Development of STREAM-Based Science E-Module for Junior High School/MTs on the Topic of Magnetism

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Abstract *- Teaching materials can assist teachers in achieving learning objectives. However, teaching materials integrated with Quranic verses in science learning are still limited. This research aims to produce products in the form of electronic teaching materials (e-modules) based on STREAM (Science, Technology, Religion, Engineering, Art and Mathematics) on the topic of magnetism. The existence of STREAM-based and attractively presented e-module products is expected to support students' self-learning. Through the research and development (R&D) method, reseachers adopt the Borg and Gall R&D method, which is limited to the fifth step, namely the initial main product revision. The results showed 85% valid in terms of teaching materials, 95% valid in terms of preparation of teaching materials, 86% valid in terms of integration of science in the Quran and 95% declared practical. Thus, it can be concluded that the e-module-based STREAM is valid and practical to implement during science learning on the topic of magnetism. The integration of Qur'an verses in e-modules helps connect science with religious values and expects to provide contextual learning experiences for junior high school students. This e-module-based STREAM for junior high school science e-module on the topic of magnetism presents an innovative approach in STREAM-based learning and improves the quality and efficiency of the teaching-learning process. The integration of the latest technology is expected to facilitate interactive, collaborative and effective learning experiences, thus improving significant learning outcomes.*

Keywords*: E-module; Junior High School; STREAM.*

INTRODUCTION

Learning is a process that involves the integration of various elements such as human factors, materials, space, equipment, and methods, all working together to achieve specific learning objectives (Nurâ et al., 2023). Natural Science (IPA) is characterized as a body of knowledge that employs experimental, observational, and deductive methods to gather data and provide reliable explanations for various phenomena (Sakliressy et al., 2021; Widodo, 2019). Science learning involves activities of observing and experimenting, encouraging students to identify and define tangible concepts (Mubarokah & Julianto, 2022). To enhance the effectiveness of science learning, it is essential to incorporate digital media in the process (Wahidin & Syaelfudin, 2018). One such method is using electronic teaching materials, commonly referred to as e-modules.

Current technological advancements present significant opportunities for teachers to develop electronic-based teaching materials (Herianto & Lestari, 2021). These electronic teaching materials must be designed in a way that allows direct usage by students, making the learning process more student-centered. The use of electronic teaching materials in education has become an increasingly prevalent trend (Wang & Hsu, 2006). Moreover, technological advancements have improved the quality and quantity of teaching materials, providing substantial benefits for both teachers and students (Koparan, 2017). The rapid development of technology offers teachers a great opportunity to create engaging, interactive, effective, and student-focused electronic teaching materials. Additionally,

electronic teaching materials are expected to assist teachers in achieving learning objectives effectively.

Based on a literature review of previous studies, a key issue identified is the limited availability of teaching materials in schools that can enhance higher-order thinking skills in students (Ramdani et al., 2020; Ramdani et al., 2021). Furthermore, the development of teaching materials by teachers is still rarely carried out, despite its importance in supporting more effective and in-depth learning (Hasanah et al., 2019). Schools generally rely on textbooks published by certain publishers as their main teaching materials. These textbooks, however, have several drawbacks, such as containing low-level questions, rarely encouraging the practice of higher-order thinking skills, and being overly text-heavy (Ramdani et al., 2021). Komalasari et al. (2019) also highlighted that many teaching materials used in schools lack procedural activities relevant to daily life. Additionally, much of the science material remains abstract and difficult for students to understand, while the learning process tends to be teacher-centered. Unlike conventional textbooks, e-modules offer interactive features and unique opportunities that cater to the learning needs of students and optimize the learning process (Alhammad & Ku, 2019).

An e-module is an online learning tool that integrates text, audio, images, graphics, animations, and videos accessible across various devices (Nugraha et al., 2015; Sriwahyuni et al., 2019). However, during the development of an e-module, it is crucial not to overlook the main components of a learning module: experiential-based learning and consideration of the resources available to students (Inguva et al., 2021). An electronic module is an enhanced version of print-based teaching materials, integrating technology to make learning materials less text-heavy and more interactive by combining audio, video, text, and animations.

Based on observations and interviews with science teachers at SMP Telecommunication Pekanbaru, it was found that both teachers and students had used electronic teaching materials, but only in grade VIII. There is a need to develop electronic teaching materials further, such as for grades VII and IX. The topic of magnetism in grade IX is considered challenging, requiring electronic teaching materials to aid students in understanding the subject. Teaching materials often used in grade IX include Student Worksheets (LKPD), whereas electronic teaching materials are rarely used. This is because students still struggle with understanding science content, and teaching methods primarily rely on lectures. Additionally, teachers face time and skill constraints in creating interactive and engaging electronic teaching materials.

Respondents also emphasized the importance of integrating science education with religious values and real-world experiences to achieve educational objectives. Furthermore, the current curriculum mandates character-building components for students.

In response to these issues, this study proposes the development of electronic teaching materials designed using a specific application and based on the STREAM (*Science, Technology, Religion, Engineering, Arts, and Mathematics*) approach. This aims to provide a new learning experience in understanding science content, particularly on the topic of magnetism. The development of the STREAM-based e-module will focus contextually on magnetism concepts and integrate elements of creative thinking to

enhance learning outcomes and foster students' creative thinking skills.

The STREAM approach evolves from the STEM approach by incorporating elements of arts (Art) and religion (Religion), creating an interdisciplinary method known as STREAM (Safitri & Priyambodo, 2016). According to Shahali et al. (2017), interdisciplinary approaches are effective in fostering problem-solving skills, as they allow students to connect subject-specific expertise to real-world problems through project-based learning. Shatunova et al. (2019) found that incorporating artistic elements into STEM learning enhances students' critical thinking, problem-solving, and creativity. Students tend to be more creative in their learning activities when artistic components are included.

Art is understood as a form of freedom of thought. According to Khoiri et al. (2017), to prevent students from adopting scientific knowledge or ideas that contradict their faith and religion, it is necessary to incorporate religious elements into science and arts education. This aligns with the goals of national education, which include producing intelligent, responsible, and morally upright individuals (Azizah et al., 2019).

A previous study found that including artistic components in the implementation of the STEM approach helps students better understand concepts of light and optics while fostering their creativity (Wandari et al., 2018). Through project activities involving contextual problems, the STREAM approach also helps students develop critical and creative thinking skills (Rahmawati et al., 2019). STREAM-based learning provides students with opportunities to use creativity during the learning process, as the inclusion of arts enables innovative thinking (Agustina et al., 2019).

The STREAM methodology enhances students' abilities to create high-quality compositions (Agustina et al., 2018). One of the strengths of the STREAM approach is the inclusion of religious elements in science education. Religion and science are interconnected, and STREAM-based learning enables students to become more aware of the Creator's greatness by integrating religious values into science education, fostering not only knowledgeable but also morally upright individuals (Lailiyah, 2018). Logical reasoning should be developed by connecting physics concepts, particularly magnetism, to real-world problems to find the best solutions. Additionally, character education that instills religious values complements the learning process.

The objectives of this study are:

1. To develop a STREAM-based science e-module for junior high school/MTs on the topic of magnetism.
2. To analyze the validity, practicality, and student responses to the STREAM-based science e-module on the topic of magnetism.

RESEARCH METHODS

The type of research used in this study is Research and Development (R&D). The design adopted in this research follows the Borg and Gall development model. According to Borg and Gall 1983 in (Rengganis et al., 2022), the research and development process consists of ten implementation steps, including: 1) research and information collecting, 2) planning, 3) develop preliminary of product, 4) preliminary field testing, 5) main product revision, 6) main field test, 7) operational product revision, 8) operational field testing, 9) final product revision, and 10) dissemination and implementation. This study is limited to the initial revision stage of

developing the STREAM-based science e-module for junior high school/MTs on the topic of magnetism. According to Ardhana in (Haryanto, Dwiyogo & Sulistyorini, 2015), the development process depends on the challenges faced by researchers, allowing each development to choose and decide on the most appropriate steps.

1. Research and information collection

A broad overview of the conditions surrounding the needs of students in the teaching and learning process of science at SMP/MTs can be identified through research and information gathering, including curriculum analysis and needs analysis. Research and information gathering are obtained from observation sheets and interview results. The next step is to analyze the students' needs and the content structure of the 2013 curriculum related to core competencies and basic competencies in the syllabus, particularly on the topic of magnetism.

2. Planning

Planning is the second stage. This stage includes selecting the software or application to be used for the development of the e-module, preparing the content and supporting materials (such as images, videos, and animations), and designing the instruments to be used during the research. These instruments include validation questionnaires for material experts, teaching material experts, experts in the integration of Science and the Qur'an, practicality test questionnaires, and student response questionnaires.

3. Develop preliminary of product

The initial product development stage, which is the third stage, includes the preparation of STREAM integration, design preparation, and readiness for evaluating the feasibility of the e-module. After the product development is complete, validation will be conducted by material experts, teaching material validators, and Qur'an interpretation validators qualified to evaluate various aspects of the STREAM-based science e-module for junior high school/MTs. Validators are selected based on their academic background and expertise in relevant fields, such as holding a master's degree (S2) in Physics Education and Qur'an Interpretation Education, with experience as lecturers and experts in material development, teaching materials, and Qur'an interpretation.

4. *Preliminary field testing*

The fourth stage of this research is the preliminary field testing to evaluate student responses and the implementation of the developed product. The preliminary field testing in this study was conducted with 15 students at SMP Telecommunication Pekanbaru and two teaching staff. The STREAM-based science e-module for junior high school/MTs on the topic of magnetism was used as the basis for practicality questionnaires for educators and response questionnaires for students. Additionally, a descriptive analysis of the findings will be conducted in this research.

5. Main product revision

The final stage of this research is product revision. The product revision process involves the researcher making adjustments to the product based on findings from the initial product development and field testing stages. Revisions are carried out multiple times before the final product is ready for testing. The revised product is also validated by validators using the same criteria as those used during the initial product validation.

The data analysis techniques used to assess the validity and practicality of the STREAM-based science e-module for junior high school/MTs include qualitative descriptive analysis and quantitative descriptive analysis. Qualitative descriptive

analysis involves processing interview data in the form of suggestions and feedback from validators regarding the product. Quantitative descriptive analysis is carried out by analyzing data obtained from questionnaires. The scores from expert reviews are calculated as the average score for each assessed aspect, and the results are then presented using the following equation:

$$percentage = \frac{average\ of\ skills}{highest\ score}\ x\ 100\% \qquad (1)$$

The results are then converted into statements to determine the validity and practicality of the STREAM-based science e-module for junior high school/MTs using the product validity assessment criteria proposed by Arikunto (2014) as follows.

Table 1. Criteria for Product Validity Assessment

No	Percentage (%)	Criteria
1	0 % - 25 %	Not Feasible
2	26 % - 50 %	Adequately Feasible
3	51 % - 75 %	Feasible
4	76 % - 100 %	Very Feasible

RESULTS AND DISCUSSION

This research has two objectives: the first is to develop a STREAM-based science e-module for junior high school/MTs on the topic of magnetism, and the second is to determine the validity, practicality, and student responses to the STREAM-based e-module developed for the topic of magnetism.

First Stage: Research and Information Gathering. In this stage, the researcher conducted observations, interviews, and curriculum analysis. Based on the analysis, it was found that the 2013 curriculum can be integrated with Qur'an verses as teaching materials for science, allowing Core Competency 1 (KI-1) to be applied not only in religious studies but also in other subjects. This aligns with the statement by Imaduddin (2020), who asserts that in the context of the 2013 Curriculum, the relationship between science and religion can be realized in KI-1 (religious attitude). However, observations and interviews revealed that few students possess integrated science textbooks or learning resources that include Qur'an verses. Therefore, the development of teaching materials integrated with Qur'an verses is highly needed.

Second Stage: Planning. This stage involved designing the concept of teaching materials for the e-module, including the cover, preface, content, and usage instructions, as well as Core Competencies (KI) and Basic Competencies (KD), a table of contents, and a concept map. The content section includes materials integrated with STREAM aspects, which involve the addition of Qur'an verses, virtual simulations, summaries, competency tests, and science skills. The final section of the e-module includes evaluation, a glossary, and references. Furthermore, the researcher prepared supporting references for the development of the e-module, such as science and physics books and Qur'an interpretation texts. Indicators for KD were then determined based on the 2013 curriculum.

The e-module was developed using Canva Pro, and the outputs from Canva were converted into an animated book using Flip PDF Professional. This tool allows the inclusion of audio, video, animation, simulations, and interactive quizzes. The output format includes files in (.exe), (.app), (.html), and others. This research utilized the (.html) format because it can be accessed anywhere, either on mobile phones or computers, using only an available browser application. This aligns with the research by Yunianto et al. (2019), where the output was

in the form of a computer application (.exe) usable on computers and laptops.

This research further develops the previous study by producing a file in (.html) format. However, to simplify storage, the (.html) file was converted into an Android application using the Website to APK Builder software. At this stage, the researcher also prepared research instruments to evaluate the STREAM-based science e-module for junior high school/MTs that was developed.

Figure 1. Design of E-module

The third stage of this research is the development of a STREAM-based science e-module for junior high school/MTs. At this stage, the researcher began compiling the STREAM-based e-module comprehensively, starting from the material to the evaluation. This stage also included validation testing by experts in the integration of Science and the Qur'an, material experts, and teaching material experts. Based on the validation results from the expert on Qur'an integration, the overall percentage score for all assessment indicators was 86%, categorized as highly feasible. However, revisions were required in some parts based on the suggestions and feedback from the validator.

In the aspect of Qur'an integration, three assessment indicators were evaluated. The first indicator, which focuses on the appropriateness of Qur'an verse usage, consists of three statements: the relevance of Qur'an verses to the material, the systematic placement of Qur'an verses, and the accuracy of Qur'an verse writing. This indicator achieved a feasibility percentage score of 92%. The Qur'an verses incorporated into this e-module include: QS. Al-Hadid: 25 regarding Earth's magnetism, QS. Al-Anbiya: 32 regarding the Van Allen radiation belts, and QS. Al-Mulk: 19 about bird migration.

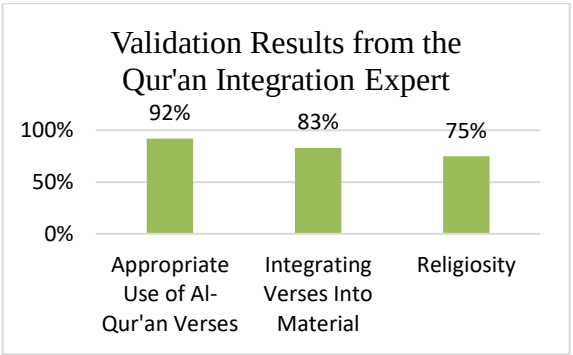

Figure 2. Validation Results from the Qur'an Integration Expert

The second indicator of Qur'an integration assessment evaluates the integration of Qur'an verses into the material. This indicator includes two statements: further explanation regarding the

relationship between the material and the Qur'an, and whether the integrated Qur'an verses are easily understood by students. This indicator received a feasibility percentage score of 83%, as shown in Figure 1. Based on the suggestions and feedback from the validator, additional narrative and further explanation of the Qur'an verses related to the material being discussed should be provided, along with broader knowledge about the referenced verses.

This aligns with the research by Sholihah and Kartika (2018), which employed an informative integration-interconnection model. According to them, this model provides information from one discipline to another, thus broadening perspectives and knowledge. The third indicator assesses the religiosity of students, measured by the statement that the integration of Qur'an verses in this e-module can enhance students' faith (religiosity). This indicator received a feasibility percentage score of 75%, as shown in Figure 2.

The research continued with an evaluation by a teaching material expert. Based on the validation results, the overall percentage score for all assessment aspects was 95%, categorized as highly feasible but requiring revisions according to the expert's feedback and suggestions. The teaching material expert's assessment consisted of four aspects: the first aspect is Graphical Aspect. This aspect included eight statements and received a feasibility percentage score of 98%, as shown in Figure 2. This assessment focused on the size, cover, and content of the e-module. Based on the feedback from the teaching material expert, the cover of the e-module does not yet reflect its STREAM-based design, necessitating improvements by incorporating images that represent the STREAM aspects in the e-module. Additionally, the inclusion of more images accompanied by descriptions in the e-module content was suggested. These improvements align with Alias and Siraj (2012), who stated that a module should be designed as attractively as possible to motivate students to read and understand it. The second aspect is Multimedia and Language Aspect. This aspect included six statements and achieved a feasibility percentage score of 96%, as shown in Figure 3.

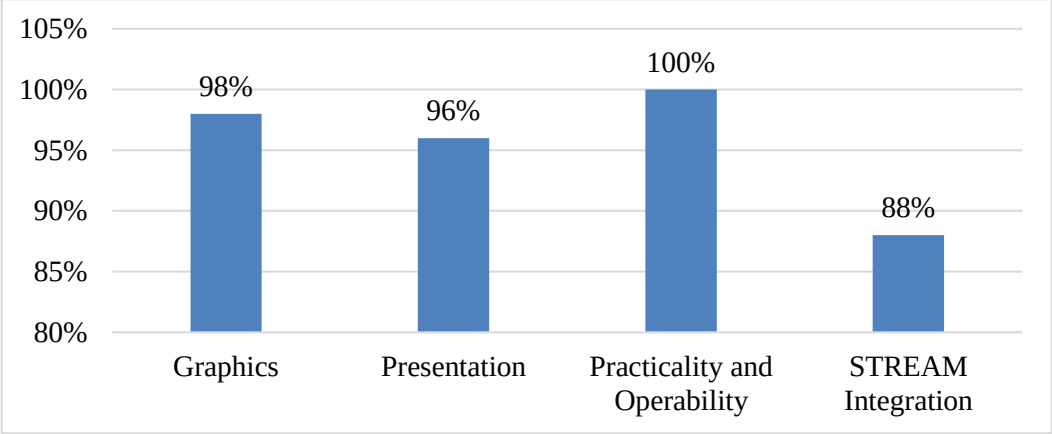

Figure 3. Validation Results from Teaching Material Expert

In this assessment, the validator evaluated the appropriateness of multimedia usage and language. Based on the suggestions and feedback from the teaching material expert, it was advised to ensure that sentences in the e-module are free from plagiarism and to correct any typos in the text. The researcher made revisions based on

these suggestions and feedback. These corrections were necessary because, according to Idris and Mustofa (2022), typos or errors in spelling and word usage can lead to negative consequences as they may alter the intended meaning of the knowledge being conveyed, resulting in the reader receiving inaccurate information.

The third aspect, practicality and operability, consists of two statements and received a perfect score of 100%, as shown in Figure 2. The fourth aspect is the integration of science, where, based on suggestions and feedback from the validator, additional Qur'an verses were recommended for the magnetism material under the religion aspect. Overall, the validator's assessment indicated that the developed science e-module is highly valid and suitable for testing in schools.

Next, the material in this science e-module was evaluated by a material expert validator. Based on the material expert's validation, the overall percentage score for all assessment aspects was 85%, categorized as highly feasible but requiring revisions based on the validator's feedback and suggestions. The content expert validation consists of three assessment aspects.

The first aspect is material feasibility, with two indicators: alignment of the material with Core Competencies (KI) and Basic Competencies (KD), and the accuracy of the material. This aspect includes 10 statements and received a feasibility percentage score of 83%, as shown in Figure 3. The e-module covers three subtopics related to magnetism, including the basic theory of magnetism, electromagnetic induction, and the application of magnetic fields in daily life. Based on the validator's feedback on this aspect, improvements were needed in the concept map and preconception sections, as well as aligning the evaluation questions with the existing KD. A thorough review of the questions in the evaluation section was also suggested.

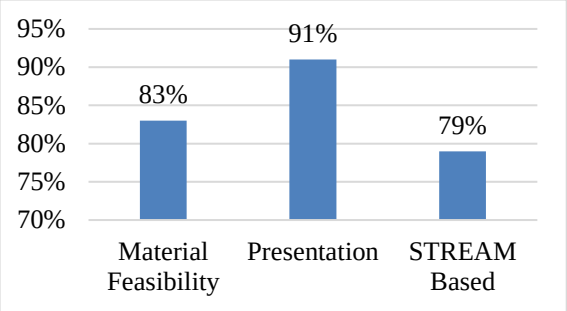

Figure 4. Validation from Expert

The second assessment aspect is presentation, which includes 12 statements and received a feasibility percentage score of 91%, as shown in Figure 4. In this assessment, the validator evaluated the systematic presentation and supporting elements of the presentation. Based on the suggestions and feedback from the material expert validator for this aspect, improvements were needed in the bibliography. The third aspect of the assessment is the integration of STREAM (Science, Technology, Religion, Engineering, Art, and Mathematics). This aspect received a score of 79%, as shown in Figure 4. The overall validation results are summarized in the diagram below.

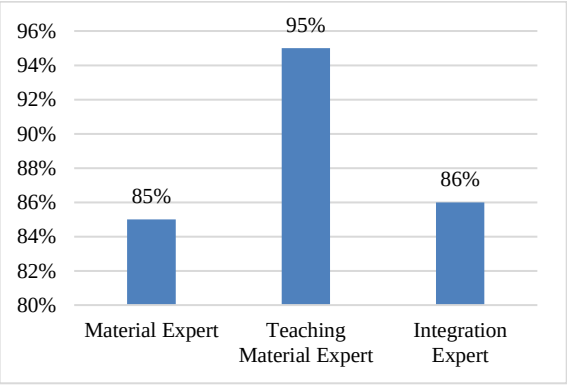

Figure 5. The overall of validation results

Fourth Stage: Preliminary Field Testing. At this stage, the researcher conducted practicality assessments by the

educator and gathered responses from students. The practicality assessment was carried out by one educator, and a limited trial was conducted with 11 students at SMP Telecommunication Pekanbaru. The results of the practicality assessment of the e-module teaching material by the educator were categorized as "highly practical," with an assessment score of 95%, as shown in Figure 6.

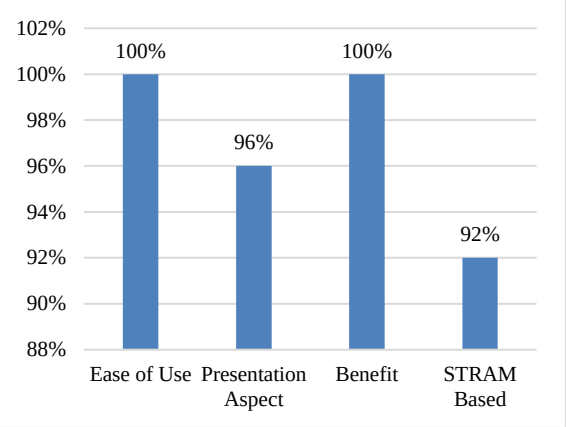

Figure 6. Results of Practicality assessments

The overall score for the student response assessment was 95.6%, indicating that the students' responses to the e-module were highly positive.

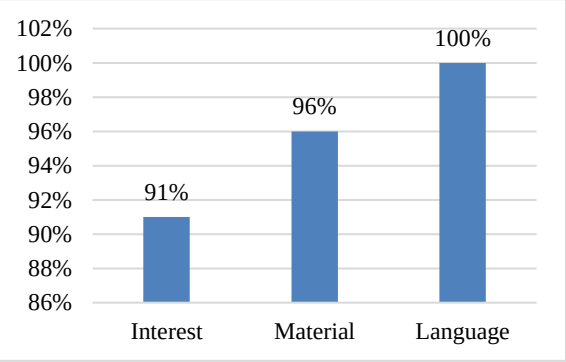

Figure 7. The results of student responses

Fifth Stage: Initial Product Revision. After conducting the preliminary field testing to evaluate the appeal of the STREAM-based science e-module for junior high school/MTs, the researcher revised the e-module based on feedback and suggestions from the validators. This process aimed to produce a final version of the STREAM-based science e-module that is both valid and practical. This e-module is intended to serve as a learning resource for both students and educators in junior high school/MTs on the topic of magnetism for grade IX.

Based on the explanations provided, it can be concluded that the developed e-module reflects a valid teaching material. However, further review is necessary regarding the integration of STREAM aspects into the material. Therefore, additional research is required to refine this science e-module further. Furthermore, research is needed to analyze the impact and effectiveness of the STREAM-based science e-module for junior high school/MTs during its implementation in the teaching and learning process.

CONCLUSION

Specifically, the material validation result was 85%, the teaching material validation result was 95%, and the validation by the Qur'an science integration expert was 86%. The STREAM-based science e-module for junior high school/MTs also achieved a practicality score of 95%, categorized as highly practical. The student response score was 95.6%. Overall, the STREAM-based science e-module for junior high school/MTs on the topic of magnetism was deemed highly valid with a score of 89% and highly practical with a score of 95%. The STREAM-based science e-module for junior high school/MTs on the topic of magnetism has the potential to be implemented in other schools and further tested to measure its broader impact on students' learning outcomes.

REFERENCES

Agustina, T. W., Rustaman, N. Y., Riandi, & Purwianingsih, W. (2018). The learning of compost practice in

university. *Journal of Physics: Conference Series*, *1013*(1). https://doi.org/10.1088/1742-6596/895/1/012128

Agustina, T. W., Rustaman, N. Y., Riandi, & Purwianingsih, W. (2019). Membekalkan kreativitas mahasiswa melalui strategi pembelajaran berbasis STREAM menggunakan konten bioteknologi tradisional. *Program Studi Pendidikan Biologi*, *9*(1), 43–52.

Alias, N., & Siraj, S. (2012). Design and development of physics module based on learning style and appropriate technology by employing Isman instructional design model. *The Turkish Online Journal of Educational Technology*, *1*(4), 12–17.

Azizah, W. A., Sarwi, & Ellianawati. (2019). Pendekatan STREAM terhadap peningkatan kemampuan berpikir kritis peserta didik sekolah dasar. *Seminar Nasional Pascasarjana 2019*, 462–452.

Haryanto, T. S., Dwiyogi, W. D., & Sulistyorini. (2015). Pengembangan pembelajaran permainan bola voli menggunakan media interaktif di SMP Negeri 6 Kabupaten Situbondo. *Jurnal Pendidikan Jasmani*, *25*(1), 123–128.

Herianto, H., & Lestari, D. P. (2021). Implementasi teori konstruktivisme dalam pembelajaran IPA melalui pemanfaatan bahan ajar elektronik. *Jurnal Pembangunan Pendidikan: Fondasi Dan Aplikasi*, *9*(1), 49–57.

Idris, I. S. K., & Mustofa, Y. A. (2022). Typo checking menggunakan algoritma Rabin-Karp. *Jambura Journal of Electrical and Electronics Engineering*, *4*(1), 87–91. https://doi.org/10.37905/jjeee.v4i1.12150

Imaduddin, M. (2020). A new way to promote Islamization of science: I-SETS design for pre-service science teachers. *Journal of Natural Science and Integration*, *3*(1), 1–8. DOI: http://dx.doi.org/10.24014/jnsi.v3i1.8774

Inguva, P., Shah, P., Shah, U., & Brechtelsbauer, C. (2021). How to design experiential learning resources for independent learning. *Journal of Chemical Education*, *98*(4), 1182–1192. https://doi.org/[DOI-anda-di-sini]

Khoiri, A., Agussuryani, Q., & Hartini, P. (2017). Penumbuhan karakter Islami melalui pembelajaran fisika berbasis integrasi sains-Islam. *Tadris: Jurnal Keguruan dan Ilmu Tarbiyah*, *2*(1), 19–28. http://dx.doi.org/10.24042/tadris.v2i1.1735

Komalasari, B. S., Jufri, A. W., & Santoso, D. (2019). Pengembangan bahan ajar IPA berbasis inkuiri terbimbing untuk meningkatkan literasi sains. *Jurnal Penelitian Pendidikan IPA*, *5*(2), 219–227.

Koparan, T. (2017). Analysis of teaching materials developed by prospective mathematics teachers and their views on material development. *Malaysian Online Journal of Educational Technology*, *5*(4), 8–28.

Lailiyah, S. (2018). Pentingnya membangun pendidikan sains yang relevan dengan ajaran Islam. *Spektra: Jurnal Kajian Pendidikan Sains*, *4*(2), 178–185.

Mubarokah, Y. M., & Julianto. (2022). Pengembangan e-modul berbasis pendekatan STEAM pada pembelajaran IPA materi komponen listrik dan fungsinya dalam rangkaian listrik sederhana kelas 6 sekolah dasar. *JPGSD*, *10*(1), 171–181.

Nugraha, A., Subarkah, C. Z., & Sari. (2015). Penggunaan e-module pembelajaran pada konsep sifat koligatif larutan untuk mengembangkan literasi kimia peserta didik. *Prosiding Simposium Nasional Inovasi dan Pembelajaran Sains (SNIPS)*, 51–56.

Nurâ, S., Jumyati, J., Yuliyanti, Y.,

Nulhakim, L., & Leksono, S. M. (2023). Scientific approach to learning science in elementary schools. *Jurnal Penelitian Pendidikan IPA, 9*(8), 6659–6666.

Rahmawati, Y., Ridwan, A., Hadinugrahaningsih, T., & Soeprijanto. (2019). Developing critical and creative thinking skills through STEAM integration in chemistry learning. *Journal of Physics: Conference Series, 1156*(1). https://doi.org/10.1088/1742-6596/1156/1/012033

Ramdani, A., Jufri, A. W., Gunawan, G., Fahrurrozi, M., & Yustiqvar, M. (2021). Analysis of students' critical thinking skills in terms of gender using science teaching materials based on the 5E learning cycle integrated with local wisdom. *Jurnal Pendidikan IPA Indonesia, 10*(2), 187–199.

Ramdani, A., Syukur, A., Gunawan, G., Permatasari, I., & Yustiqvar, M. (2020). Increasing students' metacognition awareness: Learning studies using science teaching materials based on SETS integrated inquiry. *International Journal of Advanced Science and Technology, 29*(5), 6708–6721.

Rengganis, A., Haruna, N. H., Sari, A. C., Sitopu, J. W., Brata, D. P. N., Gurning, K., Karwanto, & Subakti, H. (2022). *Penelitian dan pengembangan* (R. Watrianthos & J. Simaemata, Eds.; 1st ed.). Yayasan Kita Menulis.

Safitri, Y., & Priyambodo, E. (2016). Pengembangan subject specific pedagogy (SSP) berbasis science, technology, religion, engineering, and mathematic (STREAM) pada materi polimer untuk SMK. *Jurnal Pendidikan Kimia, 28*(7), 123–132.

Sakliressy, M. T., Sunarno, W., & Nurosyid, F. (2021). Students scientific attitude in learning physics using problem based learning model with experimental and project methods. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni, 10*(1), 59–70. https://doi.org/10.24042/jipfalbiruni.v10i1.8347

Shahali, E. H. M., Halim, L., Rasul, M. S., Osman, K., & Zulkifeli, M. A. (2017). STEM learning through engineering design: Impact on middle secondary students' interest towards STEM. *Eurasia Journal of Mathematics, Science and Technology Education, 13*(5), 1189–1211. https://doi.org/10.12973/eurasia.2017.00667a

Shatunova, O., Anisimova, T., Sabirova, F., & Kalimullina, O. (2019). STEAM as an innovative educational technology. *Journal of Social Studies Education Research, 10*(2), 131–144.

Sholihah, N., & Kartika, I. (2018). Pengembangan modul IPA terintegrasi dengan ayat Al Qur'an dan hadis. *Lentera Pendidikan: Jurnal Ilmu Tarbiyah dan Keguruan, 21*(1), 12–22.

Wahidin, U., & Syaefudin, A. (2018). Pendidik dalam perspektif pendidikan Islam. *Edukasi Islam: Jurnal Pendidikan Islam, 7*(1), 47–66.

Wandari, G. A., Wijaya, A. F. C., & Agustin, R. R. (2018). The effect of STEAM-based learning on students' concept mastery and creativity in learning light and optics. *Journal of Science Learning, 2*(1), 26.

Wang, H. C., & Hsu, C. W. (2006). Teaching-material design center: An ontology-based system for customizing reusable e-materials. *Computers & Education, 46*(4), 458–470.

Yunianto, T., Negara, H. S., & Suherman. (2019). Flip Builder: Pengembangannya pada media pembelajaran matematika. *Jurnal Pendidikan dan Pembelajaran Dasar, 6*(2), 115–127.