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Development of BIDIBO (Biology Digital Book) Based on Digital Flipbook Related to Mangrove Food Processing as a Learning Medium for Students

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Abstract

This study aimed to develop BIDIBO (Biology Digital Book) based on Flipbook Digital as a learning medium, specifically about mangrove food processing. This study also aims to determine the feasibility of the developed product and students' responses to the use of the Biology Digital Book. The research method used is the Research and Development (R&D) method. The research was conducted from June to November 2024 at a senior high school in Serang City, Indonesia, and a state university in Banten, Indonesia. The feasibility assessment by subject matter experts on BIDIBO obtained a score of 90%, while the assessment by media experts obtained a score of 95%. Both scores are rated as highly feasible. The student acceptance of the use of BIDIBO was rated at 90.8%, also within the range of high feasibility. Hence, it could be inferred that the Digital Flipbook based on BIDIBO on mangrove food processing is highly feasible for an educational media, especially for the issue on biological diversity.

Keywords: Digital Biology Book (BIDIBO), Digital Flipbook, Mangrove Food Processing, Learning Media, Research and Development (R&D)

INTRODUCTION

One of the most important supports for the progress of a country is the quality of the learning and teaching, and its significance is becoming more and more appreciated around the world. In the field of biology study, technology provides fascinating space to create learning material that differs from the conventional ones, namely interactive instructional media, interesting, and easily to be understood by the students (Anugrah et al., 2024). One increasing popular technology in educational settings is electronic books (Khomsiyatun et al., 2022) that provide more flexibility as well as access compared to printed books (Alsalhi et al., 2020; Merkle et al., 2022). One variety of new type of digital book that has been getting a lot of attention is called a digital flipbook, which offers a more interactive reading experience where it feels like you are flipping the pages of a real book. This type of technology has the potential to support students in an interactive and fun manner to get access to learning content (Adnan, 2020).

Alternatively, Indonesia is a rich biodiversity country which had a huge natural potential and had not yet been exploited in education context (Middleton et al., 2024). Among these natural resources is the ecosystem of mangrove that besides having a relevant role in the preservation of natural resources, has a potential to be used as food (Tagulao et al., 2022). Mangroves are also known as forests mangroves that contain a variety of plants that are

beneficial to human life, among others, as a high-nutrition food source, (Afifah et al., 2024; Verawati & Idrus, 2023). The use of mangroves as food sources (Owuor et al., 2024), despite of initiating in recent years (Kurniadi & Koeslulat, 2020), perhaps only for certain groups and has yet to be integrated in a wider education curriculum (Menéndez et al., 2020).

To address this issue, an effort which is able to link between Indonesia's natural potential (Pattiasina et al., 2024; Verawati & Idrus, 2023), i.e., mangrove, and the education process at school is required (Prabowo et al., 2024). Students are not only given a new understanding of the value of natural resource diversity, but also learn a rationale regarding the reason for the conservation of ecosystems through wise use (Afifah et al., 2024; Minata et al., 2024). One of the methods that can be used is media-based learning technology that involves knowledge and understanding about mangrove ecosystem into biology learning more widely (Wardhani et al., 2022).

In this context, the creation of Biology Digital Book (BIDIBO) using digital flipbook model and the insertion of mangrove food processing topic as one of the contents of biology learning material is quite relevant. It is our hope that this digital book will help students learn more about mangroves, how they can support ecosystems, and just how much they can offer in terms of our food resources. It also is a good book for theoretical information, and for practice; the book guide us to real our every day life that can makes student aware to significance of ecosystem diversity that exist in Indonesia. Thus, in this study an interactive digital book based on flipbook for biology is created, the purpose is to be a learning medium that can teach students about mangrove food processing effectively.

The issue raised in this research is, how to develop an effective and interactive learning media able to enhance the understanding of biological concepts, especially in the aspects of using the food potential of mangroves (Purwoko et al., 2022; Asrizal et al., 2018). The science theory material that is not related to the reality of biological theory is a challenge for students learning biology (Awaliyah et al., 2023; Sugandi & Kurniawan, 2024). Thus, it is required not for conventional material deliverer but also innovative in delivering materials which can connect theoretical knowledge and practical applications in the field (Awaliyah et al., 2023). The digital flipbook-based book to be developed in this study intends to alleviate this problem by presenting biology materials in a novel manner that is both appealing to the students and connected to their everyday contexts (Owuor et al., 2024; Vaslet et al., 2015).

The hypothesis examined in this research is that a digital flipbook-based BIDIBO which contains the information of mangrove food products could enhance the students' understanding towards the biology's materials and increase the students' awareness on the

conservation and sustainable use of the mangrove ecosystem (Ningsih et al., 2023; Sari & Filayani, 2023). It is also expected that this digital book can help to guide students in constructing critical, analytical, and creative thinking in understanding the concepts of biology (Rosviani et al., 2022; Widiati, 2025).

To realize these purposes, the research uses a development design, concentrating in designing and making of a digital flipbook titles. This e-book will incorporate a number of interactive activities for your students to engage in as well as provide them with applications for video content, images, readings, and more. This book will also contain a number of case-studies of mangroves processed food products that will give the practical application of the approaches to biology explained. Then not only will students learn the textbook explanation of mangrove communities and how food is processed, they will also experience first hand how biology is practiced on a daily basis.

This research targets to design a flipbook-based digital book which could be an effective and interesting learning media that can be appropriate for the level of student in accordance with the subject of mangrove foods process (Alsalhi et al. 2020; Anugrah et al. 2024). It is anticipated that this book will enhance the comprehension of the significance of mangrove transactions among students (Liando et al., 2022) their ecological as well as food importance. Moreover, this digital book also intends to make biological materials more interesting and interactive so that students are motivated to learn biological material (Hidayat et al. 2023; Sari & Filayani, 2023).

In the literature, there has been numerous research on technology in education (Ayub et al., 2023; Kurniadi & Koeslulat, 2020), however, a gap is still obvious in the development of learning media that integrate technology with local content of the diversity of natural resources in Indonesia, particularly on the mangrove ecosystem context (Husain et al., 2020; Ikrianibangga et al., 2023). Generally, the current literature tends to pay less attention to the technology to teach common ideas of biology (Budiyanto et al., in press; Husain et al., 2020) without the advanced theme to support them, such as the ability of mangrove as a food sources (Bayu et al., 2016; Mustikasari & Norwanto, 2018). This study intended to overcome this gap by developing learning media that links biology with environmental and conservation issues which are a very crucial in Indonesia.

The novelty of this study lies in the development of technology-based learning media that includes topics closely related to those concerning the natural and environmental conditions of Indonesia (Basyuni et al., 2021). Particularly, when taking into consideration the use of digital flipbook and content related to mangrove and food processing (Gitgeatpong &

Ketpichainarong, 2022), this study provides a valuable contribution on the effectiveness of contemporary learning medium which guides behavioral foundation for the conservation of the environment through deep understanding among the younger generation (Husain et al., 2020).

The purpose of this study examines students' perceptions on the use of digital flipbook based on mangrove food processing material in learning biology in seconday school level (Klingenberg et al., 2020). The main concern is whether this medium is effective in improving the students' understanding about biological concepts of the mangroves, and in instilling the students' awareness in the conservation of such environment (Tagulao et al., 2022). The analysis of teaching media will be done by determining students' understanding level before and after using digital book as media of learning (Minata et al., 2024, Verawati & Idrus, 2023).

In related literature, it has been described how the inclusion of technology in the teaching of biology has been investigated (e.g., the creation of digital books and multimedia learning material) and how these promotion and scaffolding of a captivating educational process (Gitgeatpong & Ketpichainarong, 2022; Menéndez, et al., 2020). Furthermore, the literature on the role of technology for the teaching of subjects on biodiversity and environmental conservation is also expanding (Basyuni et al., 2021). Nevertheless, there are still limited studies on the integration of biological concepts and the possibility of mangrove food as media for learning technology, hence this research, whose findings aid in enriching the literature (Husain et al., 2020; Pegalajar-Palomino, 2022).

In summary, this research pursues the creation of a digital flipbook designed to help students engage in life science concepts in a more situated and interactive manner. Using technology as learning resources, we hope it would help students to understand and apply the understanding and knowledge of biology in their everyday-life situation and would also increase the awareness of the importance of mangrove ecosystem conservation for the future.

METHOD

This study used a Research and Development (R&D) method. The research design adapts (Sugiyono, 2018) the development model, which consists of ten stages, namely: potential and problems, data collection, product design, design validation, design revision, product testing, product revision, usage testing, product revision, and mass production. However, in this study, only six main stages were conducted: potential and problems, data collection, product design, design validation, design revision, and product testing. This

adjustment was made to optimize the development process of BIDIBO until it reaches a stage where the product is suitable for use in student learning.

RESULTS AND DISCUSSION

The BIDIBO (Biology Digital Book) learning media, based on Digital Flipbook on biodiversity, particularly the advantages of mangroves as food products, is a product of research and development conducted by researchers by adapting Sugiyono (2018) model development procedure, which was modified according to the needs. The final product of this research is a digital book based on Flipbook that can be accessed online and developed through six stages of research and development procedures, namely:

1. Potential and Issues

The development of digital learning media such as BIDIBO is very important to help students understand biodiversity material, especially when facing difficulties with complex scientific terms, although specific data on the percentage of these difficulties cannot yet be presented conclusively (Kharom et al., 2020). Media such as digital comics and educational games have proven effective in enhancing students' understanding in an interactive manner (Basyuni et al., 2021), as well as increasing student engagement in the learning process (Rosyid et al., 2024). The use of digital learning media is also in line with technological developments and relevant curriculum requirements (Susanti et al., 2020). However, low use of digital media by teachers can have a negative impact on student motivation and engagement, especially when a lack of innovation causes learning to become monotonous and uninteresting (Sukma & Handayani, 2022; Nofriyandi et al., 2023). Unskilled teachers also find it difficult to use digital media properly, thus will diminish student comprehension (Nofriyandi et al., 2023; Prasetyo & Zulherman, 2023). On the other hand, the use of innovative digital media has the potential to lead to a more interactive learning process as well as better learning results (Mulyosari & Khosiyono, 2023; Widiastari & Puspita, 2024). Accordingly, teachers should be developing their ability to implement educational technology in order to improve student motivation and achievement (Bakri and Permana, 2022, Kamlin and Keong, 2020) as well as to visualize biology concepts in an interesting way by interactive digital media (Bakri and Permana, 2022, Mulyosari and Khosiyono, 2023).

There are studies that show integration of the digital technology for biology learning has been found to increase learners' motivation as well as help learners using innovative learning and also can reduce the boredom in learning process in the classroom (Sari & Filayani, 2023). Interactive simulations, educational videos, and e-learning applications are successful at

enhancing students' learning and engagement, especially in challenging topic, such as biodiversity (Ayub et al., 2023; Ikrianibangga et al., 2023). With the presence of technologies like AR, VR, and virtual-simulation now, learning the intricate biology concepts becomes a bit easier for students to visualize and interactive better, thus leads to more profound understanding among students (Maisyura et al., 2021; Widiastari & Puspita, 2024). It also enables collaborative work and has more flexibility in access to materials, allowing for self-directed learning and scientific discourse (Wardhani et al., 2022). Thus, the presence of the responsive and interactive digital media application, BIDIBO is a strategic alternative to improving the quality of biology learning in school, which is covered through the needs and learning style of the students (Roemintoyo & Budiarto, 2021).

2. Data Collection

Data collection was implemented for the purposes of the construction of BIDIBO content which meets the needs of students and teachers. It comprises needs analysis, macro and micro curriculum analysis, and a selection of materials from the relevant sources. To ensure that resulting media products support the achievement of the Basic Competencies (KD) described in the curriculum.

3. Product Design

The design of BIDIBO was developed based on the results of a needs analysis. This product includes various interactive features such as text, illustrative images, explanatory videos, Quizizz-based quizzes, and augmented reality stimuli through the Zappar platform (Figure 1). This media was designed using Canva Professional for visual design and FlipHTML5 for the flipbook platform, enabling students to access it with an interactive digital book-like interface. BIDIBO can be opened on laptops or smartphones with an internet connection to access additional features such as videos and quizzes.

Figure 1. BIDIBO Design

4. Design Validation

Design validation was conducted by six experts, consisting of three biology experts and three learning media experts. The validation instrument used a Likert scale. The subject matter expert validation process assessed three components: curriculum, content appropriateness, and language. The results of the subject matter expert validation (Figure 2) showed that the language aspect scored 93%, the content appropriateness aspect 89%, and the curriculum aspect 88%, with an overall average of 90%, categorized as highly appropriate. This validation is necessary in order to make learning media content-appropriate, correct, interesting, easily understandable, and contextual, so that it can improve the effectiveness of learning biology, and stimulate the students to be creative and innovative (Wahyuni et al., 2019; Winaryati et al., 2021). Furthermore, media of learning with illustrations of images or animations relevant to the context of learned material can help students understand material in the learning activity.

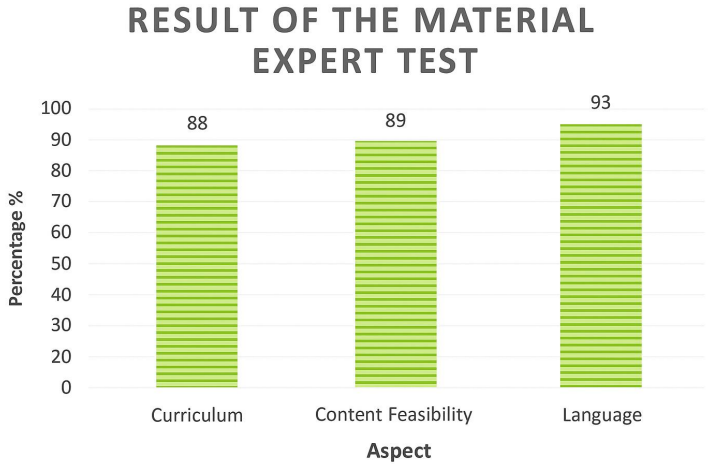

Figure 2. Results of Expert Validation Test

Furthermore, in addition to subject matter expert testing, media expert validation testing was conducted to examine the presentation and graphics of the digital biology textbook. The components evaluated by the media expert validation include interface design, content design, image and video appropriateness, as well as product anatomy and programming. The results of the media expert validation (Figure 3) show that the programming aspect received the highest score of 100%, while the interface design aspect received the lowest score of 90%, with an overall average of 95%, categorized as highly suitable. This validation ensures that the developed learning media not only meets academic standards but also receives positive evaluations supporting its suitability as an innovative and interactive learning tool (Fajarianingtyas & Hidayat, 2023; Sarumaha, 2023). Additionally, learning media that include

illustrations such as images or animations relevant to the taught material can facilitate students' understanding of the material during the learning process (Firmansyah *et al.,* 2022).

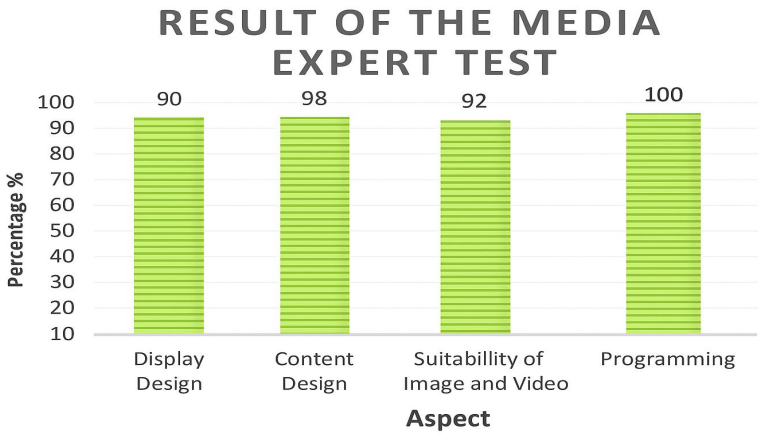

Figure 3. Results of Media Expert Validation Test

5. Design Revision

The design was revised to improve the BIDIBO product based on Flipbook Digital based on the results of evaluations and input from subject matter experts and media experts, so that the learning media developed meets the criteria for content, language, visual appearance, and better interactive functionality. These revisions were made to ensure that the product is more representative of the basic competencies being taught, improves readability and student understanding, enhances the quality of illustrations, and ensures consistency in the presentation of content relevant to the theme of mangrove food processing in the biodiversity material. Several revisions have been made based on input from experts. Revisions from subject matter experts include improvements to question wording, additions to conceptual material completeness, and alignment of illustrations with content. Input from media experts includes improvements to the cover illustration to better represent the content of BIDIBO, filling empty spaces on book pages, and replacing images with higher resolution.

6. Product Testing

The product trial was conducted on a limited scale involving 20 students and 2 biology teachers at a high school in Serang City, Indonesia, selected at random. Based on the user response test results (Figure 4), the media obtained the highest score of 92.1% in terms of usefulness, while the language aspect received the lowest score of 88.2%. Overall, the average user response score was 90.8%, indicating that the BIDIBO-based Flipbook Digital on mangrove food processing is highly suitable for use in biology lessons on biodiversity. These results emphasize the importance of developing digital learning media that are not only

aligned with the curriculum but also engaging and beneficial for students and teachers in enhancing learning effectiveness (Sarumaha, 2023).

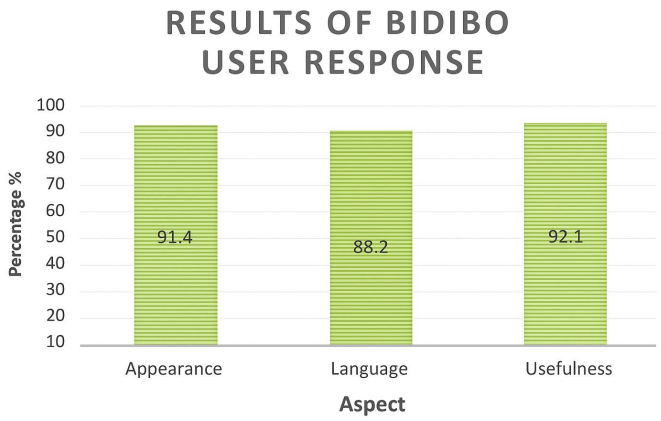

Figure 4. Results of BIDIBO User Response Test

CONCLUSION

This study successfully developed a Flipbook Digital-based BIDIBO on mangrove food processing as a learning medium. The development was carried out by following Sugiyono's six design stages, namely potential and problems, data collection, product design, design validation, design revision, and product testing. Expert and media experts validation demonstrated its adequacy with a score of 90% and 95%, respectively. A pilot study with 20 students and 2 biology teachers indicated high interest. Average rating in user feedback was 90.8%, thus indicating a good acceptance of the product. Therefore, the learning medium is innovative and also feasible, and can help the quality of contextual biology education referring to technological progress.

SUGGESTIONS

Based on the findings in this study, it is suggested for future studies to replicate the BIDIBO trial involving larger groups of students and teachers from other schools to determine more generalisable insights of its effectiveness across learning contexts. Future work can also involve incorporation of more complex interactions in BIDIBO like gamification to enhance students' engagement and motivation.

Furthermore, this research could also be used as a stepping-stone for producing other digital learning materials, e.g. ecosystems and climate change content with interactivity and engagement. Other digital technologies, for instance augmented reality (AR) or virtual reality (VR), might also be applied to enable more immersive and successful experiences for learners. It is anticipated that the adoption of these recommendations will contribute to the emergence of novel biological teaching approaches, reflecting the increasing influence of the technology.

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