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DEVELOPMENT OF JP-BASED TEACHING MATERIALS WITH STEM-C APPROACH THROUGH THE INTEGRATION OF QUR'AN VERSES IN IMPROVING STUDENTS' PROBLEM-SOLVING ABILITIES

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ABSTRACT

Cultivating holistic abilities is one of the most important things, especially in today's era with such rapid global influence. Education in schools must not only contribute to building cognitive abilities, but also students must be taught to build character and problem-solving skills through questioning, especially in science learning. This study aims to develop a question network (JP)-based teaching module using the STEM-C approach through the integration of Al-Qur'anic verses. The type of research used in this study is Research and Development (R&D) with the Borg and Gall model with a product test design in the study using one group pretest-posttest. The research sample consisted of 110 students from junior high schools in Aceh. The data in this study were analyzed using the N-gain test to see the improvement in students' problem-solving abilities. Based on the results of the analysis that has been done, it shows a significant increase in students' problem-solving abilities, with the average pre-test score obtained at 37.51 in the low category increasing to 85.08 in the very high category for the post-test score, while the increase from the N-gain test was obtained at 0.75 in the high category. This increase occurred in all problem-solving indicators, such as focusing on problems, drawing situations, planning solutions, implementing plans, and evaluating answers. Then the character values of students obtained also increased from 32.2 in the low category to 82.6 in the high category. In addition, the JP-based teaching module with the STEM-C approach through the verses of the Qur'an proved effective in improving students' problem-solving abilities and forming positive characters with an average response value obtained at 3.17 and a percentage of 79.25%. The development of JP-based teaching materials using a STEM-C approach, integrated with Qur'anic verses, is expected improve students' problem-solving abilities and foster better character.

INTRODUCTION

Positive character is a crucial element in education. Such character cannot be fostered solely through religious learning activities, but requires a continuous

collaboration between scientific knowledge and religious values. This integration enables learners to understand knowledge within a broader framework that is aligned with religious norms, particularly through the incorporation of Qur'anic verses. The integration of religion in the learning process provides students with a more comprehensive understanding, empowering them to apply religious values in their daily lives (Jannah, 2023; Muhammad et al., 2023). Religious education is not only aimed at achieving intellectual satisfaction or material gain, but also at shaping individuals who are thoughtful and who acknowledge the Creator of humankind and the universe (Amin et al., 2022).

Through education, teachers can design more meaningful learning experiences by integrating various fields of knowledge. Meaningful learning occurs when newly acquired knowledge is connected with existing knowledge, allowing students to be engaged intellectually, emotionally, and creatively in creating relevant learning situations. Such an approach enables students to directly experience and understand concepts through real-life experiences, as well as to relate these concepts across subject areas (Canquiz-Rincón et al., 2024; Hariyadi et al., 2018). Meaningful learning also contributes to the construction of students' character (Susilawati et al., 2023), helping them integrate knowledge with values that support their learning process.

Integration in learning should not only emphasize academic aspects but also adopt a holistic approach that incorporates moral and spiritual development (Azzahra et al., 2023; Nuriya et al., 2022). One effective medium for such integration is the use of teaching materials. Teaching materials serve as essential tools to foster creativity and skill development, enabling learners to understand not only the universe from a scientific perspective but also its Creator and the underlying mathematical structures.

The integration of various disciplines through teaching materials can be implemented not only in terms of methods, models, or approaches but also through engaging and responsive instructional designs. One promising approach is the use of question networks integrated with Qur'anic verses in a STEM-C framework, which represents the novelty of this study. STEM-C is a character-based adaptation of STEM learning that aligns with the values of the Qur'an. Question networks, in this context, are structured diagrams of guiding questions that support learners in exploring theories, concepts, and knowledge in depth (Albustomi & Zainab, 2024). When combined with the STEM-C approach, question networks become powerful tools for fostering students' conceptual understanding.

Preliminary observations in several schools in Aceh reveal that student engagement in learning remains limited and that the STEM-C approach has not yet been widely applied. Teachers generally rely on publisher-produced materials or create their own, often presented in a simple and less engaging manner. Such materials rarely connect with real-world problems or integrate Qur'anic values. No teaching materials have yet been developed using the STEM-C approach integrated with Qur'anic verses, especially those based on question networks. This is particularly noteworthy given Aceh's identity as the "Veranda of Mecca," where social norms are deeply rooted in religious values. A question-network-based STEM-C approach has the potential to guide students toward solving problems more meaningfully while reinforcing their faith. However, the current curriculum shows minimal integration of religious values, and teaching materials that link STEM-C with Qur'anic integration are still unavailable, leading to students' low problem-solving skills.

This finding is consistent with previous studies, which highlight that many learning processes remain abstract due to the absence of engaging teaching materials (Futrisari et al., 2024). Several schools still lack sufficient instructional resources, making it difficult for students to fully grasp the content (Nabila et al., 2022; Ramadhani et al., 2023; Johnny & Delia, 2023; Carlit et al., 2024). Moreover, many students continue to perform below the minimum learning standards (Purwati et al., 2018; Mustakim & Arham, 2024; Omidi et al., 2020). Teachers also often demonstrate limited awareness of the importance of interdisciplinary integration (David et al., 2021). Learning activities rarely incorporate religious values, while students struggle to develop holistic thinking skills (Juwairiyah & Zainuddin, 2024). Additionally, question-network-based materials remain scarce in schools (Marsen & Risda, 2023).

The use of question networks is therefore essential in guiding learners toward a more complete understanding of knowledge through problem-based inquiry. Without such integration, students struggle to connect concepts to their daily lives as Muslims and fail to appreciate the relevance and benefits of what they are learning. By developing question-network-based novelty teaching materials using a STEM-C approach integrated with Qur'anic verses, it is expected that students will not only strengthen their conceptual knowledge but also cultivate positive attitudes and skills rooted in religious norms. Thus, this study seeks to develop teaching materials based on question networks within the STEM-C framework through the integration of Qur'anic verses in order to improve students' problem-solving skills.

RESEARCH METHOD

This study employed a research and development (R&D) approach aimed at producing and testing the effectiveness of instructional products. The development process followed the Borg and Gall model, which consists of ten steps: (1) research and information collecting, (2) planning, (3) developing the preliminary form of the product, (4) preliminary field testing, (5) main product revision, (6) main field testing, (7) operational product revision, (8) operational field testing, (9) final product revision, and (10) dissemination and distribution (Borg & Gall, 1989).

A one-group pretest–posttest design was applied to evaluate the effect of using the developed instructional product. This design measured students' initial abilities (pretest) before the intervention using the teaching module and compared them with their abilities after the intervention (posttest). The teaching module was developed based on question networks integrated with Qur'anic verses within the STEM-C framework (Yusuf, 2014).

The study involved two junior high schools in Aceh that is SMP Negeri 1 Baitussalam and SMP Negeri 13 Banda Aceh selected through purposive sampling, with a total of 110 students as participants. Several instruments were used in the study, including a teaching material evaluation sheet to assess the quality and feasibility of the developed module, observation sheets, test items to measure students' problem-solving skills before and after the intervention, and questionnaires using a Likert scale to collect students' responses toward the use of the module. The data were analyzed through normality and homogeneity tests, N-Gain analysis to measure improvement in students' problem-solving skills, and response questionnaire analysis to determine students' perceptions based on the average index scores obtained.

RESULT AND DISCUSSION

The development of teaching materials in the form of a teaching module using the Borg and Gall method began with the Research and Information Collecting stage, where a needs analysis was carried out through observations and interviews with teachers and students in two junior high schools in Banda Aceh. The results of this analysis showed that there were no teaching materials based on Question Networks (QN) with a STEM-C approach integrated with Qur'anic verses, while students' problem-solving skills were still low. The second stage, Planning, was carried out by preparing a development plan for the module that focused on QN as a guide to concept understanding, the integration of Qur'anic verses as reinforcement of religious values, and the application of STEM-C

principles to develop 21st-century skills, particularly problem-solving and character development. The third stage, Develop Preliminary Form of the Product, involved designing a QN-based teaching module with a systematic structure consisting of an introduction, question networks, Qur'anic integration, STEM-C–based material, and problem-solving exercises. The module was developed by considering aspects of content feasibility, language, time allocation, presentation, and graphics. The fourth stage, Preliminary Field Testing, tested the module on a small scale with a limited group of students to assess clarity, readability, and attractiveness. Feedback from students and teachers was used as the basis for revisions. The fifth stage, Main Product Revision, involved revising the module based on the results of the initial trial, especially by clarifying the question networks, strengthening the integration of Qur'anic verses, and adjusting the difficulty level of the problem-solving tasks. The sixth stage, Main Field Testing, implemented the revised module with a larger group using a one-group pretest–posttest design. Data were collected through problem-solving tests, observations, and student response questionnaires. The seventh stage, Operational Product Revision, made further revisions based on the results of the main field test, particularly in the aspects of presentation, the relevance of Qur'anic integration with the material, and instructions for using the module to make it more practical for both teachers and students. The eighth stage, Operational Field Testing, tested the module again with a larger number of students to measure the overall effectiveness of the product. The ninth stage, Final Product Revision, refined the final product by considering input from experts, teachers, and trial results with students, making the module ready for classroom use. The tenth stage, Dissemination and Distribution, involved distributing the final product—teaching modules based on QN with a STEM-C approach integrated with Qur'anic verses—to target schools and teachers, as well as recommending its application in learning.

The results showed that the QN-based teaching module integrated with Qur'anic verses in a STEM-C approach, as assessed by material experts, media experts, instructional experts, teachers, and students, fell into the very good category, with an average score of 85.7%. This score was based on several aspects, including content feasibility, language, presentation, time allocation, and graphics. Based on these results (see Table 1), it can be concluded that the developed module is suitable for use in this study.

Table 1. Validation Results by Experts, Teachers, and Students

Validator	Aspect	Mean	Percentage
Experts	Content validity	3,4	85%
	Language	3,5	87,5%
	Time allocation	3,3	82,5%
	Presentation	3,5	87,5%
	Graphics	3,6	90%
	Total	3,46	86,5%
Teachers	Content validity	3,4	85%
	Language	3,3	82,5%
	Time allocation	3,5	87,5%
	Presentation	3,4	85%
	Graphics	3,5	87,5%
	Total	3,42	85,5%
Students	Content validity	3,3	82,5%
	Language	3,4	85%
	Time allocation	3,2	80%
	Presentation	3,5	87,5%
	Graphics	3,4	85%
	Total	3,36	84,0%
Overall Total		85,7%	

In addition, the results showed that the average initial pretest score of students' problem-solving ability was 37.51 in the low category, while the average posttest score after learning with the QN-based module integrated with Qur'anic verses and a STEM-C approach increased to 85.08, which is categorized as very high.

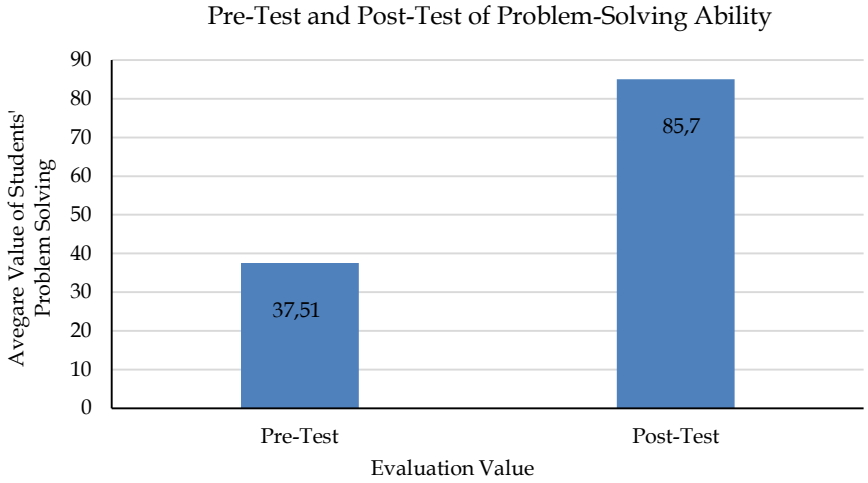

Figure 1. Mean of Pre-Test and Post-Test of Problem-Solving Ability

The graph above clearly illustrates a significant difference between the pretest and posttest scores of students' problem-solving abilities. This significant improvement occurred because learning, which was initially delivered through conventional teacher-centered methods, shifted to an interactive model with the use of the developed module.

This result is consistent with studies showing that integrated STEM instructional designs and problem-based STEM tasks significantly improve learners' problem-solving outcomes and epistemic engagement (English, 2023; Stuppan et al., 2023). Furthermore, the learning process also fostered character development through STEM-C, which was designed with Qur'anic integration. Teaching modules in schools are highly important when developed with the integration of multiple disciplines. A module is a learning tool that helps teachers provide meaningful understanding to students and can also be implemented through various technological developments. A module serves as one of the essential learning resources to enhance students' independence and comprehension, encouraging meaningful learning and enabling teachers to facilitate more effective instruction (Taufikurrahman et al., 2021). Moreover, with the integration of STEM and character (C), students are expected to develop their character through more meaningful learning that goes beyond academic skills alone, grounded in Qur'anic values.

STEM combined with character education is essential for fostering critical thinking, collaboration, and creativity (Zainil et al., 2024). These skills are crucial for students' growth and future success, firmly rooted in faith in God Almighty. Based on the results, students' character scores in the pretest averaged 32.2 in the low category, while the posttest scores increased to 82.6 in the high category. This finding shows a clear improvement in students' character, shifting from low to high. Such improvement aligns with emerging evidence that faith-contextualized STEM modules can help improve moral/ethical dispositions alongside cognitive gains (Muzakkir et al., 2024; Siregar et al., 2024). The increase occurred because, indirectly, the integration of Qur'anic values in learning enhanced students' character development (Baehaqi et al., 2024).

The integration of Islamic values, including Qur'anic teachings, into STEM learning fosters a deeper understanding of the relationship between scientific knowledge and religious principles. It also encourages students to apply their knowledge in alignment with moral values taught in religion. This approach emphasizes holistic education in building students' character, ensuring that they not only develop academically but also spiritually, thus forming better character.

Based on the N-gain values from pretest and posttest data, there was a significant improvement across several problem-solving indicators used as benchmarks in this study, namely problem focusing, drawing situations, planning solutions, implementing plans, and evaluating answers. A more detailed description of the average scores for each indicator can be seen in Table 2.

Tabel 2. Pretest, Posttest, and N-Gain Results for Problem-Solving Indicators

No	Indicator	Pre-Test	Post-Test	N-Gain
1	Problem focusing	7,45	16,71	0,73
2	Drawing situations	5,83	16,08	0,72
3	Planning solutions	8,48	17,06	0,74
4	Implementing plans	8,17	17,82	0,81
5	Evaluating answers	7,98	17,41	0,78
	Average	7,582	17,016	0,75

The results above show that for the problem-focusing indicator, students' pretest score was 7.45, while the posttest score increased to 16.71, with an N-gain value of 0.73 in the high category. For the situation-drawing indicator, the average pretest score was 5.83, which increased to 16.08 in the posttest, with an N-gain of 0.72 in the high category. For the solution-planning indicator, the average pretest score was 8.48, rising to 17.06 in the posttest, with an N-gain of 0.74 in the high category. For the plan-implementation indicator, the pretest average was 8.17, while the posttest score increased to 17.82, with an N-gain of 0.78 in the high category. Finally, for the answer-evaluation indicator, the pretest average was 7.98, which improved to 17.41 in the posttest, with an N-gain of 0.78 in the high category (See Table 2).

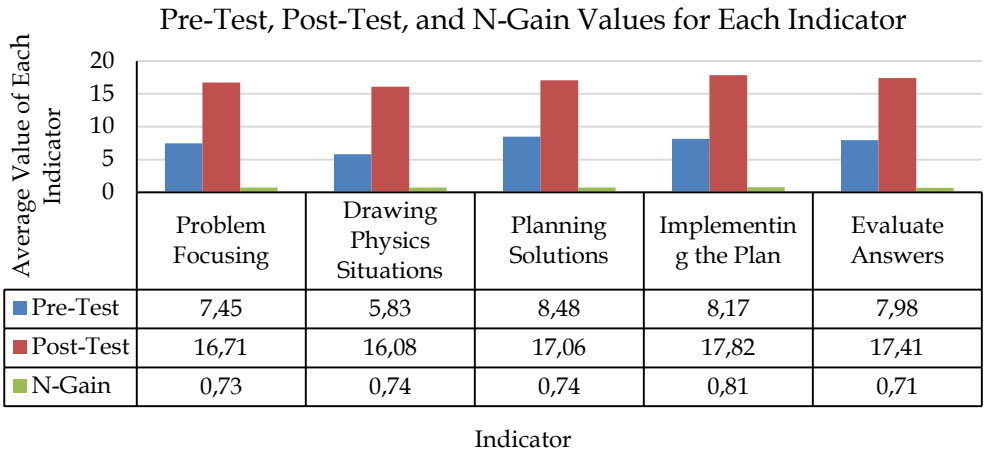

Figure 2. Pre-Test, Post-Test, dan N-gain for each indicator

The overall average values presented in Table 2 indicate that the mean pretest score was 7.58, the mean posttest score was 17.41, and the N-gain value reached 0.75, which falls into the high category. These results demonstrate that the QN-based teaching module integrated with Qur'anic verses and the STEM-C approach can effectively improve students' problem-solving skills. Several analytical and systematic investigations have revealed that instructional designs grounded in STEM and problem-based STEM approaches yield moderate to substantial improvements in students' problem-solving

development, thereby reinforcing the credibility of the present study's outcomes (Nguyen & Giang, 2024; Rais et al., 2024).

Learning tools are essential, especially when integrated with various disciplines and technologies, one of which is STEM-C. STEM does not merely involve mastery of science and technology but should also be integrated with Islamic values so that students acquire intellectual abilities alongside strong religious character (Baehaqi et al., 2024). For several indicators of problem-solving skills, the improvements observed were closely linked to this integration. In the problem-focusing indicator, Islamic values helped students view problems not only from technical aspects but also from ethical and beneficial perspectives. For the situation-drawing indicator, STEM-C enabled students to describe contexts not only scientifically but also in relation to religious values, encouraging them to connect phenomena with Qur'anic verses, thus making the situation more meaningful (Fauzian, 2022). For the solution-planning indicator, both scientific and moral considerations were involved, with responsibility and justice guiding students to propose solutions that are beneficial, fair, and non-harmful to others (Bicer et al., 2020). For the plan-implementation indicator, STEM emphasized honesty, ensuring that students did not manipulate results, while fostering collaboration and teamwork (Chang & Chen, 2022). Finally, for the answer-evaluation indicator, STEM-C required assessments not only in the cognitive domain but also in alignment with religious principles, such as fairness, honesty, and kindness, making the evaluation process more holistic (Elbashir et al., 2024).

Problem-solving ability is a key 21st-century skill that students must possess, as it enables more meaningful learning experiences. With stronger problem-solving skills, students are better able to resolve challenges, construct new and more complex understandings, and connect their knowledge to real-life contexts.

Based on students' responses to learning with the QN-based module integrated with Qur'anic verses and the STEM-C approach, the results showed very positive feedback. The average categories for student responses to each indicator are presented in Table 3 below.

Table 3. Average Student Response Categories

No	Indicator	Indicator	Indicator
1	Ease of Use	3,1	77,5%
2	Interest	3,2	80%
3	Clarity	3,2	80%
4	Relevance	3,1	77,5%
	Total	3,17	79,25%

Based on the above categories, this study used four response categories: very positive, positive, negative, and very negative. For the ease-of-use indicator, the average response score obtained was 3.1 in the positive category, with a percentage of 77.5%. For the interest indicator, the average score was 3.2 in the positive category. The clarity indicator also obtained an average of 3.2 in the positive category, with a percentage of 80%, while the relevance indicator showed an average of 3.1, also in the positive category, with a percentage of 77.5%. Overall, the total average score was 3.17, which falls into the positive category with a percentage of 79.25%. This indicates that, in general, students gave a highly positive response to learning with the QN-based module integrated with Qur'anic verses and the STEM-C approach.

The positive student responses can be attributed to the fact that STEM-C learning, when connected to Qur'anic values, allowed students to realize that knowledge is not merely technical but also part of worship and a way to understand God's creation. This perspective enhanced their motivation to learn (Hotchkins & Dancy, 2015). Through STEM-C, students felt that their Islamic identity was preserved amid the challenges of globalization. They became not only cognitively intelligent but also morally grounded, demonstrating honesty, justice, and responsibility (Howson & Kingsbury, 2024; Hamidah & Susilawati, 2023). Integrating Qur'anic values also encouraged students to be more active and directly engaged in the learning process, as they felt the lessons were relevant to both real-life experiences and their religious beliefs (Garibay, 2020). Problem-solving activities further fostered teamwork, empathy, and care, while nurturing the Islamic value of mutual help, making group work more harmonious and meaningful (Top et al., 2018). Moreover, STEM-C learning integrated with the Qur'an not only encouraged students to think critically about science and technology in practical terms but also made them aware of moral and social implications, strengthening moral foundations as part of character building.

From these findings, it can be seen that learning tools-particularly teaching modules-designed through STEM-C integration with Qur'anic values are effective in improving students' problem-solving skills. In addition, such learning tools also enrich students' moral values, which is essential in shaping better human development. This not only enhances students' cognitive growth but also strengthens their morality and ethics, ultimately contributing to the formation of high-quality character in the present and future, especially amid the social challenges that exist in educational environments.

CONCLUSION AND SUGGESTIONS

This research on the development of QN-based teaching modules with a STEM-C approach integrated with Qur'anic verses produced modules that were feasible and valid according to material experts, media experts, and instructional experts, with a very good category score of 85.7%. Furthermore, the application of this module proved effective in improving students' problem-solving skills. The pretest results, with an average score of 37.51 in the low category, increased significantly to 85.08 in the posttest (high category), with an N-gain value of 0.75 (high category). Improvements were observed across all problem-solving indicators, including problem focusing, situation drawing, solution planning, plan implementation, and answer evaluation. This demonstrates that integrating Qur'anic values into STEM-C can strengthen critical, creative, collaborative, and solution-oriented thinking skills. The STEM-C module integrated with the Qur'an also proved effective in shaping students' positive character. The average character score increased from 32.2 (low) to 82.6 (high). This confirms that learning based on the integration of science and religion fosters honesty, responsibility, justice, and spirituality. In addition, students' responses to the learning process using the module were positive, with an average response score of 3.17. The positive response emerged because students found the learning process more engaging, easier to understand, relevant to real life, and consistent with their Islamic identity. This shows that STEM-C integrated with the Qur'an is highly relevant for improving students' skills and character development through instructional materials.

It is expected that teachers can use the QN-based STEM-C module integrated with the Qur'an as an alternative instructional resource. Schools should support the development of innovative learning tools that integrate science with religious values, ensuring students' growth both academically and spiritually. Students are also encouraged to use STEM-C modules more actively, as they can help improve problem-solving skills while strengthening Islamic character values in daily life. Future researchers may expand the trials to broader scopes and different educational levels, as well as develop further variations of STEM-C teaching materials integrated with the Qur'an. The results of this study are expected to serve as a consideration in formulating curriculum policies that integrate STEM with character values (STEM-C), particularly in religious-based regions such as Aceh. In addition, teacher training programs should be implemented to enhance teachers' capacity in developing innovative instructional materials that integrate science and religion.

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