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ORIGINAL

Design of Science E-Modules Based on Guided Inquiry to Improve Science Literacy Using Canva and Heyzine

Diseño de módulos electrónicos de ciencias basados en la indagación guiada para mejorar la alfabetización científica utilizando Canva y Heyzine

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ABSTRACT

Introduction: the development of guided inquiry-based e-modules emphasizes the need for relevant and interesting materials to improve students' scientific literacy.
Method: a descriptive qualitative method was used, applying a guided inquiry approach to create engaging and relevant materials to improve science literacy. The e-module prototype was developed using Canva and Hayzine, chosen for its interactive and easy-to-use features.
Results: the feasibility of the guided inquiry-based science e-module was evaluated by expert validators specializing in educational media and science education content. Key aspects such as readability, interactivity, and curriculum alignment were assessed. The findings confirmed that the prototype met the standards required for effective teaching materials and showed significant potential to improve elementary science education.
Conclusion: the study showed that integrating the Guided Inquiry approach with Canva and Hayzine created an engaging and culturally relevant e-module. This resource effectively supports better science education by increasing student engagement and science literacy skills.

Keywords: Science E-Module Design; Guided Inquiry; Canva; Heyzine; Science Education.

RESUMEN

Introducción: el desarrollo de módulos electrónicos basados en la investigación guiada enfatiza la necesidad de materiales relevantes e interesantes para mejorar la alfabetización científica de los estudiantes.
Método: se empleó un método cualitativo descriptivo, aplicando un enfoque de indagación guiada para crear materiales atractivos y relevantes que mejoren la alfabetización científica. El prototipo del módulo electrónico se desarrolló con Canva y Hayzine, seleccionados por sus funciones interactivas y fáciles de usar.
Resultados: la viabilidad del módulo electrónico de ciencias basado en la indagación guiada fue evaluada por validadores expertos especializados en medios educativos y contenido de educación científica. Se evaluaron aspectos clave como la legibilidad, la interactividad y la adecuación curricular. Los resultados confirmaron que el prototipo cumplía con los estándares requeridos para materiales didácticos eficaces y mostró un potencial significativo para mejorar la educación científica en primaria.
Conclusión: el estudio demostró que la integración del enfoque de Indagación Guiada con Canva y Hayzine creó un módulo electrónico atractivo y culturalmente relevante. Este recurso contribuye eficazmente a una mejor educación científica al aumentar la participación de los estudiantes y sus habilidades de alfabetización científica.

Palabras clave: Diseño de Módulos Electrónicos de Ciencias; Investigación Guiada; Canva; Heyzine; Educación Científica.

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INTRODUCTION

Science education in elementary schools plays an important role in building a strong foundation of scientific understanding for students from an early age.[1] Through exploration-based learning, simple experiments, and direct observation, students can develop curiosity and critical thinking skills about natural phenomena around them. Basic concepts such as changes in the state of objects, force and motion, and ecosystems are taught in a contextual way so that they are easy to understand and relevant to everyday life.[2]

The most important part of science learning is scientific literacy skills. Scientific literacy is a skill that is greatly needed by students in the development of the 21st century which can be seen from the rapid development of science and technology.[3] Cai Ting We, et al.[4] argued that in the 21st century the scientific literacy of a nation is the key in education, because the mastery of science and technology is the key in a nation. Scientific literacy is an individual competency needed to view and respond critically to issues that include the ability to explain natural phenomena and their impact on society, the ability to use knowledge and understanding of scientific inquiry to identify questions, interpret and evaluate data and evidence scientifically.[5]

Scientific literacy requires individuals to not only know scientific facts, but also understand scientific processes such as observation, experimentation, and logical reasoning. In addition, scientific literacy also involves the ability to evaluate scientific information skeptically and objectively, and communicate effectively on scientific topics [6]

However, in its implementation, science education faces quite significant challenges, especially in terms of the scientific literacy skills of students in elementary schools. One crucial challenge is the excessive reliance on printed textbooks as the main learning source. These textbooks often present general material that is less relevant to scientific literacy skills.[7] As a result, students often find it difficult to connect the material to everyday life and experiences. In addition, traditional textbooks tend to emphasize memorization of concepts and terminology rather than fostering critical thinking or the ability to analyze social issues in the real world.[7,8] This limitation weakens the potential of students and their scientific literacy skills in forming individuals with scientific insight and broad insight.

The dominance of printed textbooks is also in stark contrast to the demands of 21st-century learning. Effective learning in the modern era requires media that are in line with the characteristics of student development and the ever-evolving digital landscape.[9] Based on Piaget's cognitive development theory, elementary school students are in the concrete operational phase. Thus, the media used must be concrete or real, so that students can understand the concept of the material comprehensively. This underscores the need for innovative learning resources that go beyond static and text-heavy materials.

Another challenge lies in the effort to overcome the gap in students' literacy skills in viewing current life phenomena. Science education should ideally help students understand phenomena that occur in real life.[10] However, existing resources often fail to include science literacy skills, making the learning experience less interesting and relevant for students from various backgrounds. This highlights the importance of a responsive approach to science literacy skills in developing educational content.

Therefore, learning media that empowers students in learning is needed. Teachers need to develop quality teaching strategies and skills in order to effectively integrate learning technology into learning. Current technological advances have implications for the development of learning media.[8] Viewed from the field of utilization of learning technology, media can be used systematically for learning. Utilization of media is a decision-making process based on learning design specifications that are associated with student characteristics.[11] This is in line with Tuhuteru's opinion, that media can develop sensory abilities and attract students' attention and interest, so that students' literacy skills will improve.

Related to this, one of the media that can be used is an e-module based on guided inquiry. E-Modules are a form of publication consisting of text and other media presented in digital form, so that they can be read on computers or other electronic devices.[12] This is in line with the opinion that e-modules are published in digital form, and displayed in the form of flipbooks.

One of the e-module creation applications is Canva assisted by Heyzine. The Heyzine application can be used to convert design results from Canva into a flip-page format and allows the creation of interactive learning content with several supporting features.[12,13] This application makes it easy to add various types of animated media to flipbooks. The e-module developed in this study is based on guided inquiry. This is in line with the goal of education in the 21st century to form a young generation that is intelligent, has character, and is responsible. E-modules based on guided inquiry have the potential to overcome several challenges in science learning.[14]

This study attempts to overcome the limitations of using printed books in science learning which tend to be static and do not improve science literacy. Printed books generally present general and less contextual material, so that students have difficulty relating the material to everyday experiences. By utilizing guided inquiry-based e-modules with the Canva and Heyzine applications, this study is expected to provide innovative solutions to support science learning that is more relevant, interactive, and in accordance with the learning needs of elementary school students in the digital era so that science literacy skills can be maximized.

There are several relevant studies, which show that the use of e-modules can improve scientific literacy. Research conducted by Rizhal Hendi et al.[3] The use of interactive-based e-modules in learning has succeeded in increasing student engagement and understanding of the material. Meanwhile, research by Safrizal et al.[14] emphasizes the importance of developing learning media that can be easily accessed and is interesting for elementary school students. E-modules based on guided inquiry assisted by Canva and Heyzine provide a solution in this regard because they provide interactive features such as animation, video, and quizzes that can increase the appeal, effectiveness of learning, and scientific literacy.

In recent years, digital learning media has been increasingly used to improve the quality of education. One of the software that is often used is canva and heyzine which allows the integration of various interactive elements such as animation, video, audio, and practice questions in digital book format. This application is considered effective in increasing student engagement, especially at the elementary education level which is at the concrete operational development stage according to Piaget's theory.[12] In addition,

the guided inquiry approach has been widely applied in education to present material that is more relevant to literacy skills, so that students feel more connected to the content being studied. Studies show that the application of interactive digital media and the guided inquiry approach can improve students' science literacy.[2,14] This innovation combines canva and heyzine technology with the guided inquiry approach which has not been widely used in science education materials in elementary schools, resulting in e-modules that are not only interactive but also contextual.

This study aims to develop a prototype of an e-module based on guided inquiry for science education using Canva and Heyzine. By combining the interactive capabilities of digital technology with responsive content, this study seeks to create learning media that are not only interesting and effective but also aligned in improving science literacy skills. This innovation overcomes the limitations of traditional textbooks and offers a path to transform science education into a more impactful and meaningful learning experience for elementary school students.

METHOD

This study uses a descriptive qualitative research methodology with a focus on designing and testing the feasibility of a guided inquiry-based science e-module prototype in improving students' science literacy. This methodology involves observing and describing qualitative data to provide insight into events, phenomena, or social situations, as described by relevant literature. The type of investigation used is descriptive because it aims to systematically document and analyze the design and validation process.[15]

This project was implemented in October 2024 to February 2025 in public elementary schools in Palembang City, South Sumatra, Indonesia. The timeline includes the design stage, expert validation, and data analysis. The term prototype in this context refers to the initial version of the e-module created to test the feasibility of integrating scientific literacy into science learning.[16] The guided inquiry approach is defined as a pedagogical framework that incorporates life phenomena into science learning.

The research began with a needs analysis to identify the specific needs of elementary school students and teachers for science materials. This stage involved reviewing the current curriculum and observing classroom practices to ensure that the digital book prototype would effectively meet educational objectives. In the prototype design stage, the e-module was developed using the Canva and Heyzine applications. This design included interactive elements such as hyperlinks, animations, and multimedia content to increase user engagement. The Guided Inquiry approach was applied to integrate life phenomena into the content, making the material more relevant and meaningful to students. The next stage was validation by experts, involving two groups of professionals. Media design experts assessed the readability, usability, and interactivity of the e-module, while science education content experts evaluated the alignment of the material with curriculum standards and the accuracy of the science principles presented. For data collection and processing, the researcher used a validation checklist and evaluation rubric. The experts provided quantitative scores and qualitative feedback based on certain criteria. The collected data was stored securely in a database and analyzed thematically to identify strengths and areas for improvement in the prototype. Finally, the data presentation stage involves depicting the results to provide a comprehensive picture of the feasibility of the prototype and its potential effectiveness in improving students' scientific literacy towards life phenomena in science learning.[17]

RESULT AND DISCUSSION

According to Pratiwi[12] e-modules are publications consisting of text, images, videos, sounds and published in digital form that can be read on a computer or other electronic device. E-modules are modules published in digital form, and displayed in flipbook form. Furthermore, e-modules are modules that are arranged, converted, and published in digital format, and can be read or displayed using electronic devices. On the other hand, Pedaste[18] added that e-modules can make it easier for users to turn pages, access thousands of titles, the price is relatively cheaper or even free, so there is no need to worry about availability.

E-modules offer several advantages, including their ability to mimic the page-turning experience of a physical book, their capacity to incorporate multimedia elements (e.g., animation, video), interactivity, and engaging layouts that enhance students' motivation and literacy skills. In addition, e-modules provide access to a wider range of titles at a more affordable price, or even for free, with widespread availability that is not limited by physical boundaries.

One of the applications for creating e-modules is Canva and Heyzine, which allows educators to develop interactive learning materials. This application allows users to design a module and convert PDFs into interactive flipbooks enriched with multimedia elements such as audio, animation, text, video, and flash. Some important advantages of this application are its ability to produce attractive designs and interactive publications, provide a variety of templates, support various types of media, and offer flexible output options. For example, the integration of interactive multimedia into Heyzine improves the understanding and engagement of elementary school students during the learning process. Similarly, research by Firdayanti found that the use of Canva and Heyzine in science education significantly improved students' conceptual understanding and literacy.[19]

In the context of learning using guided inquiry, this approach has been shown to increase the relevance and equity of education by incorporating students' life phenomena into the learning process.[20] Guided inquiry encourages the integration of elements of life phenomena into teaching materials, which are very important for human life. For example, research by Concanon revealed that guided inquiry, when applied in science studies, increased students' awareness and literacy skills.[2] Similarly, Kahar reported that guided inquiry-based e-modules encouraged greater student engagement and understanding by presenting content that was aligned with life experiences and the context of existing phenomena.[14]

The combination of canva and heyzine with a guided inquiry approach is an innovative solution to current challenges in education. By utilizing design and multimedia capabilities that can embed relevant content in real terms, educators can create interactive, engaging, and contextually meaningful modules. Research by Ramadhan shows that guided inquiry-based e-modules

developed using canva and heyzine significantly improve student learning outcomes in science learning, especially in areas related to phenomena that exist in life. The combination of interactive digital media and guided inquiry increases student participation and their literacy to connect learning materials with real-world experiences.[21]

The integration of guided inquiry into digital learning media is in line with the goals of 21st-century education, which emphasizes the creation of an inclusive and realistic learning environment. The capacity of Canva and Heyzine to embed multimedia elements, such as video phenomena, further supports this goal. As highlighted by Selpi Susilawati et al., interactive e-modules based on guided inquiry provide a platform to promote literacy, making them a powerful tool to transform basic education in Indonesia.[11]

This e-module prototype was developed using Canva and Heyzine, a powerful application for creating interactive e-book designs in PDF format and converted using Heyzine into a flipbook. This software allows developers to combine various multimedia elements, such as audio, video, text, and flash, so that the content is more attractive to users. In addition, Canva and Heyzine support various output formats, including those that are friendly for all mobile phones. This application is also equipped with a page editor, which allows developers to easily embed multimedia components into e-modules.

E-modules, also called electronic modules, function as environmentally friendly teaching materials by reducing paper usage. E-modules are very effective as interactive learning tools because they are integrated with multimedia features. For this project, e-modules were designed to increase the interactivity and engagement of science materials by combining visual and auditory elements to support a variety of learning styles.

At the e-module design stage, researchers need to create flowcharts and e-module designs via Canva and Heyzine. The flowchart in figure 1 illustrates the interactive learning flow in the Science e-module with the learning material "Photosynthesis".

1. The initial stage of this e-module is the cover. Next, users will be directed to the foreword and table of contents. The cover functions as the opening display of the e-module and provides general information about the e-module.
2. After the title page, users will arrive at the e-module usage instructions sheet and continue with the menu of learning achievements and objectives related to photosynthesis.
3. In the next section, users are given an apperception sheet in the form of a song related to the learning material.
4. The Content section presents a science material that is in elementary school, namely photosynthesis. This material discusses a process that is most important in the life of living things, namely a process that produces glucose and oxygen. Before entering into the core discussion, this e-module introduces plants as a whole.
5. After studying the photosynthesis material, users can see a simple experiment that shows that the process of photosynthesis really happens.
6. After studying the material and seeing a simple experiment, users are directed to questions that are relevant to the material being studied.
7. After working on the questions, users will get evaluation results.
8. Based on the evaluation results, if the user gets good results, the user will be directed to the Enrichment section. This section provides more in-depth follow-up material. Meanwhile, if the results are not good, users will be directed to Remedial. This section contains repetition of material that aims to help users relearn the material that has been presented in the form of quizzes.

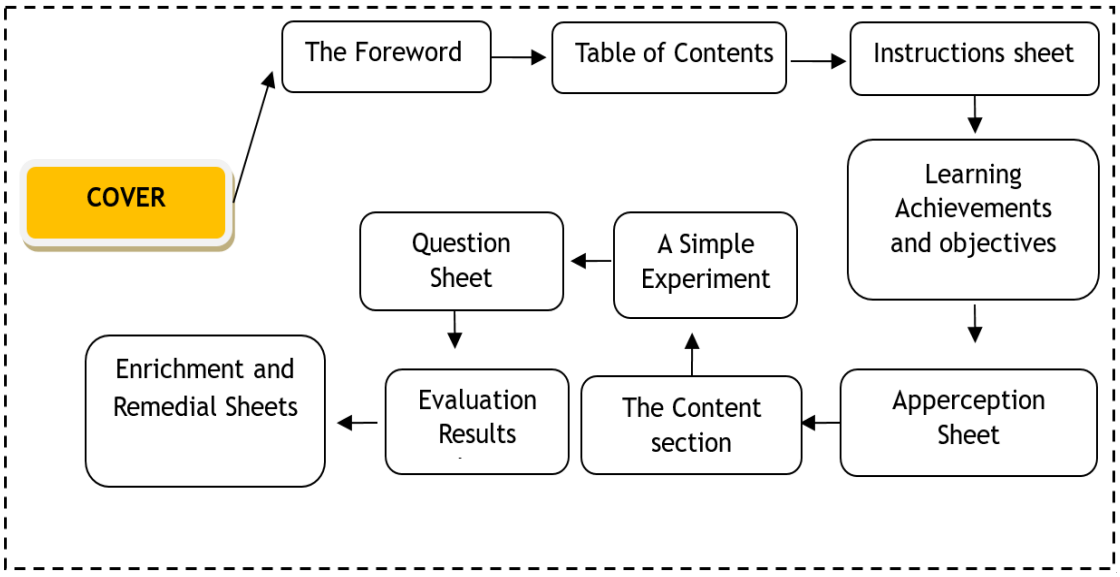

Figure 1. Science E-Module Design

The e-module diagram is designed to provide an adaptive and interactive learning experience. It is hoped that this design can increase students' scientific engagement and literacy in science learning, by providing space for them to learn independently according to their respective levels of understanding. After creating the flowchart, the researcher then created an e-module design using Canva and Heyzine.

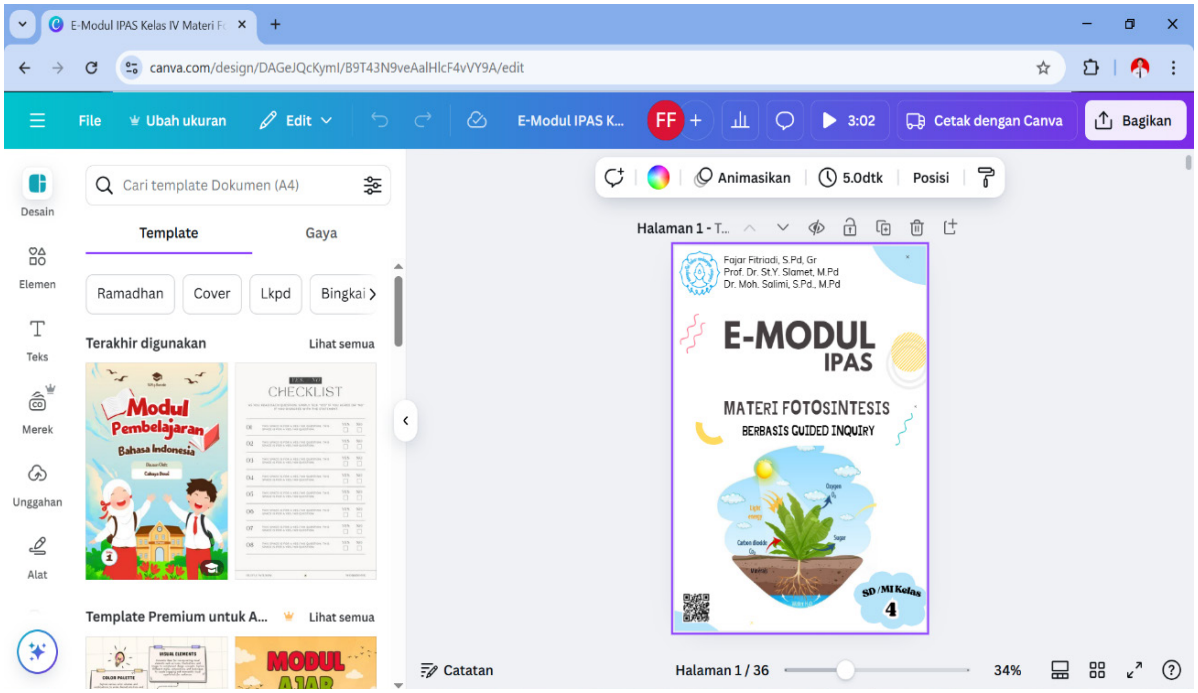

Figure 2. Canva application in e-module design

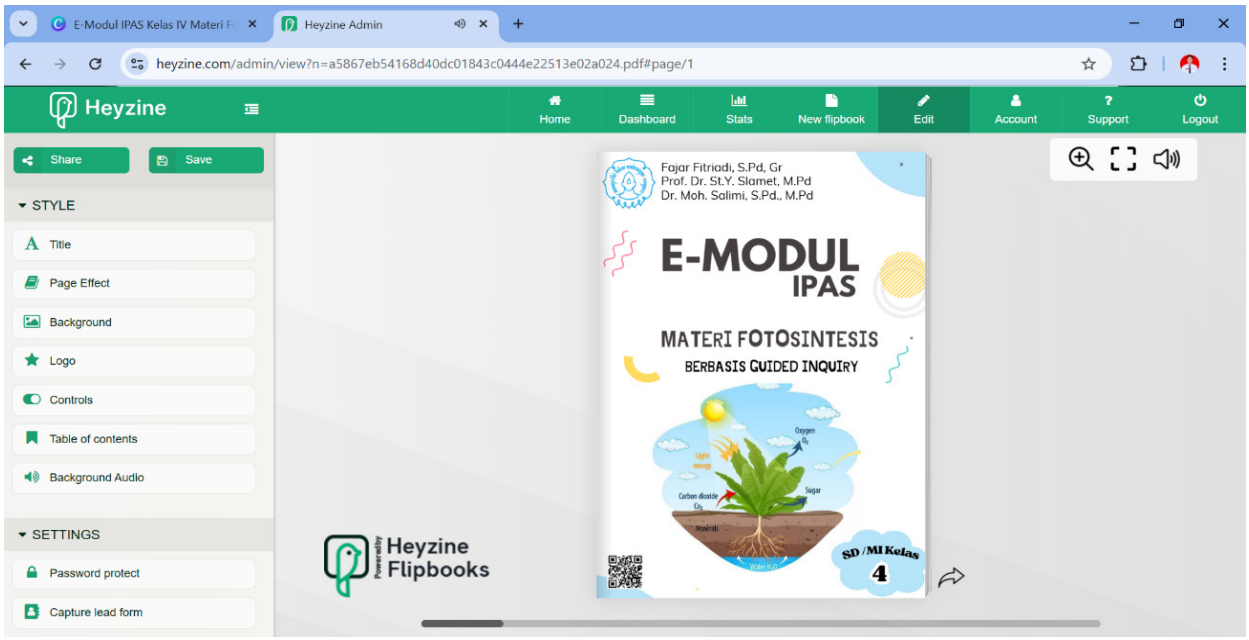

Figure 3. Heyzine application in creating e-modules

Based on figures 2 and 3, this study designed a digital book using the Canva and Heyzine applications. Several aspects that need to be considered in this design are as follows.

1. User Interface: Heyzine provides several customizable settings, such as templates, languages, page-turning animation speed, and display mode. Through these settings, users can learn according to their learning speed.
2. E-Module Content Design: The digital book cover displays scientific elements such as plants, sunlight, carbon dioxide, oxygen, and chlorophyll. These elements represent important components in the process of photosynthesis
3. Interactivity and video: Heyzine provides a page-turning feature with customizable animations. This can provide a more interactive and engaging learning experience. This book also provides options for displaying a full-screen menu, zooming in/out, and page search, making it easier for users to explore and find the information they need more efficiently.
4. Self-Evaluation and Learning Features: Heyzine supports the addition of interactive elements such as practice questions in the form of quizzes. The quiz is packed with a gamification system, making it more interesting and fun. Users can also do the exercises repeatedly, according to their needs.

Overall, the design of the science e-module using canva and heyzine aims to create teaching materials that are more interesting,

interactive, and relevant to existing phenomena. This design is designed to be easily accessible and understood by elementary school students, and encourages their active involvement in studying the phenomena that occur around them.

This study uses a questionnaire instrument to assess the feasibility of a guided inquiry-based science e-module using canva and heyzine designs. This questionnaire was assessed by three validators, namely media experts, language experts and material experts.

1. Validation Results by Media Experts

The science e-module based on questioned inquiry was validated by a media expert named Dr. Eka Budhi Santosa, ST., M.Pd. and obtained a total score of 83 with an overall average of 3,33 on a scale of 4 which is included in the category of "suitable for use". This assessment includes four main aspects.

a. The program guide aspect obtained an average score of 3,4 with a good category. This shows that the science e-module prototype is considered clear in providing instructions for use, the language used is easy to understand, the images and symbols are clear.

b. The Program Objectives aspect obtained an average score of 3,1. This shows that the science e-module prototype is considered to provide clarity in terms of learning objectives. Provides clarity in terms of indicator formulation, suitability with material content, and is consistent in providing objectives and material content.

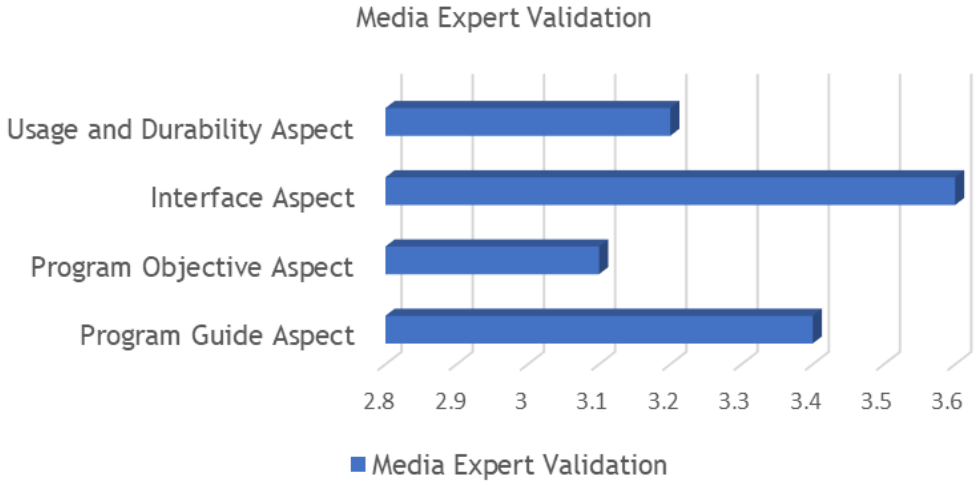

Figure 4. Media Expert Validation

c. The Interface aspect obtained an average score of 3,6. This shows that the science e-module is considered clear in providing an appearance that is in accordance with the characteristics of elementary school students. Consistent use of color, typography, layout, and navigation creates a harmonious appearance and helps students understand the material better.

d. The Usage and Durability aspect has an average score of 3,2. This shows that the science e-module is considered appropriate for the cognitive and psychological development of elementary school students. This aspect is important to ensure that this learning media can be used optimally to support student development.

2. Validation Results by Material Experts

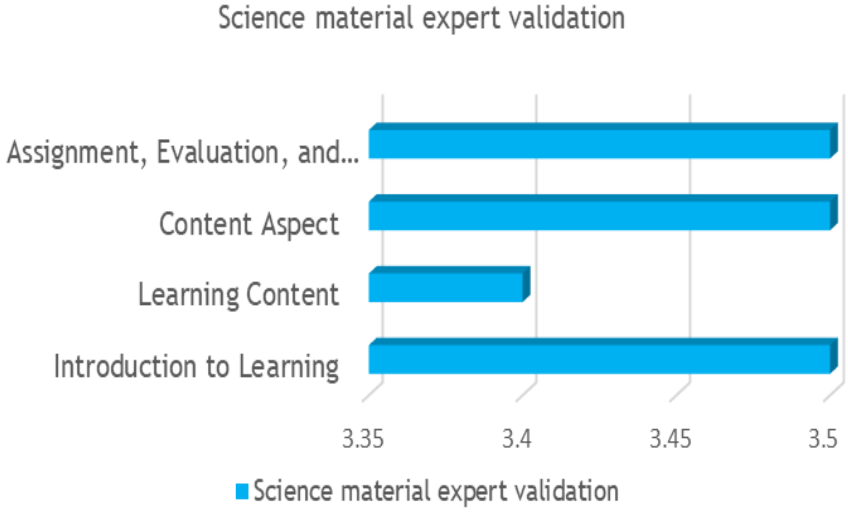

Figure 5. Science material expert validation

The validation results from the material/content expert by Dr. Alpahmi Aji Satria, M.Pd. showed a total score of 87 with an overall average of 3,47, also included in the "suitable for use" category. This assessment includes four main aspects.

a. Introduction to Learning, has an average score of 3,5. This shows that the guided inquiry-based science e-module is in accordance with the instructions for use, steps in learning preparation, the accuracy of the application of learning strategies, and the completeness of the introductory components.

b. The Learning Aspect has an average score of 3,4. This shows that the guided inquiry-based science e-module is in accordance with the material in the independent curriculum, learning achievements and indicators, the accuracy of the material, and the attractiveness in motivating students.

c. The Content Aspect has an average score of 3,5. This shows that the guided inquiry-based science e-module can be easily understood, and the summary of the material included makes this e-module more comprehensive. This e-module has the potential to improve students' scientific literacy skills, which is in line with the objectives of science learning.

d. The Task, Evaluation, and Assessment aspects have an average score of 3,5. This shows that the guided inquiry-based science e-module can be easily understood in working on practice questions, questions are presented comprehensively, the appropriateness of the difficulty of the questions and clarity in the evaluation in providing problem solving. This e-module has the potential to improve students' scientific literacy skills, which is in line with the objectives of science learning.

3. Validation Results by Indonesian Language Experts

Figure 6. Validation Results by Indonesian Language Experts

The validation results from linguists by Dr. Septi Yulisetiani, M.Pd. showed a total score of 75 with an overall average of 3,0, also included in the category of "suitable for use". This assessment includes four main aspects.

a. Good and correct Indonesian, has an average score of 3,0. This shows that the guided inquiry-based science e-module is in accordance with PUEBI rules and the use of language is in accordance with PUEBI rules.

b. The Terminology aspect has an average score of 3,0. This shows that the guided inquiry-based science e-module uses terminology that is in accordance with the topic in the e-module.

c. The Language Clarity aspect has an average score of 3,0. This shows that the guided inquiry-based science e-module uses simple, straightforward, and easy-to-understand language for students.

d. The Language Suitability aspect has an average score of 3,0. This shows that the guided inquiry-based science e-module uses communicative language and develops students' thinking skills in understanding concepts. This e-module has the potential to improve students' scientific literacy skills, which is in line with the objectives of science learning.

Based on validation from media experts, material experts, and language experts, it can be concluded that this e-module prototype can be developed and is suitable for use as a learning medium for science education at the elementary school level. Overall, this study shows that e-modules based on Guided Inquiry can be an alternative solution in science learning in elementary schools.

Of course, the development of e-modules has a basis such as Piaget's theory which states that elementary school students are at the concrete operational stage, which is the stage where they learn better through real activities.[22] Therefore, interactive and visual learning media such as guided inquiry-based e-modules are very appropriate for the cognitive characteristics of students at this stage. Animation, video, and flipping features on e-modules allow students to visualize the material more realistically and in line with the principles of constructivism.

In addition, the Guided Inquiry learning model is integrated into the design of this e-module. This e-module is also based on the theory of the relevance of phenomena in the learning process. Learning that is responsive to phenomena makes students feel recognized and appreciated, so that it can increase learning motivation. The use of elements of phenomena in everyday life in this e-module aims to make science education materials more contextual. In other words, Guided Inquiry learning not only enriches

students' understanding of science, but also strengthens students' emotional attachment to science literacy.

The findings of this study are in line with previous studies, such as the Muhajir study which emphasized the effectiveness of responsive teaching to existing phenomena in improving students' scientific literacy.[23] However, our study extends this framework by combining the design features of Canva and Heyzine. While previous studies have mainly focused on theoretical implementation and using other applications, our study shows its practicality and impact when embedded in a Guided Inquiry-based science e-module.

An important difference between this study and previous works is the integration of everyday phenomena into multimedia content, namely e-modules. For example, animations depicting the process of photosynthesis where plants absorb carbon dioxide and release oxygen or interactive quizzes based on phenomena that students experience. Not only does it enrich the learning experience but it also creates an emotional connection with the material. This addresses one of the criticisms of traditional digital textbooks, which often lack realistic context and interactivity.

Furthermore, while Muhajir[23] and Adolph[9] reported increased student engagement in learning, our findings suggest that the inclusion of multimedia elements amplified this effect. The use of canva and heyzine allows for a more dynamic and personalized learning experience, tailored to different learning styles. This is especially important for primary school students, as Piaget's theory highlights the importance of concrete and visual representations at the operational stage of cognitive development.

The importance of concrete and visual representations at the operational stage of cognitive development. Despite its strengths, this study has limitations. First, the focus on Science Education in Indonesia may limit its generalizability to other subjects or countries. Furthermore, although Indonesian media, content, and language experts validated the e-module, further empirical testing with a wider student population would provide stronger evidence of its effectiveness. Future research could explore the scalability of this approach and its applicability to diverse settings or disciplines.

In conclusion, this study contributes to the growing literature on digital learning and phenomenon-responsive teaching by demonstrating the practical integration of Guided Inquiry with interactive multimedia. By addressing the unique context of everyday phenomena and leveraging technology, this approach not only enhances learning outcomes but also promotes awareness and appreciation of science. These findings underscore the potential of guided inquiry-based e-modules as transformative tools in modern education, particularly in fostering inclusivity and equity in diverse learning environments.

CONCLUSIONS

This innovation shows significant potential in improving the quality of Science Education at the elementary school level. With its interactive design, content relevant to everyday phenomena, and easy-to-use access, this e-module serves as an effective alternative to support learning in the digital era. For media developers, it is recommended to integrate adaptive learning features to personalize content delivery, while educators are encouraged to use this e-module in conjunction with practical activities that strengthen students' science literacy. Future research can focus on measuring the impact of this digital book on student learning outcomes and exploring the application of the Guided Inquiry learning model in other subjects.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION

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Research: Fajar Fitriadi.
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Software: Fajar Fitriadi, St. Y. Slamet, Moh. Salimi.
Supervision: Fajar Fitriadi, St. Y. Slamet, Moh. Salimi.
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Display: Fajar Fitriadi, St. Y. Slamet, Moh. Salimi.
Drafting - original draft: Fajar Fitriadi, St. Y. Slamet, Moh. Salimi.
Writing - proofreading and editing: Moh. Salimi.

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