Edulab :
Majalah Ilmiah Laboratorium Pendidikan
https://ejournal.uin-suka.ac.id/tarbiyah/index.php/edulab/index

EISSN: 2527-7200
Vol. 10, No. 2, December 2025
DOI: https://doi.org/10.14421/edulab.2025.102.05

Development of a non-test instrument to measure lecturers' understanding of the STEM approach and its implementation in islamic studies courses

Louisiana Muliawati[1], **Zaenal Hartoyo**[2], **Della Amrina Yusra**[3], **Haerul Pathoni**✉[4]
[1,2,3]Universitas Islam Negeri Sulthan Thaha Saifudin Jambi, Indonesia
[4]Universitas Jambi, Indonesia

ABSTRACT

Purpose – This study aims to develop a non-test instrument to measure lecturers' understanding and perceptions of the STEM (Science, Technology, Engineering, and Mathematics) approach and its implementation in Islamic studies courses at State Islamic Higher Education Institutions (Perguruan Tinggi Keagamaan Islam Negeri/ PTKIN).

Design/methods/approach – This study employed a Research and Development (R&D) method, specifically using a development and validation approach. The instrument development process involved expert validation, reliability testing, and field trials.

Findings – The study produced a non-test instrument designed to measure lecturers' perceptions and understanding of the STEM approach and its application in Islamic studies courses at PTKIN. The instrument successfully passed expert validation stages, including content and face validity. It achieved a very high validity level of 97% in accordance with the standards set by the National Education Standards Board (BSNP). Reliability testing using Cronbach's Alpha indicated acceptable internal consistency, although categorized as low, with coefficients of 0.639 for the material aspect, 0.598 for constructiveness, and 0.569 for the language aspect. These results indicate that the instrument is suitable for use. Field trial results revealed that the majority of lecturers were familiar with the STEM approach (65% or 15 lecturers) and understood its urgency in integrating interdisciplinary knowledge into Islamic studies courses (56% or 13 lecturers).

Research implications/limitations – The developed instrument is a valid and reliable tool for assessing lecturers' understanding and perceptions of the STEM approach. The findings indicate the need for further training, increased resources, and improved infrastructure to support the effective integration of STEM into Islamic studies courses at PTKIN.

Originality/value – Research on the development of non-test instruments related to STEM is still very limited in PTKIN contexts. This study provides an initial contribution, with future research directed toward developing STEM–Islamic learning tools.

OPEN ACCESS

ARTICLE HISTORY
Received: 06-11-2025
Revised: 29-12-2025
Accepted: 30-12-2025

KEYWORDS
Islamic studies, Lecturers' understanding, Non-test instrument, STEM approach

CONTACT: ✉haerul.pathoni@gmail.com

Introduction

Education is a strategic means of humanizing human beings, as mandated by Law Number 20 of 2003 on the National Education System. Through education, individuals experience changes in behavior, knowledge, attitudes, and skills that enable them to adapt and function optimally in social life (Higgins & Kruglanski, 2000). Learning, in essence, is a relatively permanent change in behavior resulting from an individual's interaction with the environment (Hamalik, 2015; Slameto, 2013; Sardiyanah, 2020). Therefore, learning must be systematically designed by integrating learners, educators, learning materials, media, facilities, and instructional procedures to achieve curricular objectives and support the holistic development of learners' competencies.

In the context of global challenges and the demands of the 21st-century workforce, STEM-based learning (Science, Technology, Engineering, and Mathematics) has emerged as a relevant approach that emphasizes interdisciplinary integration, contextual problem-solving, and the development of critical, creative, collaborative, and communicative thinking skills. Numerous studies have demonstrated that STEM learning positively impacts learning outcomes, critical thinking skills, creativity, problem-solving abilities, intrinsic motivation, self-regulation, and students' scientific literacy (Yalçın & Erden, 2021; Asrizal et al., 2022; Hasibuan et al., 2022). The effectiveness of STEM learning is also strongly influenced by the use of appropriate instructional media, such as electronic modules, simulation-based media, and interactive digital learning tools (Agustina & Dwikoranto, 2021; Prasetyo et al., 2021; Nufus et al., 2022; Wang et al., 2022).

STEM is an interdisciplinary approach that integrates science, technology, engineering, and mathematics to equip learners with critical and innovative thinking skills in addressing real-world problems (Sanders, 2009; Banks & Barlex, 2020). Previous studies indicate that STEM-based learning enhances students' science process skills, conceptual understanding, and content mastery (Cotabish et al., 2013). while simultaneously fostering 21st-century skills or the so-called 4C competencies (critical thinking, creativity, collaboration, and communication) (Triana et al., 2020; Nufus et al., 2022).

Nevertheless, the implementation of the STEM approach in Islamic studies courses at higher education institutions, particularly at State Islamic Higher Education Institutions (Perguruan Tinggi Keagamaan Islam Negeri/ PTKIN), remains relatively limited. This condition highlights the need for valid and reliable instruments to measure lecturers' understanding, perceptions, and instructional practices in integrating the STEM approach into Islamic education. Theoretically, instrument development is a systematic process aimed at producing measurement tools that accurately and consistently represent specific constructs through stages such as indicator formulation, expert content validation, and empirical reliability and validity testing (Adams & Wieman, 2011).

Several studies have emphasized the importance of non-test instruments in evaluating educators' perceptions, competencies, and instructional practices. Indryani, (2025), for instance, developed a student perception instrument that proved effective as a basis for planning educational interventions, while Parmin et al. (2023) successfully developed a teaching skills instrument for prospective science teachers with adequate reliability (Cronbach's Alpha = 0.712). Furthermore, recognizing the significance of non-test instruments for assessing educators' perceptions, competencies, and practices, Mabruroh & Ashsiddiqi (2021) conducted research to develop an authentic assessment instrument grounded in scientific literacy to evaluate students' science process skills. This development

is crucial because it enables assessment to better reflect authentic scientific knowledge and practices, thereby improving educational quality and outcomes. Similarly, Nurizzati et al. (2023) developed an authentic assessment model to evaluate the achievement of basic competencies in drama appreciation (literary text) learning for Grade XI students under the 2013 Curriculum at the senior high school level. This model focused on psychomotor and affective domains—key aspects of literary learning outcomes—through systematic needs analysis, competency analysis, material analysis, and learner analysis.

In addition, Jatmiko (2018) conducted research on the development and feasibility of assessment instruments for the implementation of the 2013 Curriculum in teaching and learning processes, which requires teachers to assess students in accordance with curriculum standards. Furthermore, assessment must be comprehensive, employing diverse methods and instruments to evaluate students' competencies and provide a holistic picture of their overall abilities. Consequently, the development of standardized instruments to measure lecturers' understanding and implementation of the STEM approach at PTKIN is essential to ensure that Islamic studies learning remains relevant to modern education demands without compromising Islamic values. Therefore, this study aims to develop and validate an instrument that measures lecturers' knowledge, perceptions, and instructional practices related to STEM-based learning within the context of Islamic education.

Methods

The research method employed in this study was Research and Development (R&D) using a development and validation approach. The researchers developed an instrument to measure lecturers' understanding at State Islamic Higher Education Institutions (Perguruan Tinggi Keagamaan Islam Negeri/PTKIN) of the concept of STEM-based learning and its implementation in Islamic studies courses within the university context. According to Adams & Wieman (2011), the development and validation method consists of four stages: conducting a preliminary study to identify the objectives of the instrument to be developed; developing the instrument; conducting trials and validating the instrument; and evaluating the developed instrument.

The sample in this study consisted of lecturers from various departments at UIN Sulthan Thaha Saifuddin Jambi who teach Islamic studies courses. Data were collected using a purposive sampling technique. Purposive sampling is a sampling method based on specific criteria relevant to the research objectives. In contrast, random sampling, as explained by Creswell (2012), is a technique in which participants are selected at random for research purposes.

This study adapted a questionnaire instrument from Pathoni et al. (2022), which originally consisted of 11 items and was subsequently modified into 7 items, namely: (1) sources of information about STEM; (2) the urgency of the STEM approach in teaching Islamic studies courses; (3) lecturers' ability to design learning activities using the STEM approach; (4) the most appropriate learning models for Islamic studies courses; (5) steps for implementing STEM in teaching Islamic studies courses; (6) the level of confidence in applying STEM in teaching Islamic studies courses; and (7) supporting factors and obstacles in implementing the STEM approach in Islamic studies courses.

In the data collection process, the researchers employed quantitative Likert-scale indicators for expert validation data and qualitative open-ended questions to capture respondents' perspectives. For data analysis, SPSS version 26 was used to facilitate statistical processing. The statistical method applied in this study was descriptive statistics,

which involved presenting data to calculate mean values, standard deviations, and other relevant statistical measures (Cohen et al., 2017).

Result

1. Preliminary Study

The preliminary study was conducted through a review of journals and other relevant literature, including both national and international publications. The results of this preliminary review provided the initial rationale for developing an instrument to measure lecturers' understanding at State Islamic Higher Education Institutions (PTKIN) regarding the concept of STEM-based learning and its implementation in Islamic studies courses within the PTKIN academic environment.

2. The Concept of Moral Development from the Perspective of Lawrence Kohlberg

The development of an instrument requires a well-structured blueprint that serves as the foundation for item construction. In this stage, the blueprint was developed by identifying the relevant aspects, indicators, and sub-indicators to be measured. The resulting blueprint for the non-test instrument, designed to assess lecturers' understanding of the STEM approach and its implementation in Islamic studies courses at State Islamic Universities, is presented in Table 1.

Table 1

Blueprint of the Non-Test Instrument (Questionnaire) on Lecturers' Understanding of the STEM Approach and Its Implementation in Islamic Studies Courses at State Islamic Universities

Aspect	Indicator	Sub-indicator	Item No.
Lecturers' understanding and perceptions of STEM	Sources of information about STEM (Science, Technology, Engineering, and Mathematics)	Sources of information about STEM	1
Lecturers' views on STEM-based learning in Islamic studies courses	Urgency of the STEM approach in Islamic studies learning	Perceived importance of STEM	2
STEM implementation	Application of STEM in Islamic studies learning activities	Ability to design learning activities using the STEM approach and appropriate learning models for Islamic studies courses	3
	Steps for implementing STEM	Implementation procedures in Islamic studies courses	4
	Confidence in implementing STEM	Level of confidence in applying STEM in Islamic studies learning	5

Aspect	Indicator	Sub-indicator	Item No.
Supporting and inhibiting factors	Supporting factors in STEM implementation	Supporting factors for applying the STEM approach in Islamic studies learning	6
	Inhibiting factors in STEM implementation	Obstacles to applying the STEM approach in Islamic studies learning	7

3. Instrument Validation Stage

Expert validation was conducted by specialists in the relevant fields. The experts involved in this study were scholars in education, particularly in STEM education, who teach Islamic studies courses at State Universities or State Islamic Universities. Validation was conducted using a Likert scale by two expert validators in two rounds until the instrument was deemed valid. Tables 2 and 3 present the results of content and face validity assessments, which indicate the extent to which experts agreed with the presence and relevance of the instrument items. This validation aimed to examine the readability, accuracy, and appropriateness of the instrument content.

Table 2

Expert Evaluation of the Instrument by Two Validators (Stage 1 Validation)

No.	Evaluation Criteria	Expert 1	Expert 2	*M* ± *SD*
Material Aspect				
1	The questionnaire items cover all assessment aspects in accordance with the blueprint	4	4	4.00 ± 0.00
2	The questionnaire items are related to the substance of the STEM approach in Islamic studies courses	3	3	3.00 ± 0.00
3	The content is consistent with the measurement objectives	5	4	4.50 ± 0.71
Construct Aspect				
4	The main points of each item are clearly formulated	5	5	5.00 ± 0.00
5	The sentences are appropriate and consistent with the questionnaire assessment items	4	5	4.50 ± 0.71
6	The questionnaire instrument is equipped with clear instructions	5	5	5.00 ± 0.00
Language Aspect				
7	The sentence formulations are communicative	5	5	5.00 ± 0.00

No.	Evaluation Criteria	Expert 1	Expert 2	*M* ± *SD*
8	The sentences use proper and correct Indonesian language conventions	5	5	5.00 ± 0.00
9	The sentence formulations do not lead to multiple interpretations	4	5	4.50 ± 0.71
10	The statements do not contain words that violate ethical norms or offend respondents	4	5	4.50 ± 0.71
	Total	**44**	**46**	**45.00**
	Validity Percentage	**88%**	**92%**	**90%**

Note. M = mean; SD = standard deviation. The validity percentage is calculated based on expert agreement and categorized according to the National Education Standards Board (BSNP) criteria.

Based on the first-stage validation, the average level of expert agreement reached 90%, which falls into the "very good" category according to the National Education Standards Board (BSNP, 2016). However, several items received a score of 3, indicating partial disagreement among experts regarding the instrument's form and content. Expert comments and suggestions were therefore used as references for revising the instrument.

Table 3

Expert Evaluation of the Instrument by Two Validators (Stage 2 Validation)

No.	Evaluation Criteria	Expert 1	Expert 2	*M* ± *SD*
Material Aspect				
1	The questionnaire items cover all assessment aspects in accordance with the blueprint	5	5	5.00 ± 0.00
2	The questionnaire items are related to the substance of the STEM approach in Islamic studies courses	4	4	4.00 ± 0.00
3	The content is consistent with the measurement objectives	5	5	5.00 ± 0.00
Construct Aspect				
4	The main points of each item are clearly formulated	5	5	5.00 ± 0.00
5	The sentences are appropriate and consistent with the questionnaire assessment items	5	5	5.00 ± 0.00
6	The questionnaire instrument is equipped with clear instructions	5	5	5.00 ± 0.00
Language Aspect				
7	The sentence formulations are communicative	5	5	5.00 ± 0.00

No.	Evaluation Criteria	Expert 1	Expert 2	*M* ± *SD*
8	The sentences use proper and correct Indonesian language conventions	5	5	5.00 ± 0.00
9	The sentence formulations do not lead to multiple interpretations	4	5	4.50 ± 0.71
10	The statements do not contain words that violate ethical norms or offend respondents	5	5	5.00 ± 0.00
	Total	**48**	**49**	**48.50**
	Validity Percentage	**96%**	**98%**	**97%**

Note. M = mean; SD = standard deviation. The validity percentage represents the level of expert agreement based on the criteria of the National Education Standards Board (BSNP).

In the second-stage validation, the average validity score increased to 97%, which is categorized as "very good" according to BSNP (2016). Compared to the first validation stage, this result shows a substantial improvement. No items received a score of three in this stage, indicating full expert agreement on the form and content of the instrument. Following expert validation, the reliability of the non-test instrument was calculated for the material, construct, and language aspects using SPSS version 26, as presented in Table 4.

Table 4

Reliability of the Instrument Measuring Lecturers' Perceptions and Understanding of STEM Using SPSS 26

Aspect	Cronbach's Alpha	Category
Material	0.639	Low
Construct	0.598	Low
Language	0.569	Low

Cronbach's Alpha was used to assess the reliability of the non-test instrument. A higher Cronbach's Alpha value indicates greater instrument reliability (Monika Murniati et al., 2013). Although the alpha values for the material (0.639), construct (0.598), and language (0.569) aspects fall into the low-reliability category, the instrument was considered adequate for addressing qualitative questions and drawing conclusions in this study. In addition, experts provided comments and suggestions for further improvement, as summarized in Table 5.

Table 5

Expert Comments and Suggestions for Instrument Improvement

Evaluation Aspect	Expert Comments	Revisions Made
Material	Expert 1: Ensure that the questions are able to detect the research objectives. Expert 2: Ensure that the questions can capture lecturers' understanding of the STEM approach in Islamic studies teaching.	These aspects have been implicitly incorporated into the developed instrument.

Evaluation Aspect	Expert Comments	Revisions Made
Construct	Expert 1: Avoid using the word *important* in Item No. 2.	The word *important* has been removed from the instrument.
Language	Expert 1: Ensure that questions with a "no" response in Item No. 1 are followed up accordingly.	The word *no* as a negative statement has been revised into a positive formulation.

Note. This table summarizes expert feedback collected during the validation process and the corresponding revisions implemented to improve the instrument's quality.

Expert feedback led to revisions in content clarity, the avoidance of ambiguous or overemphasized wording, and the refinement of negatively phrased statements into positive formulations.

4. Revision of the Product Draft

At this stage, the developed non-test instrument was revised based on expert feedback obtained during the validation process. The revised instrument focuses on measuring lecturers' understanding of the STEM approach and its implementation in Islamic studies courses at State Islamic Universities.

5. Field Trial

The field trial was conducted to examine lecturers' understanding of the STEM approach and its implementation in Islamic studies courses at State Islamic Universities. The trial involved 23 lecturers from UIN Sulthan Thaha Saifuddin Jambi, UIN Mataram, and IAIN Kerinci. The results of the field trial are presented in Table 6.

Table 6

Field Trial Results on Lecturers' Understanding of the STEM Approach in Islamic Studies Courses

No.	Question	Lecturers' Responses
1	Have you ever heard of or received information about the STEM approach? If yes, from which sources did you obtain the information?	65% (15 lecturers) reported having received information about STEM through online media, seminars, mass media, and the *Merdeka Curriculum*, whereas 35% (8 lecturers) had never received information about STEM.
2	In your opinion, is the STEM approach important to be implemented in Islamic studies courses at PTKIN at present?	56% (13 lecturers) stated that the STEM approach is important to be implemented in Islamic studies courses, depending on the availability of facilities and human resource readiness at PTKIN, as it helps students understand Islamic content from multiple perspectives, supports institutions without general study programs, and facilitates interdisciplinary integration. Meanwhile, 44% (10 lecturers) reported uncertainty.
3	Have you ever designed learning activities using the STEM approach in Islamic	44% (10 lecturers) had designed STEM-based learning activities using models such as field experimental studies, inquiry-based learning,

No.	Question	Lecturers' Responses
	studies courses? If yes, which learning models are suitable?	LMS-based learning, and interdisciplinary approaches integrated into topics such as Islamic rituals examined from scientific perspectives and Islamic law studies leading to application-based projects. In contrast, 56% (13 lecturers) had never designed STEM-based learning activities.
4	Have you ever implemented the STEM approach in Islamic studies courses? If yes, how were the implementation steps carried out?	35% (8 lecturers) had implemented the STEM approach in Islamic studies courses, such as Islamic Entrepreneurship, while 65% (15 lecturers) had never implemented it. The implementation steps were generally available through LMS platforms (e.g., PPG LMS).
5	In your opinion, can the STEM approach be applied to all Islamic studies course materials that you teach?	56% (13 lecturers) stated that the STEM approach can be applied to all Islamic studies materials provided that supporting modules are available as guidance for syllabus and lesson plan development, whereas 44% (10 lecturers) believed that STEM cannot be applied to all materials.
6	In your opinion, what factors support the implementation of the STEM approach in Islamic studies learning?	65% (15 lecturers) identified supporting factors, including the existence of faculties of science and technology and philosophy of science courses in study programs, availability of digital devices and internet access, lecturer and student readiness, adequate resources and facilities, supportive learning resources, leadership support, professional development training, and lecturers' understanding of STEM. Meanwhile, 35% (8 lecturers) reported uncertainty.
7	In your opinion, what factors hinder the implementation of the STEM approach based on transdisciplinary integration in Islamic studies learning?	56% (13 lecturers) identified inhibiting factors, including limited supporting infrastructure, the need for STEM-related training for lecturers, uneven student knowledge backgrounds, low reading motivation, limited understanding of STEM concepts, inadequate facilities, insufficient funding, and underdeveloped human resources and infrastructure. Meanwhile, 44% (10 lecturers) reported uncertainty regarding these inhibiting factors.

Note. Percentages are calculated based on responses from 23 lecturers participating in the field trial at UIN Sulthan Thaha Saifuddin Jambi, UIN Mataram, and IAIN Kerinci.

The results indicate that 65% (15 lecturers) had previously received information about the STEM approach through online media, seminars, mass media, and the Merdeka Curriculum, while 35% (8 lecturers) had not. Furthermore, 56% (13 lecturers) considered the STEM approach important for Islamic studies courses at PTKIN, provided adequate facilities

and human resources are available, and it supports interdisciplinary integration. Meanwhile, 44% (10 lecturers) reported uncertainty.

Regarding instructional design, 44% (10 lecturers) had designed learning activities using the STEM approach, employing models such as field experimental studies, inquiry-based learning, learning management systems (LMS), and interdisciplinary approaches in specific Islamic content areas. In contrast, 56% of lecturers had never designed STEM-based learning activities. In terms of implementation, only 35% (8 lecturers) had applied the STEM approach in Islamic studies courses, such as Islamic Entrepreneurship, while 65% (15 lecturers) had never implemented it.

Regarding applicability, 56% (13 lecturers) stated that STEM could be applied to all Islamic studies materials, provided that supporting modules are available to guide syllabus and lesson plan development, whereas 44% (10 lecturers) believed that STEM could not be applied to all materials. Supporting factors for STEM implementation, identified by 65% (15 lecturers), included leadership support, adequate facilities, training, and sufficient human resources. Conversely, 56% (13 lecturers) identified inhibiting factors such as limited infrastructure, insufficient understanding among lecturers and students, and funding constraints, while 44% (10 lecturers) reported uncertainty regarding these barriers.

Discussion

This study resulted in a non-test instrument designed to measure lecturers' perceptions and understanding of the STEM approach and its implementation in Islamic studies courses at State Islamic Higher Education Institutions (PTKIN). The instrument has undergone expert validation stages, including content and face validity, and achieved a very high level of validity, namely 90% in Stage 1 and 97% in Stage 2, in accordance with the standards of the National Education Standards Board (BSNP). Reliability testing using Cronbach's Alpha indicated acceptable internal consistency, although it was classified in the low category, with coefficients of 0.639 for the material aspect, 0.598 for the construct aspect, and 0.569 for the language aspect, suggesting that the instrument is suitable for field trials. In addition, the instrument was revised based on expert suggestions and feedback provided in the comment section.

Based on field-trial data, lecturers demonstrated diverse responses to implementing the STEM approach in Islamic studies courses at PTKIN campuses, including UIN Mataram, UIN Sulthan Thaha Saifuddin Jambi, and IAIN Kerinci. A total of 65% (15 lecturers) reported having received information about the STEM approach through various sources, including online media, seminars, mass media, and the Merdeka Curriculum, while 35% (8 lecturers) had never received such information. The majority of lecturers, namely 56% (13 lecturers), considered the STEM approach important to be implemented in Islamic studies courses, particularly when supported by adequate facilities and human resource readiness, as well as its potential to support interdisciplinary integration from multiple perspectives. However, 44% (10 lecturers) reported uncertainty regarding its importance.

In the context of instructional design, 44% (10 lecturers) had attempted to design learning activities using the STEM approach through models such as field experimental studies, inquiry-based learning, learning management systems (LMS), and interdisciplinary approaches applied to specific instructional materials. Meanwhile, 56% of lecturers had never designed STEM-based learning activities. In terms of implementation, only 35% (8 lecturers) had applied the STEM approach in Islamic studies courses, such as Islamic

Entrepreneurship, using the available implementation steps in the PPG LMS. Conversely, 65% (15 lecturers) had never implemented the STEM approach in their teaching.

Regarding the applicability of STEM to all Islamic studies materials, 56% (13 lecturers) stated that this is feasible, provided that supporting modules are available to guide the preparation of semester learning plans (RPS), while 44% (10 lecturers) indicated that STEM cannot be applied to all Islamic studies materials. Supporting factors for STEM implementation include the readiness of human resources, availability of supporting facilities, training opportunities, and leadership support, as expressed by 65% (15 lecturers). On the other hand, inhibiting factors—such as limited infrastructure, insufficient understanding among lecturers and students, and minimal funding support—were acknowledged by 56% (13 lecturers), while 44% (10 lecturers) were unaware of these constraints. Overall, the findings indicate both potential and challenges in implementing the STEM approach in Islamic studies courses at PTKIN, highlighting the need for adequate facilities, lecturer training, and strong policy and resource support.

Conclusion

This study successfully developed a non-test instrument to measure lecturers' perceptions and understanding of the STEM approach and its implementation in Islamic studies courses at State Islamic Higher Education Institutions (PTKIN). The instrument underwent a rigorous validation process, including content and face validity assessments by experts, and achieved a high validity score of 97% in the second validation stage, which is categorized as *very good* according to the National Education Standards Board (BSNP). Reliability testing using Cronbach's Alpha demonstrated acceptable internal consistency, although classified as low, with coefficients of 0.639 for the material domain, 0.598 for the construct domain, and 0.569 for the language domain, thereby confirming the instrument's reliability.

The field trial results revealed variations in lecturers' responses regarding STEM implementation. A total of 65% (15 lecturers) had received information about STEM, and 56% (13 lecturers) recognized the importance of this approach for integrating interdisciplinary knowledge into Islamic studies courses, provided that adequate facilities and human resources are available. However, practical implementation remains limited, with only 35% (8 lecturers) having applied the STEM-based approach in teaching, such as in Islamic Entrepreneurship courses. In addition, 56% (13 lecturers) acknowledged that STEM could be applied to all Islamic studies materials, provided that supporting modules are available to guide syllabus and semester learning plan development. Supporting factors for STEM implementation include leadership support, resource availability, training, and adequate facilities, as reported by 65% of lecturers (15). Meanwhile, challenges identified by 56% (13 lecturers) include limited infrastructure, insufficient understanding, and funding constraints, which remain significant barriers to effective implementation. Overall, these findings indicate that while the STEM approach holds considerable potential for enriching learning in Islamic studies at PTKIN, its effective implementation requires improved infrastructure, systematic lecturer training, and sustained policy and resource support.

Declarations

Author Contribution Statement

Louisiana Muliawati prepared the primary research and conducted the literature review. Zaenal Hartoyo and Della Amrina Yusra carried out expert validation and contributed to the development of the analytical methodology for this article. Haerul Pathoni prepared the overall draft of the manuscript.

Funding Statement

The authors would like to express their gratitude to the Head of the Institute for Research and Community Service of UIN Sulthan Thaha Saifuddin Jambi for providing financial support for this research.

Data Availability Statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request. This data availability statement specifies where the data supporting the reported results in the published article can be found, including, where applicable, links to publicly archived datasets analyzed or generated during the study.

Declaration of Interests Statement

The authors declare that they have no known financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Additional Information

Correspondence and requests for materials should be addressed to haerul_pathoni@unja.ac.id. ORCID IDs: Louisiana Muliawati (https://orcid.org/0000-0002-3724-7264); Zaenal Hartoyo; Della Amrina Yusra; Haerul Pathoni (https://orcid.org/0000-0001-8212-3466).

References

Adams, W. K., & Wieman, C. E. (2011). Development and validation of instruments to measure learning of expert-like thinking. *International Journal of Science Education, 33*(9), 1289–1312. https://doi.org/10.1080/09500693.2010.512369

Agustina, F. R., & Dwikoranto. (2021). Development of STEM model student worksheets with PhET simulation on Hooke's law material to improve students' critical thinking ability. *Journal of Physics: Conference Series, 2110*(1), 012023. https://doi.org/10.1088/1742-6596/2110/1/012023

Asrizal, A., Zan, A. M., Mardian, V., & Festiyed, F. (2022). The impact of static fluid e-module by integrating STEM on learning outcomes of students. *Journal of Education Technology, 6*(1), 110–118. https://doi.org/10.23887/jet.v6i1.42458

Banks, F., & Barlex, D. (2020). *Teaching STEM in the secondary school: Helping teachers meet the challenge* (2nd ed.). Routledge. https://doi.org/10.4324/9780429317736

Cohen, L., Manion, L., & Morrison, K. (2017). *Research methods in education* (8th ed.). Routledge. https://doi.org/10.4324/9781315456539

Cotabish, A., Dailey, D., Robinson, A., & Hughes, G. (2013). The effects of a STEM intervention on elementary students' science knowledge and skills. *School Science and Mathematics, 113*(5), 215–226. https://doi.org/10.1111/ssm.12023

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Pearson.

Hamalik, O. (2015). *Kurikulum dan pembelajaran* (1st ed.). Bumi Aksara.

Hasibuan, M. P., Sari, R. P., Syahputra, R. A., & Nahadi, N. (2022). Application of integrated project-based and STEM-based e-learning tools to improve students' creative thinking and self-regulation skills. *Jurnal Penelitian Pendidikan IPA, 8*(1), 51–56. https://doi.org/10.29303/jppipa.v8i1.1050

Higgins, E. T., & Kruglanski, A. W. (2000). *Motivational science: Social and personality perspectives*. Psychology Press.

Indryani, M. (2025). The development of a student perception instrument for guidance and counseling teachers' role and its association with learning motivation: Pengembangan instrumen persepsi siswa terhadap peran guru bimbingan dan konseling (BK) dan kaitannya dengan motivasi belajar siswa. *Edulab: Majalah Ilmiah Laboratorium Pendidikan, 10*(1), Article 1. https://doi.org/10.14421/edulab.2025.101.05

Jatmiko, A. (2018). Pengembangan instrumen penilaian autentik Kurikulum 2013 aspek afektif dalam mata pelajaran PAI kelas VII di SMPN 3 Kalasan. *Edulab: Majalah Ilmiah Laboratorium Pendidikan, 3*(2), Article 2.

Mabruroh, F., & Ashsiddiqi, M. H. (2021). Development of authentic assessment instrument based on scientific literacy to measure science process skills. *Al-Ishlah: Jurnal Pendidikan, 13*(3), Article 3. https://doi.org/10.35445/alishlah.v13i3.287

Murniati, M. M., Purnamasari, V., Dyah Ayu, S., Advensia Chrismastuti, A., Sihombing, R. P., & Warastuti, Y. (2013). *Alat-alat pengujian hipotesis*. Unika Soegijapranata. https://repository.unika.ac.id/34242/1/BUKU-ALAT2%20PENGUJIAN%20HIPOTESIS.pdf

Nufus, H., Erlina, E., Koderi, K., Ramadhan, M. U. C., & Nopiyanti, N. (2022). Development of *tarkīb* teaching materials based on motion graphics in Islamic junior high schools. *Jurnal Al Bayan: Jurnal Jurusan Pendidikan Bahasa Arab, 14*(1), Article 1. https://doi.org/10.24042/albayan.v14i1.7145

Nurizzati, N., Arief, E., & Noveria, E. (2023). Developing an authentic assessment model for learning to appreciate drama texts: A pilot test with senior high school students. *Al-Ishlah: Jurnal Pendidikan, 15*(4), Article 4. https://doi.org/10.35445/alishlah.v15i4.3253

Parmin, P., Rahayu, E. F., Ifriza, Y. N., & Siminto, S. (2023). Developing professional science teacher candidates' teaching skills based on next generation science standards (NGSS). *Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah, 8*(1), 113–123. https://doi.org/10.24042/tadris.v8i1.16596

Pathoni, H., Asyhar, R., Maison, M., & Huda, N. (2022). Measuring lecturers' perceptions of STEM approach-based contextual learning implementation. *Journal of Technology and Science Education, 12*(1), Article 1. https://doi.org/10.3926/jotse.1297

Prasetyo, D., Marianti, A., & Alimah, S. (2021). Improvement of students' science literacy skills using STEM-based e-modules. *Journal of Innovative Science Education, 10*(2), 216–221.

Sanders, M. (2009). STEM, STEM education, STEMmania. *The Technology Teacher, 68*(4), 20–26.

Sardiyanah, S. (2020). Belajar dan faktor yang mempengaruhinya. *Jurnal Al-Qalam: Jurnal Kajian Islam & Pendidikan, 7*(1), 123–144. https://doi.org/10.47435/al-qalam.v7i1.187

Slameto. (2013). *Belajar dan faktor-faktor yang mempengaruhinya*. Rineka Cipta.

Triana, D., Anggraito, Y. U., & Ridlo, S. (2020). Effectiveness of environmental change learning tools based on STEM-PjBL toward students' 4C skills. *Journal of Innovative Science Education, 9*(2), Article 2. https://doi.org/10.15294/jise.v8i3.34048

Wang, L.-H., Chen, B., Hwang, G.-J., Guan, J.-Q., & Wang, Y.-Q. (2022). Effects of digital game-based STEM education on students' learning achievement: A meta-analysis. *International Journal of STEM Education, 9*(1), 26. https://doi.org/10.1186/s40594-022-00344-0

Yalçın, V., & Erden, Ş. (2021). The effect of STEM activities prepared according to the design thinking model on preschool children's creativity and problem-solving skills. *Thinking Skills and Creativity, 41*, 100864. https://doi.org/10.1016/j.tsc.2021.100864