JIPS 6 (2) (2025)

Jurnal Inovasi Pendidikan dan Sains

E-ISSN 2721-9119

https://ejournal.unwmataram.ac.id/index.php/JIPS

Developing E-Module Integrated of Islamic Values in Mathematics Learning: A Study Three-Dimensional Material

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Accepted: May 13th 2025. Approved: August 06th. Published: August 13th 2025

ABSTRACT

Various certified journals have conducted and disseminated numerous studies on the application of e-modules in mathematics education. Currently, there is no scientific work that examines the application of E-Modules integrated with Islamic values in three-dimensional materials, considering mathematical abilities and the learning approach or model used. This study aims to evaluate the validity, practicality, and effectiveness of e-modules designed based on Islamic values in three-dimensional materials to improve character among high school students in mathematics learning. This research employs a 4-D development model, utilizing data gathered from observations, assessments (pretest and posttest), validation forms, student feedback questionnaires, and observation sheets. The study's results indicated that the e-module was very valid, getting a score of 87.5% from experts; practical, according to observers (3.4) and student feedback (85.71%); and somewhat effective, with a score of 91.4% for effectiveness. The findings suggest that e-modules grounded in Islamic values inside three-dimensional materials effectively enhance learning outcomes and student character in mathematics education.

Keywords: three dimensions, e-module, Islamic values, 4-D model

INTRODUCTION

Education plays an important role in shaping children's personality and intelligence. Integrating Islamic values into learning is a continuous effort to strengthen character education in Indonesia [1]. This initiative gives students the opportunity to explore important themes or issues, such as honesty, discipline, mutual respect, consistency, and responsibility. Therefore, one of the areas of education that can integrate Islamic values is mathematics [2].

In the educational environment, mathematics learning is one of the important aspects that can shape a modern Islamic society with quality human resources [3]. Mathematics is an important subject because it offers benefits in everyday life, especially in answering various social problems that are relevant to the context and era [4]. Therefore, mathematics is a compulsory subject at every level of education, from elementary education to higher education.

Mathematics is included in the field of education that relies on thinking procedures in building its understanding and is considered appropriate to be given to students [5], [6]. Through mathematics learning, students should expand their high reasoning skills, problem-solving skills, advanced thinking, and literacy skills [7], [8], [9]. The 21st century requires students to possess these mathematical abilities. Therefore, it is crucial to focus mathematics learning on attaining the anticipated competencies.

Learning is a process of facilitating students to be able to learn [10]. The 21st century focuses on preparing students to utilize technological skills and connections in their daily lives. According to Dilekçi and Karatay, 21st-century learning requires students to have expertise, skills, and abilities in technology, media, and information [11]. The same thing was conveyed by Serrano-Ausejo: that students need to be given experiences that help with skills that are in line with advances in science and technology [12]. Therefore, the learning process must involve and improve technological and communication skills.

The rapid development of technology in the 21st century provides ample opportunities for mathematics educators to utilize it in enhancing mathematics learning [13]. The use of digital technology has an effective impact on students, namely increasing learning achievement [14]. This statement is in line with Chen and Tsai: technology is a means that can advance students' academic achievement [15]. Learning through technology can have a major impact on student motivation in the classroom and play an important role as a facilitator, motivator, and communicator in seeking knowledge. Thus, it is necessary to have technology-based and information-based learning materials that support student learning.

The availability of teaching materials plays an important role in the learning process [16]. One of the teaching materials is E-Modules (Electronic Modules). In terms of presentation, e-modules are systematically organized transfers from printed forms to electronic forms that serve independent learning in a way that requires students to practice solving problems independently [17]. E-modules are digital modules that include text, images, or both, and they contain electronic materials with relevant replications to support the learning process [18]. According to Saryadi and Sulisworo, learning using E-Modules will bring creativity, be productive in thinking, and create an intense, useful, progressive, and interesting atmosphere [19]. Therefore, the application of e-modules is essential in supporting the teaching process.

Mathematical teaching integrates e-modules with various approaches or learning models. Integrating e-modules into learning through various approaches or models leads to significant improvements in mathematics. This aligns with the explanation provided by Ramadanti, which states that the resulting mathematics E-modules can enhance students' perseverance in learning mathematics [20]. Thus, it is important to study the approaches or learning models applied in the use of E-Modules, and it is also necessary to see the mathematical competence of students that can be improved.

Researchers have carried out and published several studies on the application of e-modules in mathematics learning in several nationally accredited journals. Research conducted on e-modules is generally associated with learning models and improved mathematical abilities. Among them, E-Module Research uses learning models, such as Problem-Based Learning [20], [21], [22] and Realistic Mathematics Education learning models [16], [23]. Meanwhile, E-Module research related to improved mathematical abilities includes problem-solving abilities [24] and critical thinking skills [25], [26]. Research on the application of e-modules has been carried out separately in terms of mathematical abilities and the learning approaches or models applied. Research is needed on the integration of e-modules with the learning models used and the improvement of math skills.

The results of the author's preliminary study by interviewing 5 mathematics teachers at public high school 2 Takalar showed that many students scored below the Minimum Completion Criteria standard, which was 75 for three-dimensional material. Many students struggle to understand three-dimensional material in mathematics, as they find it difficult and often feel bored and fatigued by the abstract and theoretical nature of mathematical concepts. Several mathematics teachers have created conventional learning modules for three-dimensional material, but the mathematics learning elements used in class are considered uninteresting and do not make students interactive in class. Conventional modules often weigh heavy and necessitate storage space, causing inconvenience for students who must carry numerous books. In addition, the preliminary study found that students tend to be interested in Islamic-themed activities, such as Al-Qur'an literacy and other rohis activities, which are associated with better academic achievement. However, specifically, students' interest in subjects is still lacking, especially in mathematics.

Several other facts also show that there are still many students who have difficulty in understanding mathematics lessons, especially in three-dimensional material, so that the grades obtained tend to be low [27], [28]. Students feel that three-dimensional material in mathematics is very difficult because it involves many formulas that are difficult to understand.

The results of the preliminary study require an action that can support the learning process. We need a module form that incorporates interactive elements to enhance the visual and dynamic understanding of complex mathematical concepts. A module is needed that is easier to access anywhere using electronic devices such as smartphones, laptops, or tablets, either online or downloaded for offline access.

Building upon several studies that have been conducted previously, there has been no research on the development of integrated Islamic values mathematics e-modules in the three-dimensional material of class XII. Therefore, we need to create a module that is more interactive, easier to access, and combines Islamic values with three-dimensional material for class XII in the form of E-modules. This is because many students do not like the three-dimensional material in mathematics subjects; most students prefer lessons with Islamic themes.

RESEARCH METHODS

This study employs a 4-D development model to create an integrated learning E-module focused on Islamic values presented in three-dimensional material. The 4-D development model is a learning device development model developed by Thiagarajan [29], [30]. The 4-D development model consists of four main stages, namely, define, design, develop, and disseminate.

The E-module development procedure follows a 4-D development model; however, due to modifications and limitations imposed by the researcher, it only includes three stages: define, design, and develop. The object of the study is an e-module that integrates Islamic values in three-dimensional material. The subjects of this study were class XII students at public high school 2 Takalar.

Data collection instruments include observation, tests (pretest and posttest), validation sheets, student response questionnaires, and observation sheets. The data obtained were analyzed, and the direction was to revise the developed E-module. The data analyses carried out were:

1. **E-module Validation Data Analysis**

   The E-module validation sheet contains the necessary components for validating an E-module. We analyze the data from expert assessments for each E-module, considering the validator's

suggestions and comments. An e-module that has been validated by the validator is said to be valid if the assessment of each aspect given by the validator is ≥ 3 or meets the valid criteria. If the E-module is not yet valid, the revision process will take it into consideration. To determine the validity category, the total average is matched with the instrument validity criteria established by Khabibah, which are as follows: 4 ≤ RTV ≤ 5 = Very Valid (80-100)%, 3 ≤ RTV < 4 = Valid (75-80)%, 2 ≤ RTV < 3 = Less Valid (65-75)%, and 1 ≤ RTV < 2 = Not Valid (0-65)% [31]. The following presents the instrument validity criteria in Table 1.

Table 1. Instrument Validity Criteria

Assessment	Percentage (%)	Criteria
4 ≤ RTV ≤ 5	80-100	Very Valid
3 ≤ RTV < 4	75-80	Valid
2 ≤ RTV < 3	65-75	Less Valid
1 ≤ RTV < 2	0-65	Not Valid

2. E-Module Practicality Data Analysis

The data from the observation assessment of teacher activities in managing learning will then be analyzed by the researcher. The researcher obtained the results of this analysis by having another teacher act as an observer. The assessment of teacher activity uses 4 criteria, namely a score of 1 for the criterion "very impractical," a score of 2 for the criterion "less practical," a score of 3 for the criterion "practical," and a score of 4 for the criterion "very practical." The teacher's activity in managing learning is said to be good if each aspect assessed in learning is ≥ 3 or at least in the good category. The following presents an assessment of teacher activity using 4 criteria in Table 2 [32].

Table 2. Assessment of Teacher Activity

Assessment	Criteria
1	Very Impractical
2	Less Practical
3	Practical
4	Very Practical

3. Data Analysis of E-Module Effectiveness

a. Learning Outcome Data Analysis

We then analyzed data from the learning outcome test, which we obtained as a posttest, to determine the completeness of classical learning. In this study, there are two categories of learning completeness, namely individual and classical. We declare individual completeness when students achieve a minimum completion criteria score in the learning outcomes. Classical learning completeness is when the learning outcomes are classically complete, where 80% of all students in the class have achieved the minimum completion criteria score.

b. Student response data analysis

Student response data analysis consists of several questions with answers (Y/N). We consider the developed e-module effective if 80% or more of the student responses positively to answer each question. We consider student responses positive when 80% or more students respond positively to each aspect of the question.

RESULT AND DISCUSSION

We conducted the research using a development research model, which yielded an electronic module known as an "e-module." This research used a 4-D development model with the main objective of producing a valid, practical, and effective e-module product.

1. Define stage

The analysis stage began with observations at public high school 2 Takalar, which aimed to collect information about the teaching and learning process at the school. The analysis revealed insights into learning outcomes, competencies, and objectives, with Class XII implementing the Merdeka Curriculum. The teaching materials currently used are only printed books provided by the Ministry of Education and Culture. Analysis of students shows that Class XII shows diverse characteristics, with some students showing low abilities while others show high abilities, influenced by the materials and teaching methods used by the instructors.

The study began with observations to analyze the curriculum, students, classroom environment, and technology at public high school 2 Takalar, which were conducted through interviews with mathematics teachers and school observations. The results of the study indicated that the school implemented one curriculum, namely the Merdeka Curriculum. Students often feel bored because the teaching method is still lecture-based and conventional. The teaching materials used are only printed books. In terms of character education, schools provide opportunities for students to develop various skills to help pupils solve problems effectively and engage in a more meaningful learning process [33], [34]. However, teachers have not carried out activities or training aimed at improving students' learning abilities. These results can be seen from students' answers, which are generally short

and unclear, especially when answering essay questions related to mathematics, such as the application of three-dimensional material in everyday life that is integrated with Islamic values. The use of technology in schools is also limited. Students mainly rely on devices such as cellphones and laptops for tasks such as typing and searching for information online. Overall, the integration of technology into the learning process is very minimal and rare.

Based on the results of interviews, analysis conducted at public high school 2 Takalar, and previous literature reviews, researchers developed an e-module based on Islamic values on three-dimensional material in mathematics learning. The use of digital technology has an effective impact on students, namely increasing learning achievement [35]. This statement is in line with Chen and Tsai: technology is a means that can advance students' academic achievement [15]. Learning through technology can have a major impact on student motivation in the classroom and play an important role as a facilitator, motivator, and communicator in the search for knowledge. So that the E-Module allows students to develop a mindset that encourages openness to new evidence, systematic and scientific thinking, conclusions based on facts, and effective problem solving, thereby fostering logical and critical thinking skills.

The electronic module based on Islamic values on three-dimensional material is a product developed through development research. For an electronic module (e-module) to be considered feasible for use, it must meet three main criteria: validity, practicality, and effectiveness. This viewpoint is in line with the perspective of Kasih & Siregar and Vini, which states that the assessment of the feasibility of the product being developed is divided into three main aspects: validity, practicality, and effectiveness [36], [37]. The e-module includes content such as learning materials, practice questions designed to improve critical reasoning, group assignments based on three-dimensional thinking graphs, and competency tests. Students can access these components online, simplifying their learning and assessment process.

2. Design Stage

The design stage focuses on developing an e-module that incorporates Islamic values and utilizes three-dimensional materials as teaching resources. This design is in line with the teaching module, Learning Objective Flow, and assessment of learning outcomes based on Islamic values in three-dimensional material. We create the e-module using Canva, convert it to JPG or PNG format, and then upload it to Google Drive. The e-module based on Islamic values in Three-Dimensional Material consists of 68 pages, including the cover, foreword, table of contents, introduction, contents, summary, competency test, and bibliography. The module includes a worksheet that explores Islamic values in three-dimensional material. Figure 1 and Figure 2 illustrate the cover and contents of the e-module.

Once the e-module has been well organized and deemed complete based on the material, we upload it to Google Drive. The next step is to publish the e-module and obtain an access link (https://drive.google.com/file/d/18VD4Uenxb27-j0o8wqR-qjGlpo2rsCb-/view?usp=sharing). Students can easily access this access link by sharing it with them via the WhatsApp application.

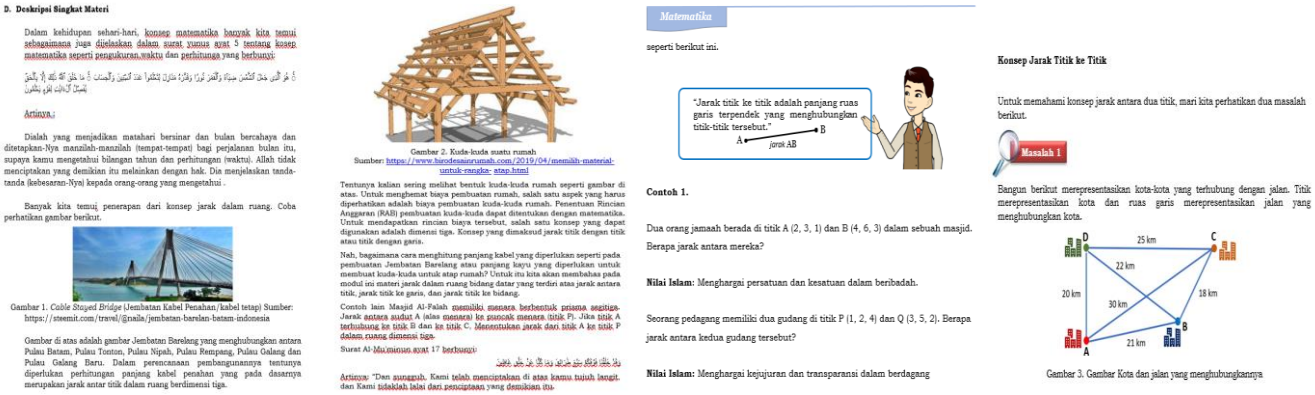

Figure 2. Contents of e-module based on Islamic Values in Three-Dimensional Material

Experts design and validate the e-module design during the development stage. Experts carry out validation to determine the e-module's feasibility for use in the learning process. Validation also serves to review and assess the questions that have been prepared, which support development research. Thereafter, the validator consisting of two teachers and one lecturer—will evaluate the feasibility of the e-module and provide feedback on its effectiveness. The results of the validation of the e-module based on Islamic values on the three-dimensional material are presented in Table 3.

Table 3. Validity results of e-modules based on Islamic values

Aspects	Score Interval (Validator)			Percentage (%)	Category
	1	2	3		
Islamic values in Material	3	4	3	83	Very Valid
Language	4	3	4	92	Very Valid
Content	3	3	4	83	Very Valid
Practicality	4	3	4	92	Very Valid
Average Score	3,5	3,25	3,75	87,5	Very Valid

Based on the validation results from 3 validators in Table 3, the average for all aspects was 87.5%, and the assessment category obtained was very valid. These results indicate that the e-module, which incorporates Islamic values into the three-dimensional material, is suitable for use in the learning process. The validator's suggestions led to several adjustments at this stage.

The results of the assessment by three validators can be concluded that the e-module based on Islamic values on three-dimensional material is very valid. Both in terms of the suitability of the content and the material, when viewed from various aspects, it is considered valid. This conclusion is supported by Yolanda and Laia, who stated that media validity can be assessed through content validity and construct validity. Content validity determines the relevance of learning media to learning materials, with a focus on spatial and visual suitability to enhance student intelligence, as well as material alignment. Construct validity refers to the theoretical basis underlying the development of the instrument. We evaluate content and construct validity from several aspects, including the three-dimensional thinking graphic approach that enhances critical reasoning, language, content, and practicality.

The e-module's content and Islamic values were validated, both scoring 83%, so it is very valid. The practicality aspect included in the construct validation obtained a final score of 97%, so it is categorized as very valid. This high value is reflected in the attractive e-module design and user-friendly interface, ensuring that students remain interested and feel practical in following the learning process. The design and appearance of the e-module media based on Islamic values effectively support an engaging and easily accessible learning experience for students. The result of the validation of the e-module based on three-dimensional thinking graphics was 87.5%, so it is categorized as very valid. Therefore, we can declare the e-module to be valid for use.

Electronic modules are considered effective and suitable for learning if they meet certain criteria, including being self-instructional, self-contained, stand-alone, adaptive, and user-friendly. These features ensure that the e-module functions effectively as a teaching tool, allowing students to engage in self-directed learning and assess their understanding through exercises provided in the module [38]. The e-module includes learning materials, integration of Islamic values with the material, and related questions to help students understand the three-dimensional concept.

3. Stage Develop

We conducted a trial of the e-module product based on Islamic values in the three-dimensional material with 35 grade XII students at public high school 2 Takalar, selecting them randomly from a total of 372 students. Three observers collected practicality assessment data using an implementation observation sheet. We use the learning implementation observer sheet to assess and observe each step of the learning implementation. The observer filled in the results of the learning implementation, as shown in Table 4.

Table 4. The results of implementing e-modules based on Islamic values on three-dimensional material

Observation Aspect	Learning implementation score (Observer)			Average Score	Category
	1	2	3		
Students can access the e-module application and utilize it effectively.	4	4	4	4	Very Practical
Students can develop proficiency in using e-modules	4	3	3	3.3	Practical
Students can obtain and process information and ideas effectively.	3	3	3	3	Practical
Students can reflect on their thoughts and cognitive processes.	3	4	3	3.3	Practical
Average Score	3.5	3.5	3.25	3.4	Practical

The findings in Table 4 indicate that using Islamic value-based e-modules for three-dimensional material had an average score of 3.4 across all sessions, which means it is considered practical learning. The evaluation of different parts of the learning process, checked by three observers over four meetings, indicated that the e-module was successfully included in the learning module. This evidence indicates that the use of Islamic value-

based e-modules on three-dimensional material can be considered practical and applicable.

At the end of the learning process, we conducted an evaluation stage to gauge the students' responses to the developed e-module product. This stage serves as the main benchmark for analyzing the effectiveness of Islamic value-based e-modules on three-dimensional material. We administered validated test questions to Class XII students at public high school 2 Takalar to assess the effectiveness of the e-module. The assessment involved two tests: pretest and posttest. Table 5 displays the results of the pretest and posttest for Class XII students.

Table 5. Results of Student Effectiveness Test on Three-Dimensional Material

Score	Score		Classical Completion (%)	Category
	Number of Students	Average		
Pre-Test	35	44.14	31.4	Low
Post-Test	35	81.31	91.4	High

The assessment showed an average pre-test score of 44.14 and a post-test score of 81.31. We analyzed the pre-test and post-test results using classical completeness tests to evaluate the improvement in student learning outcomes through e-modules. The classical completeness value of the post-test was 91.4%, categorized as high. This value shows a significant increase after the use of e-modules based on Islamic values for three-dimensional materials.

Furthermore, the analysis of student responses to e-modules based on Islamic values on three-dimensional material evaluates the effectiveness of these e-modules. We administered student response questionnaires to 35 grade XII students at public high school 2 Takalar. The results of the analysis of student response data to e-modules based on Islamic values on three-dimensional material are presented in Table 6.

Table 6. Results of the Student Response Questionnaire Effectiveness Test

Aspect	Percentage (%)	Category
Interest	82.85	Effective
Material	85.71	Very Effective
Language	88.57	Very Effective
Average	85.71	Very Effective

Building upon the questionnaire responses, the average student response rate was 85.71%, placing it in the very effective category. All aspects of interest, material, and language can make students understand and be motivated to carry out the teaching and learning process on three-dimensional material using e-modules based on Islamic values. The data show that the use of e-modules based on Islamic values in three-dimensional material is excellent and effective in improving student learning outcomes and character.

The final value of the use of Islamic value-based e-modules on three-dimensional material is 3.4, so it is categorized as practical. This evidence shows that the implementation of learning using the e-module is practical. The assessment of practicality is based on the analysis of various aspects observed during the learning process, including learning steps, use of e-module teaching materials, and evaluation. According to Rahim and Wahyuni, the practicality of a learning device is said to be satisfactory or excellent if the device developed can be applied effectively according to expert assessment and can be successfully implemented in a real classroom atmosphere during the learning process [39].

We evaluated the effectiveness of Islamic value-based e-modules on three-dimensional material using pretest, posttest, and student response questionnaires. The pretest had an average score of 44.14, while the posttest score increased to 81.31. We analyzed the pretest and posttest results using classical completeness tests to measure improvements in student learning outcomes. The final classical completeness percentage (post-test) was 91.4%, which was categorized as high. This study shows a significant increase in student learning outcomes after using Islamic value-based e-modules on three-dimensional material [40]. Based on the results of the classical completion percentage, the use of this e-module can be said to be effective because it causes an increase in students' learning outcomes. This finding is supported by the opinion of Faridah and Afridiani that the effectiveness obtained can be used to determine the level of success of using media in the learning process [41].

The student response questionnaire on the use of e-modules was given to 35 grade XII students at public high school 2 Takalar. Analysis of student responses to e-modules based on Islamic values on three-dimensional material produced results of 85.71% with a very effective category. E-modules effectively motivate students and help them understand the material on three dimensions integrated with Islamic values. The use of attractive designs, clear operating instructions, and practice questions contributes to improving student learning outcomes. These features make it easier for students to engage and benefit from e-modules. In accordance with the opinion of Nahdiyah, e-modules with attractive designs and easy-to-understand features can increase student motivation and involvement in the learning process [42]. Such engagement in turn has a positive effect on learning outcomes and contributes to improving student character.

Research Implications

The role of learning media in learning activities is as a means of conveying information, created and used in accordance with learning theory, thereby encouraging the learning process [43], [44]. With the help of learning media, students are expected to be able to absorb information more effectively than learning without it.

Grade XII students at High School 2 Takalar have positively received the role of e-module learning media in mathematics, particularly in three-dimensional material. Students' motivation to learn has significantly increased thanks to the e-module learning media. Furthermore, the e-module learning media provides a solution to the problems students experience. Furthermore, the e-module learning media can be used independently and does not require dependence on other learning media.

The implication of this research is that the e-module learning media based on Islamic values in mathematics, particularly in three-dimensional material, can be a learning medium that can be further developed and refined in the future. The e-module's independent use enables students to learn independently, fueling this hope.

The researcher aspires to implement the role of technology, specifically in teaching, in schools to foster enjoyable learning experiences for students. Hopefully, many other researchers will be inspired by this research and start building or developing other learning media to improve the quality of Indonesian education.

CONCLUSION

The study's results classify the Islamic value-based e-module as very valid, practical, and quite effective for use in three-dimensional material. The e-module obtained a validity score of 87.5%, while the practicality assessment based on the observation sheet also obtained a score of 3.4. In addition, the practicality measured by the student response questionnaire was 85.71%, and the effectiveness in assessing student learning outcomes was set at 91.4%. The findings of the study showed a significant increase in student scores on learning outcomes as evidenced by the e-module assessment and the tests given. Overall, using the Islamic value-based e-module on three-dimensional material to enhance student learning and character has met the necessary standards and can be successfully included in the math lessons for high school students.

As a recommendation, the results of this study can serve as a reference for teachers in implementing learning using Islamic value-based learning media. Further research suggests developing e-modules with Android-based applications to create applications that are more effective and accessible to students and teachers.

ACKNOWLEDGMENTS

The researchers express their heartfelt gratitude to the participants of this study, notably the organizer of the mathematics education program at Muhammadiyah University of Makassar and public high school 2 Takalar. They also convey their appreciation to unnamed individuals whose help has been indispensable.

REFERENCES

[1] M. Triono and B. Santoso, “Character Development Through Religious Education Through Mathematics Education in Elementary School,” *Qalam J. Ilmu Kependidikan*, vol. 13, no. 1, pp. 57–62, 2024, doi: 10.33506/jq.v13i1.3300.

[2] A. Choirunnisa, N. Nurhanurawati, S. Dahlan, C. Choirudin, and M. S. Anwar, “Development of Islamic Value-Based Mathematics Teaching Materials to Improve Students’ Understanding of Mathematical Concepts,” *J. Anal.*, vol. 8, no. 1, pp. 11–20, 2022, doi: 10.15575/ja.v8i1.17073.

[3] S. Abas, A. D. Alirahman, and H. Mabrur, “Humanizing STEM-Based Learning (Science, Technology, Engineering, and Mathematics) for the Transformation of Islamic Education in the 21st Century,” *Educ. J. Pendidik. Islam*, vol. 8, no. 1, pp. 98–120, 2024, doi: 10.21111/educan.v8i1.11429.

[4] Z. Kohen and D. Orenstein, “Mathematical modeling of tech-related real-world problems for secondary school-level mathematics,” *Educ. Stud. Math.*, vol. 107, no. 1, pp. 71–91, May 2021, doi: 10.1007/s10649-020-10020-1.

[5] W. Hardiyanto and R. H. Santoso, “Efektivitas PBL setting TTW dan TPS ditinjau dari prestasi belajar, berpikir kritis dan self-efficacy siswa,” *J. Ris. Pendidik. Mat.*, vol. 5, no. 1, pp. 116–126, 2018, doi: 10.21831/jrpm.v5i1.11127.

[6] Y. Yelvalinda, H. Pujiastuti, and A. Fatah, “Pengaruh Model Pembelajaran Problem Based Learning terhadap Pemahaman Matematis Ditinjau dari Kemampuan Awal Matematika,” *Edumatica J. Pendidik. Mat.*, vol. 9, no. 1, pp. 23–32, 2019, doi: 10.22437/edumatica.v9i1.6108.

[7] H. Habibi and R. C. I. Prahmana, “Kemampuan Literasi Matematika, Soal Model PISA, dan Konteks Motif Batik Tulis Jahe Selawe,” *J. Varidika*, vol. 33, no. 2, pp. 116–128, 2022, doi: 10.23917/varidika.v33i2.16722.

[8] F. T. Ramadhanti, D. Juandi, and A. Jupri, “Pengaruh problem-based learning terhadap kemampuan berpikir tingkat tinggi matematis siswa,” *Aksioma*, vol. 11, no. 1, pp. 667–682, 2022.

[9] H. Hendriana, T. Johanto, and U. Sumarmo, “The Role of Problem-Based Learning to Improve Students’ Mathematical Problem-Solving Ability and Self Confidence.,” *J. Math. Educ.*, vol. 9, no. 2, pp. 291–300, 2018.

[10] C. Müller and T. Mildenberger, “Facilitating flexible learning by replacing classroom time with an online learning environment: A systematic review of blended learning in higher education,” *Educ. Res. Rev.*, vol. 34, p. 100394, 2021, doi: 10.1016/j.edurev.2021.100394.

[11] A. Dilekçi and H. Karatay, “The effects of the 21st century skills curriculum on the development of students’ creative thinking skills,” *Think. Ski. Creat.*,

vol. 47, p. 101229, 2023, doi: 10.1016/j.tsc.2022.101229.
[12] E. Serrano-Ausejo and E. Mårell-Olsson, "Opportunities and challenges of using immersive technologies to support students' spatial ability and 21st-century skills in K-12 education," *Educ. Inf. Technol.*, vol. 29, no. 5, pp. 5571–5597, 2024, doi: 10.1007/s10639-023-11981-5.
[13] B. L. Chua, O. S. Tan, and W. C. Liu, "Journey into the problem-solving process: cognitive functions in a PBL environment," *Innov. Educ. Teach. Int.*, vol. 53, no. 2, pp. 191–202, Mar. 2016, doi: 10.1080/14703297.2014.961502.
[14] S. Timotheou *et al.*, "Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review," *Educ. Inf. Technol.*, vol. 28, no. 6, pp. 6695–6726, Jun. 2023, doi: 10.1007/s10639-022-11431-8.
[15] C.-H. Chen and C.-C. Tsai, "In-service teachers' conceptions of mobile technology-integrated instruction: Tendency towards student-centered learning," *Comput. Educ.*, vol. 170, p. 104224, Sep. 2021, doi: 10.1016/j.compedu.2021.104224.
[16] R. Aspriyani and A. Suzana, "Pengembangan e-modul interaktif materi persamaan lingkaran berbasis realistic mathematics education berbantuan geogebra," *AKSIOMA J. Progr. Stud. Pendidik. Mat.*, vol. 9, no. 4, pp. 1099–1111, 2020.
[17] P. Yaniawati, J. Al-Tammar, I. I. Supianti, S. Z. M. Osman, and A. S. Malik, "Using of sigil software in math education: e-module development and effects on self-regulated learning skills," *J. Educ. Gift. Young Sci.*, vol. 9, no. 3, pp. 251–268, 2021.
[18] R. S. Saputra and B. Octavia, "E-module assisted by augmented reality with a discovery learning model on virus material to increase scientific literacy and learning independence for class X high school students," *J. Penelit. Pendidik. IPA*, vol. 10, no. 11, pp. 8507–8518, 2024, doi: 10.29303/jppipa.v10i11.8795.
[19] W. Saryadi and D. Sulisworo, "Development of e-module based on the discovery learning to improve the student creative thinking skills," *JTAM (Jurnal Teor. Dan Apl. Mat.*, vol. 7, no. 1, pp. 11–22, 2023, doi: 10.31764/jtam.v7i1.10185.
[20] F. Ramadanti, A. Mutaqin, and A. Hendrayana, "Pengembangan E-Modul Matematika Berbasis PBL (Problem Based Learning) pada Materi Penyajian Data untuk Siswa SMP," *J. Cendekia J. Pendidik. Mat.*, vol. 5, no. 3, pp. 2733–2745, 2021.
[21] M. S. Hidayatulloh, "Pengembangan e-modul matematika berbasis problem based learning berbantuan geogebra pada materi bilangan bulat," *AKSIOMA J. Mat. Dan Pendidik. Mat.*, vol. 7, no. 2, pp. 24–31, 2016.
[22] I. Islahiyah, H. Pujiastuti, and A. Mutaqin, "Pengembangan e-modul dengan model pembelajaran berbasis masalah untuk meningkatkan kemampuan pemecahan masalah matematis siswa," *AKSIOMA J. Progr. Stud. Pendidik. Mat.*, vol. 10, no. 4, p. 2107, 2021.
[23] E. T. Aulia and R. C. I. Prahmana, "Developing interactive e-module based on realistic mathematics education approach and mathematical literacy ability," *J. Elem.*, vol. 8, no. 1, pp. 231–249, 2022.
[24] M. Putri and I. Junaedi, "Development of ethnomathematics-based E-module using the inquiry learning model to improve mathematical problem solving ability," *Unnes J. Math. Educ.*, vol. 11, no. 2, pp. 174–182, 2022, doi: 10.15294/ujme.v11i2.59938.
[25] R. Y. Purwoko, B. Kusumaningrum, A. N. Laila, and E. P. Astuti, "Development of Open Ended Based Mathematics E-Modules to Enhance Students' Critical Thinking Ability," *Mathline J. Mat. Dan Pendidik. Mat.*, vol. 8, no. 1, pp. 194–206, 2023.
[26] T. A. Rismayanti, N. Anriani, and S. Sukirwan, "Pengembangan e-modul berbantu kodular pada smartphone untuk meningkatkan kemampuan berpikir kritis matematis siswa SMP," *J. Cendekia*, vol. 6, no. 1, pp. 859–873, 2022, doi: 10.31004/cendekia.v6i1.1286.
[27] E. Novalia and R. Rochmad, "Analisis kemampuan literasi matematika dan karakter kreatif pada pembelajaran synectics materi bangun ruang kelas VIII," *Unnes J. Math. Educ. Res.*, vol. 6, no. 2, pp. 225–232, 2017, [Online]. Available: https://journal.unnes.ac.id/sju/ujmer/article/view/20601
[28] F. Yudha, "Peran pendidikan matematika dalam meningkatkan sumber daya manusia guna membangun masyarakat islam modern," *J. Pendidik. Mat.*, vol. 5, no. 2, pp. 87–94, 2019, doi: 10.33474/jpm.v5i2.2725.
[29] M. Hasbi, A. Lukito, R. Sulaiman, and M. Muzaini, "Improving the Mathematical Connection Ability of Middle-School Students through Realistic Mathematics Approach," *J. Math. Pedagog.*, vol. 1, no. 1, pp. 37–46, 2019, [Online]. Available: https://journal.unesa.ac.id/index.php/JOMP/article/view/7147
[30] L. Rani and S. Maarif, "Development E-module three variables linear equations system based on mathematic communication," *J. Medives J. Math. Educ. IKIP Veteran Semarang*, vol. 5, no. 2, pp. 377–389, 2021.
[31] S. Khabibah, "Pengembangan model pembelajaran matematika dengan soal terbuka untuk meningkatkan kreativitas siswa sekolah dasar," *Disertasi, Tidak di Publ. Surabaya Progr. Pasca Sarj. Univ. Negeri Surabaya*, 2006.
[32] T. N. Sipayung and S. D. Simanjuntak, "Pengembangan Lembar Aktivitas Siswa (LAS) Matematika Kelas X SMA Dengan Penerapan Variasi Model Pembelajaran Kooperatif," *JNPM (Jurnal Nas. Pendidik. Mat.*, vol. 2, no. 1, pp. 151–164, 2018.
[33] L. I. González-Pérez and M. S. Ramírez-Montoya, "Components of Education 4.0 in 21st century skills frameworks: systematic review,"

Sustainability, vol. 14, no. 3, p. 1493, 2022, doi: 10.3390/su14031493.

[34] I. Iksal, R. A. Hayani, and A. Aslan, "Strengthening character education as a response to the challenges of the times," *Indones. J. Educ.*, vol. 4, no. 3, pp. 761–774, 2024, [Online]. Available: https://injoe.org/index.php/INJOE/article/view/116

[35] Y. Yunarti, S. Loviana, and A. Safaatin, "Pengembangan media pembelajaran matematika interaktif berbasis adobe flash Cs6," *AKSIOMA J. Progr. Stud. Pendidik. Mat.*, vol. 11, no. 1, p. 159, 2022.

[36] A. C. Kasih and T. J. Siregar, "Development of Mathematics Learning e-Modules to Improve Students' Mathematical Communication Skills," *Int. J. Trends Math. Educ. Res.*, vol. 7, no. 1, pp. 59–65, 2024, doi: 10.33122/ijtmer.v7i1.334.

[37] V. Vini, H. Sabil, and R. Junita, "Pengembangan e-Modul Berbasis Understanding by Design Berdasarkan Cognitive Load Theory untuk Meningkatkan Kemampuan Kreativitas Matematis," *Kogn. J. Ris. HOTS Pendidik. Mat.*, vol. 5, no. 1, pp. 368–382, 2025, doi: 10.51574/kognitif.v5i1.2791.

[38] U. Nuha, A. R. N. Cahyani, S. Supeno, R. Rusdianto, D. Wahyuni, and R. E. Fadhilah, "Development of e-modul based on three-dimensional thinking graph to improve critical reasoning of junior high school students," *Res. Dev. Educ.*, vol. 4, no. 2, pp. 1539–1550, 2024, doi: 10.22219/raden.v4i2.35894.

[39] R. Rahim and D. Wahyuni, "Pengembangan bahan ajar matematika berbasis pendekatan kontekstual pada siswa smk negeri 5 medan," *J. MathEducation Nusant.*, vol. 2, no. 1, pp. 21–27, 2019, doi: 10.54314/jmn.v2i1.57.

[40] N. S. Yolanda and N. Laia, "Validitas Media Pembelajaran Matematika Menggunakan Aplikasi Powtoon," *EduMatSains J. Pendidikan, Mat. dan Sains*, vol. 7, no. 2, pp. 319–331, 2023.

[41] A. Faridah and W. Afridiani, "Meningkatkan hasil belajar mahasiswa melalui e-modul berbasis android," *Mimb. Ilmu*, vol. 26, no. 3, pp. 476–482, 2021, doi: 10.23887/mi.v26i3.39008.

[42] D. Nahdiyah, M. N. Hadi, and A. Sholekhudin, "Inovasi E-Modul Berbasis MooDis Pada Mata Pelajaran Al-Qur'an Hadis Dalam Meningkatkan Motivasi Belajar Siswa Kelas X MA Ma'arif Durensewu Pandaan," *J. Dimens. Pendidik. dan Pembelajaran*, vol. 12, no. 2, pp. 169–184, 2024, doi: 10.24269/dpp.v12i2.9585.

[43] M. R. A. Haryana, S. Warsono, D. Achjari, and E. Nahartyo, "Virtual reality learning media with innovative learning materials to enhance individual learning outcomes based on cognitive load theory," *Int. J. Manag. Educ.*, vol. 20, no. 3, p. 100657, Nov. 2022, doi: 10.1016/j.ijme.2022.100657.

[44] C. Nicolaou, M. Matsiola, and G. Kalliris, "Technology-Enhanced Learning and Teaching Methodologies through Audiovisual Media," *Educ. Sci.*, vol. 9, no. 3, p. 196, Jul. 2019, doi: 10.3390/educsci9030196.