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Development and Validation of a Guided Inquiry-Based E-Module Integrating Joyful Learning for Seventh-Grade Science Education

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Abstract:
Background. Indonesian students' limited scientific literacy highlights the need for innovative digital learning materials that promote active, engaging, and meaningful science learning.
Aims. This study aimed to identify teachers' and students' needs, develop a joyful learning e-module integrated with guided Inquiry-Based Learning (IBL), and evaluate its feasibility and practicality for seventh-grade science learning.
Methods. The 4D model—define, design, develop, and disseminate—formed the basis of the study's Research and Development (R&D) methodology, which limited the development process to the develop stage. SMPN 2 Krui seventh-grade students, a science teacher, a media specialist, and a material expert participated in the study. The study used descriptive quantitative and qualitative methods to examine data gathered through expert validation sheets, student response surveys, and interviews. The needs analysis showed a need for digital teaching resources that are accessible, interesting, and interactive. Validation data show that the e-module received a feasibility score of 91.08% from the material expert, 86.56% from the media expert, and 100% from the scientific instructor. With an average score of 90.67% for the e-module and 97.94% for the combination of guided IBL and joyful learning, student responses were likewise very favorable.
Result. These findings indicate that the developed e-module is highly feasible, practical, and well accepted by students as a digital resource for supporting active and enjoyable science learning.
Conclusion. Integrating guided inquiry activities with joyful learning offers a promising approach to combining cognitive engagement with positive learning experiences.
Implementation. Further research using larger samples and experimental designs is recommended to examine its effectiveness in improving scientific literacy, critical thinking, and learning outcomes.

Keywords: joyful learning; guided inquiry; Inquiry-Based Learning; e-module; science education; scientific literacy

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INTRODUCTION

The development of scientific literacy—which includes the capacity to comprehend ideas, carry out research, and reach evidence-based conclusions—is a key component of science education in the twenty-first century. However, compared with the worldwide average, Indonesian students' scientific literacy remains quite low (Aditomo & Klieme, 2020), suggesting a disconnect between curriculum objectives and instructional strategies. Although the Merdeka Curriculum promotes student-centered learning, few cutting-edge teaching resources are available. In reality, science instruction in schools typically remains teacher-centered and does not actively involve pupils, which leads to low conceptual understanding and motivation (Zulyadaini, 2021). A useful strategy for enhancing students' conceptual knowledge and critical thinking abilities is the guided Inquiry-Based Learning (IBL) model. By enabling students to build knowledge through scientific activities, this approach strongly emphasizes their active participation in the investigative process. As a result, pupils acquire higher-order thinking abilities in addition to conceptual understanding. However, implementing guided IBL often faces challenges, most notably a lack of organized, methodical learning resources to support the learning process. This shows that creating suitable instructional materials remains crucial to implementing this strategy successfully (Anwari et al., 2024; Ristanto et al., 2020; Nofiana et al., 2020).

The joyful learning technique significantly increases students' motivation to learn. This is because it emphasizes fun, engaging, and stress-free learning experiences that improve the learning environment. Students are more likely to be active, enthusiastic, and intrinsically motivated to learn when they feel at ease and emotionally invested in their studies. As a result, a joyful learning approach may be a useful strategy for increasing students' motivation to learn (Darmayanti et al., 2023). One innovation in teaching materials that has been shown to improve students' cognitive learning outcomes is the creation of inquiry-based e-modules. This is because e-modules motivate students to learn actively through research and problem-solving exercises, leading to deeper conceptual understanding. Additionally, using technology like QR codes in conjunction with project-based e-modules has improved students' capacity for original thought. When technology is incorporated into instructional resources, students can access knowledge more widely and interactively, encouraging more creative learning. Therefore, both project-based and inquiry-based e-modules have strong potential to improve the quality of students' learning outcomes (Muhfahroyin, n.d.; Ningrum & Widowati, 2025).

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Digital learning resources greatly aid students' conceptual grasp of biology. Instructional videos are a useful medium that help students grasp abstract ideas by presenting information in a dynamic, visual way. Videos can clarify biological processes that are hard to see directly by combining visuals, animations, and voice explanations. Additionally, using films during class might improve students' focus and involvement. Consequently, video-based learning materials have been shown to enhance students' conceptual grasp of biology (Ningsih et al., 2023). Earlier research has typically studied joyful learning and inquiry-based learning (IBL) independently. Most research, especially on digital teaching resources, focuses on one strategy without integrating both into a single learning design. Combining the two methods can maximize students' cognitive and emotive learning. This suggests that little research has examined e-modules that integrate joyful learning and IBL. As a result, a research gap remains that must be addressed by creating cutting-edge instructional materials that incorporate both strategies (Fajari et al., 2023). While joyful learning has been shown to create stimulating and engaging learning settings, prior research has shown that guided inquiry-based learning (IBL) can support active scientific inquiry and conceptual understanding. Additionally, a growing number of digital and inquiry-based e-modules have been created to enhance student-centered science education. However, researchers have paid little attention to integrating guided IBL and joyful learning in a single digital instructional resource, as they have mostly studied both techniques independently. This leaves a research gap in creating an e-module that, especially for seventh-grade science instruction, simultaneously organizes students' inquiry processes and produces an interesting and pleasurable learning experience. This study develops a joyful learning e-module focused on guided IBL to close this gap. The study is novel in that it combines the affective and motivational aspects of joyful learning with the cognitive processes of guided scientific inquiry into a single digital learning resource. Student responses, teacher evaluation, and expert validation assess its viability and practicality.

METHOD

The 4D development model, which comprises the define, design, develop, and disseminate stages, was employed in this study's research and development (R&D) methodology. This model was selected because it provides a methodical product development process, from needs analysis to product refinement. Nevertheless, this study limited the development process to the "develop" stage, which included a limited trial, expert

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validation, and product revision. This restriction aligned with the research goal of creating a legitimate product for educational use.

Research Subjects

Students from SMPN 2 Krui's seventh grade served as the study's subjects and respondents during the data gathering phase. Additionally, validators, including a media specialist and a material expert, validated the product. The media expert examined the display, interaction, and usability of the e-module, while the material expert evaluated the content's appropriateness, conceptual depth, and accuracy. The goal of the research subjects' and validators' participation was to gather detailed information about the product's viability in terms of learning media design and content.

Data Collection Techniques

1. Interviews (needs analysis)
2. Expert validation sheets
3. Student response questionnaires

The instruments consisted of interview guidelines, validation sheets, and Likert-scale questionnaires.

Data Analysis Technique

The study evaluated the developed product's viability using descriptive analysis and percentage-based approaches. To facilitate interpretation, the analysis converted respondents' and validators' evaluation results into percentages. The percentages were then divided into three feasibility levels: highly feasible, feasible, and less feasible. Using this method, the researchers described the e-module's quality in a methodical and objective manner based on the collected data.

Research Ethics

After receiving permission from the school and adhering to administrative protocols and research ethics, the researchers conducted the study. Additionally, by excluding students' personal identities from the research report, the researchers preserved the anonymity of respondents' data. The researchers objectively examined all collected data and used it only

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for academic purposes. As a result, the study adhered to research ethics guidelines, especially those pertaining to research authorization and respondent privacy protection.

RESULTS AND DISCUSSION

Material Expert Validation

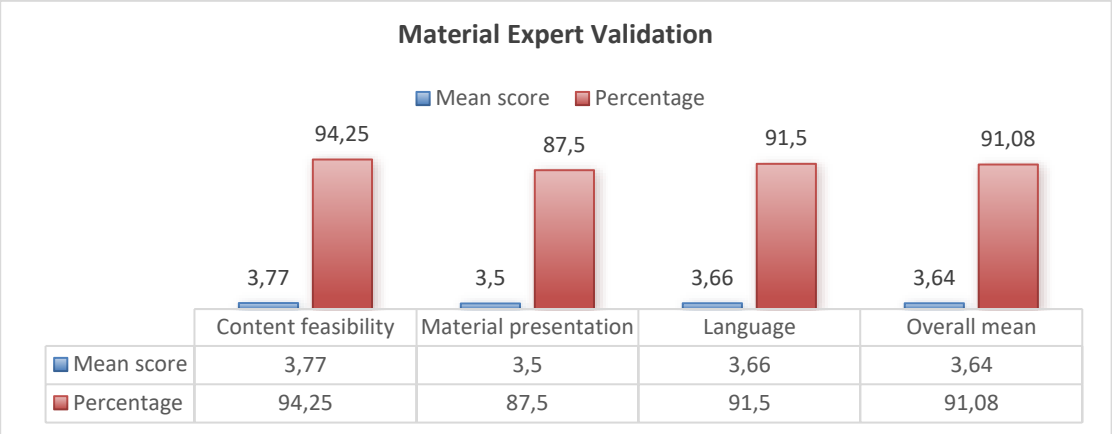


Figure 1. Results of material expert validation

According to the content feasibility aspect, the e-module's content is theoretically correct, aligned with learning objectives, and relevant to students' requirements, receiving the highest score of 94.25% (Figure 1). The e-module's consistent quality across the other assessment indicators was also in the practicable to extremely feasible category. These findings show that the material's appropriateness, presentation, and substance meet the requirements for developing instructional materials. With an average percentage of 91.08%, these results indicate that the produced e-module falls into the extremely feasible category. Additionally, the language component fell into the extremely feasible category (91.50%), indicating that the e-module's language is communicative and easy to understand. While still falling within the practicable category, the material presentation component received a marginally lower score (87.50%). This suggests that the presentation structure could be strengthened to better guide students' thought processes. Overall, these findings show that the e-module meets content feasibility requirements and is ready for educational application.

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Media Expert Validation

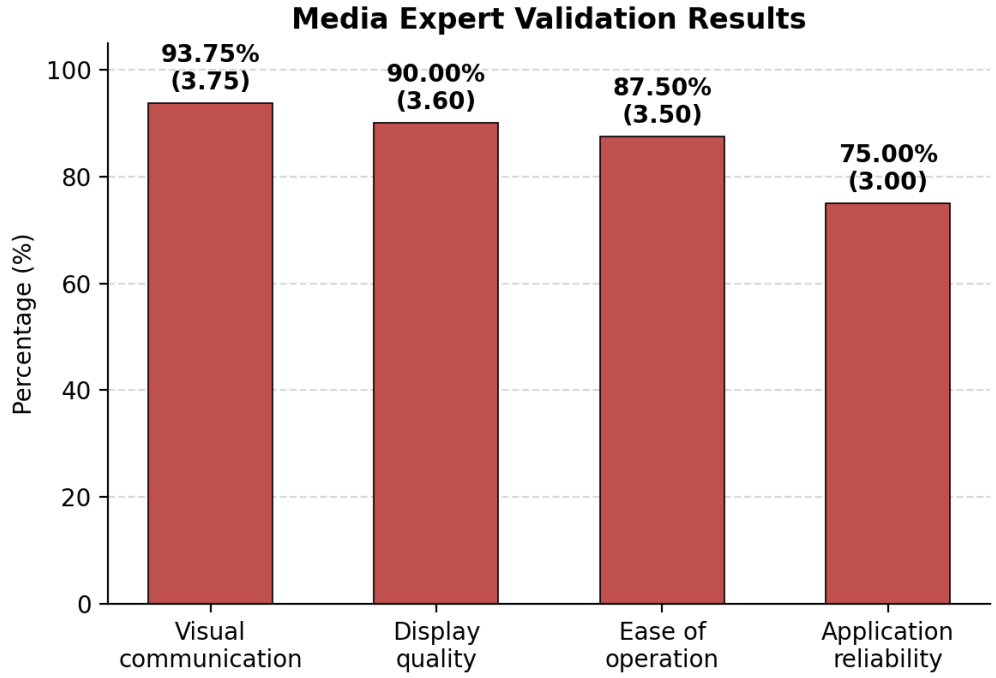


Figure 2. Results of media expert validation

The e-module received an average rating of 86.56%, placing it in the extremely feasible category (Figure 2). The visual communication component received the highest score (93.75%), indicating that the e-module's display was deemed appealing, imaginative, and able to communicate effectively with students. The e-module's good design and user-friendliness are further demonstrated by the display quality (90%) and ease of operation (87.50%). However, in the feasible category, the application reliability component received the lowest score (75%). This highlights technological shortcomings that still require improvement, such as media quality or application performance. When inquiry-based teaching resources are used, students are encouraged to actively participate in their education through investigation, observation, and conclusion-making. This involvement improves the quality of classroom learning exchanges and helps students develop deeper conceptual understanding. Additionally, compared to traditional learning, a learning method that prioritizes exploration yields more meaningful learning experiences. These results suggest that inquiry-based teaching resources can enhance students' conceptual understanding and learning quality (Nofiana et al., 2020; Suardana et al., 2022). Therefore, although

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technological aspects still need improvement, the e-module generally meets the requirements for quality learning materials.

Science Teacher's Assessment

The science teacher gave the e-module a very positive evaluation in every category. The e-module's content and language were deemed in line with curriculum standards and used understandable language for pupils. The e-module was seen as visually appealing and user-friendly in terms of media, which facilitated a comfortable learning process. In addition, the e-module was thought to enhance learning quality, promote student engagement, and offer flexibility in the learning process. The e-module is high quality in both content and implementation, as shown by consistently excellent evaluations in every area. Thus, the constructed e-module received a perfect score of 100% in the extremely feasible area and is both highly useful in classroom practice and theoretically possible.

Student Responses to the E-Module

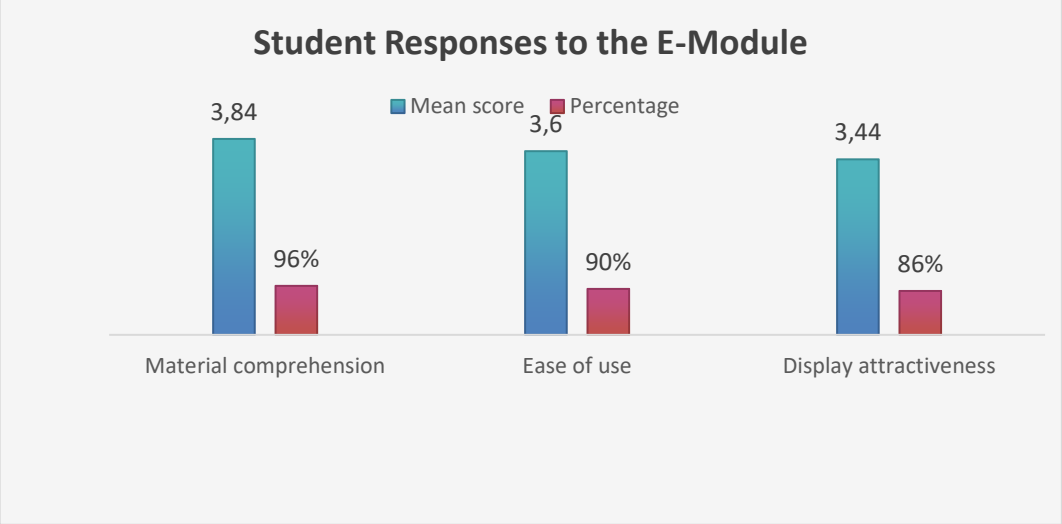


Figure 3. Student responses to the e-module

The e-module successfully helped students understand learning ideas, as shown by the content comprehension component's highest score of 96% (Figure 3). Ninety percent of students found the e-module easy to use, meaning they had no trouble navigating or using the language. Meanwhile, the display attractiveness component received an 86% score, indicating that the e-module's display is highly appealing and can hold students' interest while they learn. The e-module is of high quality in terms of content, usability, and appearance, as evidenced by the consistent scores across these factors. With an average

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percentage of 90.67%, students' responses to the e-module fall into the highly feasible group. Previous studies show that the joyful learning strategy can boost students' engagement and learning motivation, which also corroborates the extremely favorable student reactions to the e-module. When learning is enjoyable, students are more likely to participate actively and enthusiastically, which improves their acceptance of the teaching resources. Therefore, the results align with other studies and confirm that the created e-module is highly practical and well received by students (Darmayanti et al., 2023).

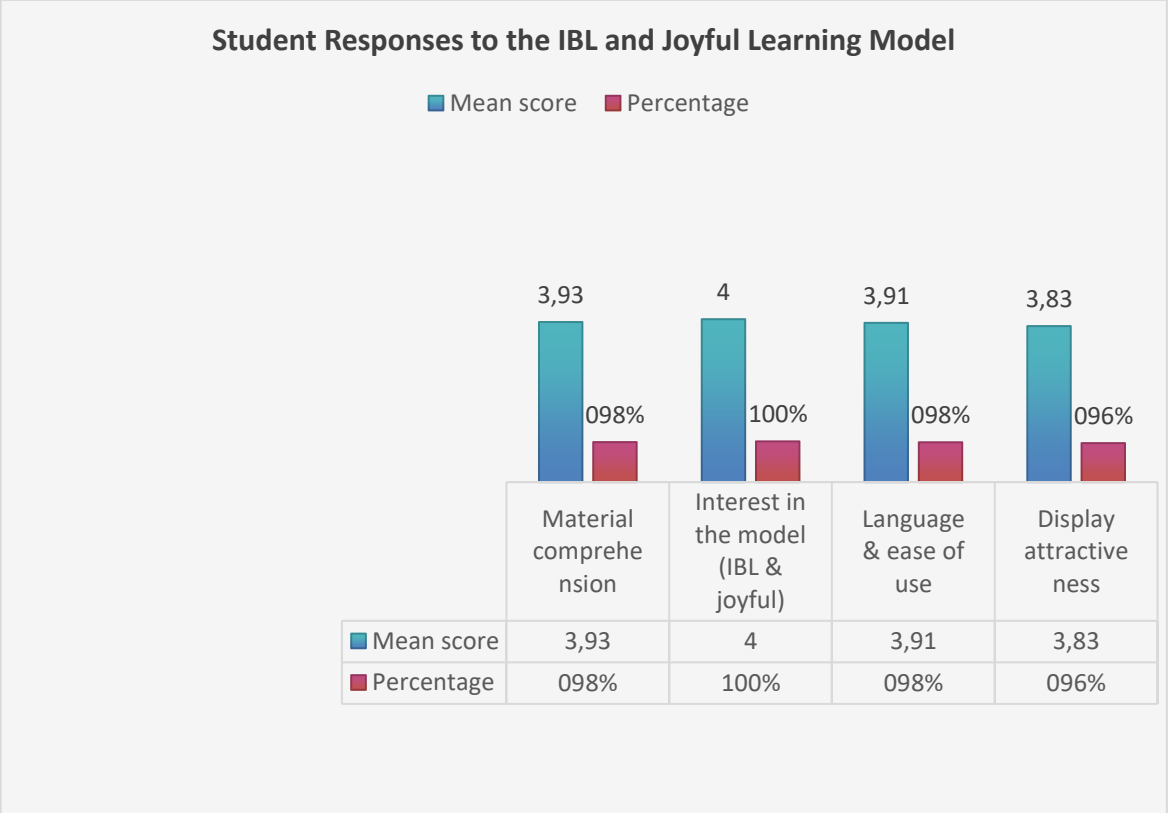


Figure 4. Student responses to the IBL and joyful learning model

The strategy greatly increased students' desire and interest in learning, as shown by the maximum score of 100% for interest in the learning model (Figure 4). This learning strategy successfully helped students develop conceptual understanding, as shown by the content comprehension aspect reaching 98.25%. Additionally, the language and ease-of-use component received a high score of 97.75%, indicating that students can easily comprehend and utilize the e-module. Meanwhile, the e-module's appealing design encourages student engagement, as shown by the display attractiveness score of 95.75%. The consistently high outcomes across all areas point to an excellent model implementation. With an average

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percentage of 97.94%, students' reactions to the application of the joyful learning model and inquiry-based learning (IBL) fell into the highly feasible group.
The high ratings in each category show that the IBL model and joyful learning can produce engaging, interactive, and joyful learning experiences. Students are more active, eager, and emotionally invested in their education when they participate in investigative activities in a fun environment. This improves comprehension of the learned concepts and boosts learning motivation. As a result, using both strategies effectively raises the caliber of students' learning outcomes and processes.

Numerous studies have shown that learning models that require active participation in research improve students' critical thinking abilities. Through learning activities, students improve their ability to analyze situations, develop hypotheses, and draw conclusions based on the data. This process fosters higher-order thinking abilities that emphasize both conceptual comprehension and scientific reasoning. These results suggest that incorporating the guided Inquiry-Based Learning (IBL) approach can enhance students' critical thinking abilities (Anwari et al., 2024; Ristanto et al., 2020). The e-module satisfies high requirements for content, presentation, and display, according to the material and media expert assessment. Furthermore, the teacher's evaluation, which scored 100% in every category, attests to the e-module's strong alignment with the school's learning objectives. The uniformity of the evaluation results from different parties demonstrates that the e-module's quality is both conceptually sound and applicable in educational settings. As a result, the constructed e-module shows a very high level of practicality across multiple dimensions, as shown in Figures 1-4. According to Novita et al. (2025), education plays a significant part in enhancing students' comprehension of scientific subjects, particularly physics. This study aims to increase junior high school students' knowledge of static electricity in grade IX at Darun Nasya using the Inquiry-Based Learning (IBL) methodology. The experiment used two groups: a control group that used traditional teaching techniques and an experimental group that used the IBL model. The study used pre- and post-tests, along with student activity observations, to gather data. The data show that the experimental group's comprehension of static electricity improved significantly. While the control group improved only slightly, the experimental group's average post-test score rose from 50% to 80%. This shows how the Inquiry-Based Learning approach can improve students' understanding of topics related to static electricity. This study recommends using the IBL model as a more effective teaching strategy for understanding junior high school physics

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content. Students highly appreciated the e-module, as shown by their responses in the extremely feasible category. The high score for the learning model aspect further suggests that combining joyful learning with inquiry-based learning (IBL) can create engaging and pleasurable learning experiences. During the learning process, this situation improves pupils' conceptual understanding and motivation to learn. As a result, the e-module is useful and efficient in enhancing classroom instruction while remaining theoretically sound. This study is novel in creating an integrated, joyful learning e-module focused on guided inquiry-based learning (IBL) for seventh-grade science instruction. The e-module integrates the structured investigative features of guided IBL with the captivating, learner-friendly concepts of happy learning into a single digital learning resource, rather than treating inquiry and pleasurable learning as distinct approaches. Additionally, the product is assessed from multiple angles, including media quality, instructor evaluation, student reactions, and subject expertise, all of which demonstrate its viability and usefulness. As a result, the study offers a digital instructional design that accounts for both the affective aspect of an engaging learning experience and the cognitive aspect of active scientific investigation.

Despite these advancements, prior research has mostly looked at joyful learning, guided inquiry, and digital learning resources as distinct or partially integrated teaching strategies. No research has yet combined joyful learning with guided IBL in a single, organized e-module. As a result, information remains limited on how a digital learning resource can support guided inquiry's methodical investigation procedures while also giving junior high school students a fun and interesting learning experience. Additionally, current research highlights the practical need for engaging, dynamic, and easy-to-understand instructional materials suited to seventh-grade students' learning needs. Recent advancements in science education have placed greater emphasis on student-centered learning through inquiry-based methods and digitally supported teaching materials. By encouraging students to participate actively in scientific research, guided inquiry-based learning (IBL) helps them investigate issues, develop solutions, build conceptual knowledge, and hone higher-order thinking skills. However, putting it into practice in the classroom requires organized, methodical learning materials that guide students through the inquiry process. At the same time, joyful learning has become a strategy for creating interactive, captivating, and psychologically supportive learning environments that can boost students' motivation and involvement. Prior studies have also shown the promise of technology-enhanced and inquiry-based e-modules.

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CONCLUSION

Using the 4D development model, this study effectively created a joyful learning e-module combined with guided Inquiry-Based Learning (IBL) for seventh-grade science learning, with the process restricted to the development stage. Validation scores of 91.08% from the material expert, 86.56% from the media expert, and 100% from the scientific instructor showed that the constructed e-module was very feasible. These findings show that the e-module satisfies the necessary requirements for language, presentation, content, visual design, usability, and alignment with classroom learning objectives. With an average response of 90.67% for the e-module and 97.94% for the combination of guided IBL and joyful learning, students also gave the generated product positive feedback. These results show that the e-module is useful, accessible, engaging, and well received by students. Combining joyful learning with guided inquiry activities creates a learning environment that promotes active involvement and offers a pleasurable learning experience. Overall, the e-module is a viable and useful digital learning tool for teaching science to seventh graders. Its primary contribution is to create a single digital learning resource that combines the engaging qualities of joyful learning with the structured investigative methods of guided IBL. However, the results may not yet be considered proof of causal changes in students' scientific literacy, critical thinking, or learning achievement because this study was limited to product creation, expert validation, and student responses. To assess the e-module's impact on these learning outcomes and improve its technical performance, future research should employ bigger, more varied samples, experimental or quasi-experimental designs, and pretest–posttest assessments.

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