.ac.id

ABSTRACT

This study examines the integration of computational thinking and Islamic values in geometry learning for Primary School Teacher Education (PSTE) students. Using a quantitative descriptive approach, the research involved 70 PSTE students at Universitas Islam Riau. Data were collected through tests, observations, and interviews, and analyzed using triangulation to ensure validity. This integration significantly improves students' conceptual understanding, as reflected in the increase in post-test scores. The one-sample t-test yielded a significance value, confirming a meaningful difference between pre- and post-test results. In addition, students internalized Islamic values such as honesty, cooperation, and spiritual awareness during learning activities. This study responds to the need for educational models that balance cognitive skills and character development. The integration of technology and Islamic principles creates a holistic learning experience, contributing to the development of competent, ethical, and responsible future educators.

ARTICLE INFO

Article History:

Submitted/Received 20 Sep 2024

First Revised 21 Jun 2025

Accepted 20 Apr 2026

First Available online 21 Apr 2026

Publication Date 01 Mar 2027

Keyword:

Computational Thinking;

Geometry;

Islamic Values;

Mathematics.

1. INTRODUCTION

Mathematics is one of the most difficult subjects. Many reports regarding mathematics have been well-documented [1, 2]. Geometry learning plays a crucial role in developing students' logical, critical, and analytical thinking skills, particularly for Primary School Teacher Education (PSTE) students. As a fundamental branch of mathematics, geometry not only involves the study of shapes, sizes, and spatial properties but also serves as a foundation for understanding other mathematical and applied science concepts [3, 4]. For PSTE students, mastering geometry is essential, as they will become educators responsible for instilling basic mathematical knowledge in elementary school students. However, traditional methods of teaching geometry often fail to align with the evolving demands of 21st-century education, necessitating the integration of modern pedagogical approaches.

Numerous studies have explored the integration of technology in mathematics education, particularly through computational thinking. Computation is one of the important aspects that can be directly implemented [5]. Computational thinking skills, which include logical reasoning, pattern recognition, and algorithmic problem-solving, have been identified as key competencies in addressing digital-era challenges [6-11]. Research has demonstrated that the application of computational thinking in geometry learning enhances students' mathematical understanding and better prepares them to face future technological advancements [12-16]. Moreover, the use of geometric visualization software allows students to interact with complex geometric concepts more effectively, supporting the development of technology-based pedagogical skills applicable to elementary school teaching [17-21].

Beyond technological integration, Islamic values play an essential role in education, particularly in faith-based institutions such as Islamic universities. Geometry learning can serve as a medium for instilling values such as honesty, responsibility, cooperation, and spiritual awareness [22, 23]. The study of geometric patterns in nature can also reinforce students' appreciation of divine creation, enriching their spiritual and ethical development [24, 25]. However, while research on technology-based learning is abundant, studies focusing on the integration of Islamic values in computational thinking approaches remain limited [26, 27]. Most prior studies have emphasized improving mathematical and technological competencies while neglecting the moral and ethical dimensions of education [28, 29]. Given the increasing reliance on technology in education, integrating spiritual values can provide a necessary balance that mitigates the potential dehumanizing effects of technological advancement [30, 31].

This study aims to explore how computational thinking and Islamic values can be effectively integrated into geometry learning for prospective elementary school teachers. Furthermore, this research seeks to bridge the gap between technology-driven pedagogy and character formation, ensuring that PSTE students develop both high-level mathematical competence and strong moral character. By developing a structured and balanced learning model, this study is expected to contribute to pedagogical innovation in mathematics education.

Using a quantitative-descriptive approach with a descriptive design, this research collects data through tests, observations, and interviews to analyze the effectiveness of integrating computational thinking and Islamic values in geometry learning. The test results are used to measure students' mathematical achievement, while observations and interviews help

understand how the developed learning model contributes to the formation of students' moral and ethical character. The novelties of this study include:

- (i) It adopts a holistic approach by integrating computational thinking with Islamic values in geometry learning, creating a balanced framework that combines technological and spiritual dimensions;
- (ii) It introduces an innovative learning model that harmonizes modern educational technology with ethical and religious principles, contributing to advancements in mathematics education;
- (iii) This study aligns with global educational trends that emphasize not only intellectual growth but also emotional and spiritual intelligence. Finally, this research plays a crucial role in preparing PSTE students to become future educators who are both intellectually proficient and ethically responsible, fostering a more comprehensive and value-driven approach to teaching.

2. METHODS

This study employed a quantitative approach with a pretest–posttest design to investigate the integration of computational thinking and Islamic values in geometry learning for PSTE students at Universitas Islam Riau. Data were collected through tests, observations, and semi-structured interviews. Tests were used to measure students' conceptual understanding of geometry and computational thinking skills before and after the intervention, while observations examined student interactions during the learning process. Interviews were conducted to explore students' perspectives on the integration of Islamic values.

Data were analyzed using triangulation to enhance validity by comparing findings from tests, observations, and interviews. Instrument validity was established through expert judgment in mathematics and Islamic education. Ethical considerations were maintained by obtaining informed consent, ensuring confidentiality, and allowing participants to withdraw at any time.

The sample consisted of third-semester PSTE students selected through purposive sampling based on criteria relevant to the research objectives. Participants had prior exposure to basic geometry and Islamic values through their educational background and university curriculum. The sample included students with diverse educational backgrounds and gender representation, reflecting typical PSTE program characteristics. These criteria ensured that participants were adequately prepared to engage in learning activities integrating computational thinking and Islamic values.

Figure 1 presents the conceptual framework of integrating computational thinking and Islamic values in geometry learning. This integration supports the development of systematic and critical thinking while fostering students' Islamic character. Decomposition encourages students to solve problems step by step with responsibility, pattern recognition promotes reflection on the order of creation, algorithmic thinking develops honesty and discipline, and abstraction supports balanced reasoning.

Table 1 describes the instrument used to assess the integration of computational thinking and Islamic values in geometry learning. The tasks were designed to develop computational thinking skills, including decomposition, pattern recognition, abstraction, and algorithmic thinking, while embedding Islamic contexts such as mosque architecture and geometric patterns. This approach enables students to connect mathematical concepts with real-life

applications and spiritual values. The collected data were analyzed statistically, with detailed procedures reported in previous studies. The data was then analyzed and statistically calculated. Detailed information on statistical calculation is reported elsewhere [32, 33].

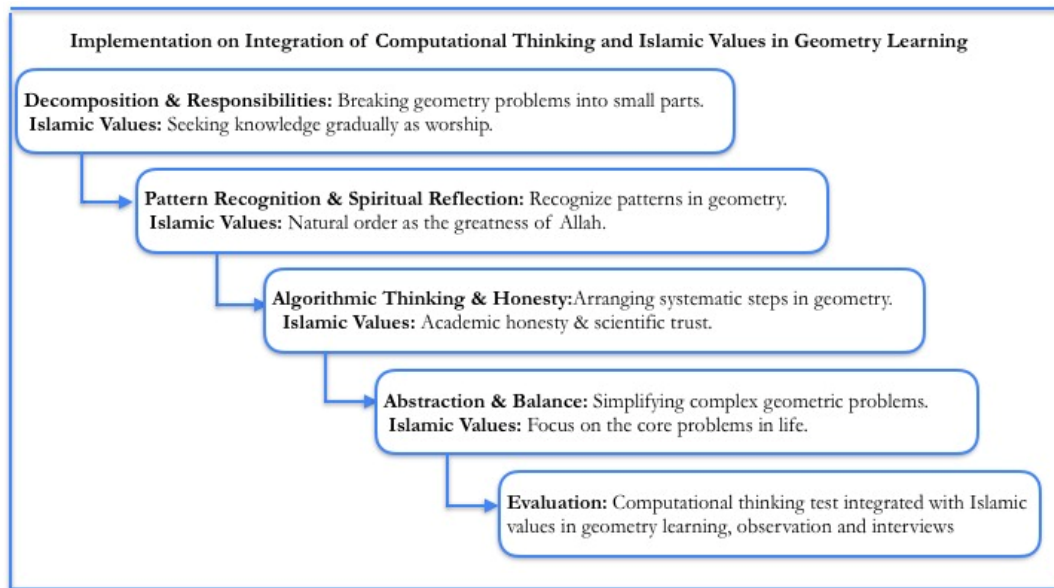


Figure 1. This illustrates the integration of computational thinking and Islamic values in learning geometry.

3. RESULTS AND DISCUSSION

This study aims to explore the integration of computational thinking and Islamic values in geometry learning for Primary School Teacher Education students. Different from other studies, we focused on Islamic schools. Many reports regarding these Islamic schools [34]. The study results showed that this approach has a positive impact on understanding geometric concepts, computational thinking skills, and strengthening Islamic values.

Table 2 shows a significant increase in students' understanding of geometry after implementing learning based on computational thinking and Islamic values. Before the learning intervention, students had an average pretest score of 65, which reflects a limited initial understanding of geometric concepts. After being given learning with an approach that integrates computational thinking and Islamic values, the average student score increased substantially to 90 on the post-test. This increase indicates that the learning strategy used is not only effective in strengthening understanding of geometric concepts but also in developing systematic and analytical thinking skills through a computational thinking approach. In addition, the pretest standard deviation of 3.5 indicates that the level of variation in students' initial scores is relatively small, indicating the homogeneity of their initial understanding. After the learning intervention, the standard deviation increased to 4.2, indicating a more varied increase in understanding among students, although it still showed significant improvement overall.

These findings strengthen the argument that the integration of computational thinking in geometry learning helps students solve problems systematically, recognize patterns, and apply algorithms in solving geometric problems. Meanwhile, Islamic values, such as honesty, cooperation, and reflection on the greatness of Allah in geometric concepts, play a role in shaping students' moral and ethical aspects during the learning process.

Table 1. The computational thinking instruments of Islamic values in geometry learning.

NO	INDICATOR	QUESTIONS
1	Understand and apply the concepts of area of an equilateral triangle and volume of a prism.	The mosque tower has a cross-section in the shape of an equilateral triangle with a side length of 6 meters. If there are 4 levels, each 3 meters high, calculate the total volume of the tower.
2	Understand the concept of area of a rectangle and surface area of a hemisphere.	The lower floor of the mosque dome is rectangular with a length of 12 meters and a width of 8 meters. If a hemispherical dome has a diameter equal to the length of the floor, what is the total area of the floor and dome?
3	Understand and apply the concept of area of a rectangle in a real context.	A rectangular mosque window is 3 meters long and 1.5 meters wide. If there are 10 similar windows, calculate the total area of the windows that need to be painted.
4	Understand the concept of the area of a triangle and apply it in repetitive calculations.	The floor of the mosque is decorated with a right-angled triangle pattern with a base of 2 meters and a height of 3 meters. If there are 20 patterns, calculate the total floor area covered by the patterns.
5	Understand and apply the concept of the area of a right triangle.	A right-angled triangle-shaped cloth is used to cover the mosque pulpit with a base of 1.2 meters and a height of 2 meters. How much fabric is needed?
6	Understand the concept of area of a rectangle and the difference between total area and interior area.	The garden in the mosque yard is rectangular with a length of 25 meters and a width of 10 meters. If the garden is surrounded by a 2-meter-wide path, calculate the area of the path.
7	Understand and apply the concept of the area of a triangle in the form of an isosceles triangle.	An isosceles triangle decoration has a base of 4 meters and a height of 6 meters. If there are 8 decorations, what is the total area of the decorations?
8	Understand the concept of square area and its application in repeating patterns.	The walls of the mosque are decorated with a symmetrical pattern in the shape of a square with sides 2 meters long. If there are 15 patterns, what is the total area decorated?
9	Understand and apply the Pythagorean Theorem in determining the length of the hypotenuse of a right triangle.	A mosque tower is 30 meters high, and its shadow forms a right triangle with a base length of 40 meters. Calculate the slant length of the triangle.
10	Understand the concept of area of a rectangle and area of a semicircle, and how to combine the two.	The mihrab of the mosque is rectangular with a length of 4 meters and a width of 2.5 meters. If there is a semi-circular decoration on top of the mihrab with a diameter equal to the width of the mihrab, calculate the total area of the mihrab and decoration.

Table 2. Description of the test of data values in geometry learning.

DESCRIPTIVE	PRE-TEST	POST-TEST
N	70	70
Mean	65	90
SD	3.5	4.2
Max	70	100
Min	55	70

The results of this research show that learning based on computational thinking combined with Islamic values not only increases students' academic competence in understanding geometric concepts but also contributes to the formation of their character and morals. Thus, this approach can be a relevant and effective learning model in building students' intellectual and spiritual competencies, in accordance with the educational needs of the 21st century.

The results of the one-sample t-test showed that the significance value obtained was 0.00. Thus, the results of this test show that there is a significant difference between the final test results of the integration of computational thinking and the Islamic value in geometry learning when compared to the initial test score. This indicates that the integration of computational thinking with Islamic values in geometry learning has a significant impact. These results reinforce the argument that the integration of computational thinking concepts with Islamic values can have a real influence on geometry learning, which can be considered in the development of teaching methods in this field.

This increase can be seen in students' ability to understand the basic properties of geometry, visualize geometric shapes, and relate concepts. geometry with daily life applications, such as Islamic ornamental designs and mosque architectural patterns. A computational thinking approach can improve problem-solving abilities in mathematics [7, 35, 36]. The results of the analysis show that computational thinking helps students solve geometric problems more systematically. Students are able to practice the four main components of computational thinking: decomposition, pattern observation, algorithm design, and abstraction. Some students are even able to design simple algorithms to solve complex geometric problems. Computational thinking is an essential skill in solving multidimensional problems [37, 38]. **Table 3** explains that the integration of computational thinking and Islamic values in geometry learning has a positive impact on student engagement, application of computational thinking, and internalization of Islamic values. Students show high enthusiasm for learning, although some still experience difficulties in technological aspects and concept abstraction. Overall, this approach increases students' understanding and motivation to learn.

Table 3. Description of the test of data values in geometry learning.

OBSERVED ASPECTS	PERCENTAGE OF STUDENTS INVOLVED (%)	ADDITIONAL INFORMATION
Student Involvement in Learning	85%	Collaboration in groups looks good; students help each other in understanding concepts.
Application of Computational Thinking in Geometry	80%	The majority of students can recognize patterns in geometry problems.
Integration of Islamic Values in Learning	95%	Almost all students show an honest attitude in completing assignments.
Performance and Adaptation to Technology	85%	Most students can use geometry applications well.
Student Responses to Learning Approaches	90%	Most students feel this method helps them understand the material better.

Observations during learning show that Islamic values, such as honesty, cooperation, and spiritual appreciation, are effectively integrated into the learning process. For example,

students are taught to use geometric data honestly when running computational simulations and work together in groups to complete geometric projects based on Islamic values. Most students reported that this approach helped them connect the science of geometry with the greatness of Allah's creation [39, 40]. Observations show that learning based on Islamic values increases interaction and collaboration between students. Group discussions are often characterized by reflections on Islamic values, such as mutual respect and cooperation. This finding is in accordance with research, which states that collaborative learning can deepen mathematical understanding [41, 42].

The following are the results of interviews with several students regarding the results of tests on the integration of computational thinking and Islamic values in learning geometry. In solving the problem of the mosque tower's volume, a student first tried to understand the structure of the building. She imagined that the tower consisted of several similar parts, so to determine the total volume, she simply calculated the volume of one part and multiplied it by the number of stories. With this approach, she felt that he could solve the problem more quickly and systematically. Beyond the calculations, the student also realized that this tower shape is commonly found in Islamic architecture. This led her to reflect that geometry is not merely a collection of numbers and formulas but also represents the beauty and order in God's creation. This awareness further strengthened her perspective that studying mathematics can be a form of spiritual reflection, as many geometric concepts are not only found in nature but also in human-made architectural designs (DA, personal communication, 21 December, 2024).

When faced with the problem of calculating the total area of the mosque's floor and dome, a student initially felt confused due to the presence of two different geometric shapes that needed to be calculated. However, after discussing with friends, she realized that breaking the problem into separate parts made the calculations more manageable. By identifying each component individually, she was able to focus better and avoid feeling overwhelmed. Beyond the mathematical aspect, the student also reflected on the role of geometry in Islamic art and architecture, such as the intricate patterns in mosques and calligraphy. This realization helped her see that mathematics is not merely about numbers and formulas but also carries aesthetic and spiritual significance. Through this understanding, she developed a greater appreciation for the learning process and began to view knowledge as something that could strengthen his faith (FA, personal communication, 21 December 2024).

When faced with the problem of calculating the total area of the mihrab and its decoration, a student immediately visualized its shape and structure. She recognized that the total area could be determined by separately calculating the area of the rectangular base and the semicircular decoration above it, then summing the two. By approaching the problem systematically, she was able to avoid unnecessary repetitions and focus on the key steps required to solve it efficiently. Beyond the mathematical calculations, the student also reflected on the significance of the mihrab in Islamic architecture. She understood that the mihrab serves as an essential space in a mosque, where the imam leads prayers, symbolizing guidance and unity. The intricate geometric designs often adorning the mihrab highlight Islam's emphasis on beauty and order. This realization deepened her appreciation for mathematics, seeing it not merely as a subject of numbers and formulas but as a means of understanding harmony in life (SY, personal communication, 21 December 2024).

Interview results revealed that students considered this learning to be more relevant and meaningful than conventional methods. This approach not only increases understanding of concepts but also strengthens students' moral foundation in applying knowledge. The values-based education can shape students' character and learning motivation, findings which are in line with the results of this research [39, 43]. The learning strategies implemented are proven to be effective in achieving learning objectives. Students showed a positive response to this method, with test scores increasing significantly. These results support research that combining technology and spiritual values can improve learning outcomes [44].

The integration of computational thinking with Islamic values in geometry learning provides significant benefits in forming students' mathematical understanding and moral character. The decomposition process trains students to break down geometric problems into small, systematic steps, instilling an attitude of responsibility and trust in completing academic assignments. In addition, recognizing patterns in geometry not only helps students understand mathematical regularities but also fosters spiritual reflection through awareness of the harmony of the universe as proof of God's greatness. By understanding patterns in flat shapes and spatial shapes, students are invited to see order as part of Allah's perfect creation, thereby increasing their awareness and appreciation of Islamic values.

In addition, algorithmic thinking teaches students to develop logical procedures in solving geometric problems, fosters an attitude of academic honesty and *istiqamah* in learning. By following systematic steps and working honestly without cheating, students not only improve their understanding of mathematics but also build a character of integrity. Meanwhile, the abstraction process allows students to simplify complex problems by focusing on the most relevant aspects, reflecting the concept of balance in Islam. Through this learning, students not only develop a deep mathematical understanding but also learn to maintain a balance between logical thinking and ethical actions in everyday life. Thus, the integration of computational thinking and Islamic values in geometry learning creates a holistic approach that not only forms intellectual intelligence but also strengthens students' moral and spiritual qualities, preparing them as competent and characterful future educators. By connecting test results, observations, and interviews, it can be concluded that the integration of computational thinking and Islamic values in geometry learning has proven effective in increasing student understanding. The increase in post-test scores reflects the effectiveness of this method in improving students' cognitive abilities, while the observation results show their active involvement in the learning process. Meanwhile, interviews strengthened the findings that this approach was more meaningful and had a wider impact in shaping students' character and systematic thinking patterns.

However, there are still challenges that need to be considered, such as students' difficulties in technological aspects and concept abstraction. Therefore, there is a need for further assistance in the use of technology and more adaptive learning strategies to accommodate differences in students' levels of understanding. Several obstacles were discovered during the research, such as limited student access to technological devices and differences in students' initial understanding of the relationship between Islamic values and geometry. This obstacle supports the study, which emphasizes the need for systematic guidance in integrating spiritual values into science education [45].

Thematic analysis shows that computational thinking acts as a bridge to connect geometric concepts with practical applications, while Islamic values strengthen the moral dimension of learning. An integrative approach like this can build better conceptual understanding as well

as shape student character. In the PSTE context, this approach is very relevant because PSTE students will become educators who are responsible for educating future generations [45, 46]. This finding is in line with research that emphasizes that educators need to have a balance of intellectual and moral competence [28, 29]. This research makes a significant contribution to the educational literature that integrates technology and spiritual values. The results show that learning based on computational thinking and Islamic values not only improves cognitive abilities but also builds students' holistic character. These findings support the vision of Islamic education that balances knowledge and faith [47-50].

4. CONCLUSION

The integration of computational thinking and Islamic values in geometry learning has a positive impact on Primary School Teacher Education students. This approach succeeded in increasing understanding of geometric concepts, computational thinking skills, and the internalization of Islamic values such as honesty, cooperation, and spiritual appreciation. The study showed a significant increase in the average post-test score of students from 65 to 90, which indicates an increase in conceptual understanding. The results of the one-sample t-test showed that the significance value obtained was 0.00. Thus, this test confirms that there is a significant difference between the initial and final test results, reinforcing the effectiveness of integrating computational thinking and Islamic values in geometry learning. Students also demonstrated the ability to solve geometric problems systematically through decomposition, observing patterns, designing algorithms, and abstraction. Apart from that, the appreciation of Islamic values through spiritual reflection-based learning enriches students' moral dimensions, strengthening their Islamic character. This approach is relevant for PSTE students who will become future educators because it is able to form a balance of intellectual and moral competence. In conclusion, the integration of computational thinking and Islamic values in geometry learning is an innovative and effective holistic learning model. This approach makes a significant contribution to the formation of students who are not only academically competent but also have strong Islamic moral character, in line with the demands of 21st-century education.

5. ACKNOWLEDGMENTS

We would like to thank Universitas Islam Riau for funding this research through the National Collaborative Professor Acceleration scheme with contract number 785/KONTRAK/P-K-PGB/DPPM-UIR/10-2024.

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

7. REFERENCES

- [1] Davidson, V. C., Maduegbunam, T. O., Odo, J. A., Adony, I. I., Ugwuara, F. S., and Agbo, C. N. (2026). Integrating artificial intelligence (AI) in mathematics education: Enhancing students' interest and achievement through adaptive learning systems. *ASEAN Journal for Science Education*, 5(1), 87-94.
- [2] Camilon, K. F., Dupitas, J. E. A., Cajandig, A. M. C., Cuba, B. A. A., Valdez, A. G., Abelito, J. T., and Marcella, A. M. A. (2025). Perceptions of senior high school science, technology, engineering, and mathematics (STEM) students toward STEM and non-

- STEM courses: A comparative qualitative study. *ASEAN Journal for Science Education*, 4(2), 105-112.
- [3] Ardianti, T., Purwoko, B., and Izzati, U. A. (2023). The effects of playing playdough on the ability to recognize geometric shapes in kindergarten. *Studies in Philosophy of Science and Education*, 4(1), 17-21.
- [4] Putri, A. A. (2020). Recognize geometry shapes through computer learning in early math skills. *Jurnal Pendidikan Usia Dini*, 14(1), 50-64.
- [5] Ahmed, M., Latif, R., Seher, S., Sajjad, R., Hussain, T., Islam, M. R., and Waleed, A. (2024). Machine learning-based CO₂ hydrogenation to high-value green fuels: A comprehensive review for computational assessment. *ASEAN Journal for Science and Engineering in Materials*, 3(2), 195-216.
- [6] English, L. (2018). On MTL's second milestone: Exploring computational thinking and mathematics learning. *Mathematical Thinking and Learning*, 20(1), 1-2.
- [7] Gong, D., Yang, H. H., and Cai, J. (2020). Exploring the key influencing factors on college students' computational thinking skills through flipped-classroom instruction. *International Journal of Educational Technology in Higher Education*, 17(1), 19.
- [8] Korkmaz, Ö., Çakir, R., and Özden, M. Y. (2017). A validity and reliability study of the computational thinking scales (CTS). *Computers in Human Behavior*, 72, 558-569.
- [9] Misirli, A., and Komis, V. (2023). Computational thinking in early childhood education: The impact of programming a tangible robot on developing debugging knowledge. *Early Childhood Research Quarterly*, 65, 139-158.
- [10] Reskianissa, A., Sakti, A. W., and Azizah, N. N. (2022). TikTok platform to train middle school students' computational thinking skills in distance learning. *ASEAN Journal of Educational Research and Technology*, 1(1), 79-86.
- [11] Abidin, Z., Herman, T., Wahyudin, W., and Farokhah, L. (2025). Bibliometric analysis using vosviewer with Publish or Perish of computational thinking and mathematical thinking in elementary school. *ASEAN Journal for Science Education*, 4(1), 7-16.
- [12] Harangus, K., and Kátai, Z. (2020). Computational thinking in secondary and higher education. *Procedia Manufacturing*, 46, 615-622.
- [13] Hsu, T. C., Chang, S. C., and Hung, Y. T. (2018). How to learn and how to teach computational thinking: Suggestions based on a review of the literature. *Computers and Education*, 126, 296-310.
- [14] Montuori, C., Pozzan, G., Padova, C., Ronconi, L., Vardanega, T., and Arfé, B. (2023). Combined unplugged and educational robotics training to promote computational thinking and cognitive abilities in preschoolers. *Education Sciences*, 13(9), 858.
- [15] Sung, W., and Black, J. B. (2021). Factors to consider when designing effective learning: Infusing computational thinking in mathematics to support thinking-doing. *Journal of Research on Technology in Education*, 53(4), 404-426.
- [16] Yang, W., Ng, D. T. K., and Gao, H. (2022). Robot programming versus block play in early childhood education: Effects on computational thinking, sequencing ability, and self-regulation. *British Journal of Educational Technology*, 53(6), 1817-1841.
- [17] Batiibwe, M. S. K. (2024). Application of interactive software in classrooms: A case of GeoGebra in learning geometry in secondary schools in Uganda. *Discover Education*, 3(1), 179.
- [18] Clements, D. H., Sarama, J., Swaminathan, S., Weber, D., and Trawick-Smith, J. (2018). Teaching and learning geometry: Early foundations. *Quadrante*, 27(2), 7-31.

- [19] Demir, Ö. (2022). An examination of the impact of game-based geometric shapes education software usage on the education of students with intellectual disabilities. *ECNU Review of Education*, 5(4), 761-783.
- [20] Lee, J. (2020). Coding in early childhood. *Contemporary Issues in Early Childhood*, 21(3), 266-269.
- [21] Madlool Abbas, A. (2021). The effect of small games in learning geometric shapes, mathematical numbers, and developing some motor skills among kindergarten children. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, 12(8), 1893-1900.
- [22] Al-Hakim, S., and Susilowati, E. (2021). Developing Islamic values-based STEM education model: A case study in Indonesian Islamic Universities. *International Journal of Islamic Educational Psychology*, 2(1), 1-18.
- [23] Aswirna, P., and Fahmi, R. (2021). Integration of Islamic values in science learning: A study of Islamic boarding schools in Indonesia. *Journal of Islamic Education*, 6(1), 45-62.
- [24] Daneshgar, M. (2020). Islamic perspectives on modern sciences: Challenges and opportunities. *Journal of Islamic Studies*, 31(2), 185-207.
- [25] Daneshgar, M. (2021). Digital humanities and Islamic studies: Preserving and analyzing classical Islamic texts through computational methods. *Digital Scholarship in the Humanities*, 36(3), 622-638.
- [26] Fauzi, A., and Zakaria, G. A. N. (2021). STEM education in achieving sustainable development goals: An Islamic perspective. *Journal of Islamic Education*, 6(1), 1-16.
- [27] Halim, L., and Mohd Salleh, S. (2021). Integrating Islamic values in STEM education: A conceptual framework. *International Journal of Islamic Educational Psychology*, 2(1), 19-37.
- [28] Ismail, N. A., Wahab, N. A., and Majid, R. A. (2022). Integrating STEM and Islamic values in early childhood education: Teachers' perspectives and practices. *Early Child Development and Care*, 192(7-8), 1159-1174.
- [29] Ismail, R., Zakariya, H., and Ahmad, A. R. (2023). Development of STEM-based Islamic educational materials: A design and development research. *International Journal of Interactive Mobile Technologies*, 17(3), 70-85.
- [30] Khelifi, A. (2019). Gender equality in STEM education: An Islamic perspective. *International Journal of Gender and Women's Studies*, 7(1), 1-10.
- [31] Munadi, M., Susilowati, E., and Zubaidah, S. (2021). Promoting scientific literacy through Islamic-based STEM learning: A case study in Indonesian Islamic elementary schools. *Journal of Science Learning*, 4(2), 173-185.
- [32] Al Husaeni, D. F., Al Husaeni, D. N., Fiandini, M., and Nandiyanto, A. B. D. (2024). The research trend of statistical significance test: Bibliometric analysis. *ASEAN Journal of Educational Research and Technology*, 3(1), 71-80.
- [33] Nandiyanto, A. B. D., and Hofifah, S. N. (2024). How to conduct paired-t-test SPSS: comprehension in adsorption with bibliometric. *International Journal of Evaluation and Research in Education (IJERE)*, 13(1), 151-158.
- [34] Darojah, T. Z., Windayani, N., and Irwansyah, F. S. (2024). Implementing project-based worksheets on making kaolin soap with the addition of kefir curd to develop students' scientific performance in Islamic school. *ASEAN Journal for Science and Engineering in Materials*, 3(1), 59-74.
- [35] Bati, K. (2018). Computational thinking test (CTT) for middle school students. *Mediterranean Journal of Educational Research*, 12(23), 89-101.

- [36] Lin, Y. S., Chen, S. Y., Tsai, C. W., and Lai, Y. H. (2021). Exploring computational thinking skills training through augmented reality and AIoT learning. *Frontiers in Psychology, 12*, 640115.
- [37] Román-González, M. (2015). Computational thinking test: Design guidelines and content validation. *Computers in Human Behavior, 36*, 2436-2444.
- [38] Shute, V. J., Sun, C., and Asbell-Clarke, J. (2017). Demystifying computational thinking. *Educational Research Review, 22*, 142-158.
- [39] Zulkifli, N. A., Hussain, N. H., and Wahab, N. A. (2021). STEM education in Islamic schools: teachers' perspectives on 21st-century skills integration. *International Journal of Academic Research in Business and Social Sciences, 11(14)*, 230-245.
- [40] Zulkifli, M., Meerah, T. S. M., and Halim, L. (2022). Developing a framework for Islamic STEM education: A delphi study. *International Journal of STEM Education, 9(1)*, 1-18.
- [41] Gecu-Parmaksiz, Z., and Delialioglu, O. (2019). Augmented reality-based virtual manipulatives versus physical manipulatives for teaching geometric shapes to preschool children. *British Journal of Educational Technology, 50(6)*, 3376-3390.
- [42] Khotimah, N., Rakhmawati, N. I. S., and Hasibuan, R. (2020). The effectiveness of computer-assisted instruction on students' cognitive skill to know geometric shapes. *Ilmu Pendidikan: Jurnal Kajian Teori dan Praktik Kependidikan, 5(2)*, 63-72.
- [43] Aksan, S. M., Zein, M., and Saumur, A. S. (2023). Islamic educational thought on STEM (Science, Technology, Engineering, Mathematics): Perspectives and implementation. *International Journal of Trends in Mathematics Education Research, 6(4)*, 378-386.
- [44] Kim, Y. R., Park, M. S., and Tjoe, H. (2021). Discovering concepts of geometry through robotics coding activities. *International Journal of Education in Mathematics, Science and Technology, 9(3)*, 406-425.
- [45] Musa, M. (2022). Tawhidic epistemology and its implications for STEM education in Islam. *International Journal of Islamic Educational Psychology, 3(1)*, 1-18.
- [46] Aslan, D., Dağaynası, S., and Ceylan, M. (2024). Technology and geometry: Fostering young children's geometrical concepts through a research-based robotic coding program. *Education and Information Technologies, 29(17)*, 22699-22721.
- [47] Çelik, H. C. (2020). The effect of modelling, collaborative and game-based learning on the geometry success of third-grade students. *Education and Information Technologies, 25(1)*, 449-469.
- [48] Masran, M. N., and Abidin, R. (2018). Tangram game software in helping understanding of geometric concepts among pre school children. *Advanced Science Letters, 24(7)*, 5338-5341.
- [49] Rahman, N. A., Halim, L., and Ahmad, A. R. (2020). Integrating STEM education with Islamic values: A conceptual model for 21st-century muslim learners. *Journal of Islamic Education, 5(1)*, 62-80.
- [50] Suhendi, H. Y., Mulhayatiah, D., and Zakwandi, R. (2022). Developing Islamic values-based assessment model for STEM education: A design and development research. *International Journal of Instruction, 15(1)*, 247-268.