Development of *EKSIS* (*ebook ekosistem*) to introduce the ecosystem concept in class 3 elementary school

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Article info	Abstract
Keywords: ebook, ecosystem, instructional media, digital learning, elementary school	This study aims to develop and validate the EKSIS product, a learning media based on ecosystem materials designed to introduce the concept of ecosystems to third-grade elementary school students. The research method used is Design and Development (D&D), with the ADDIE development model consisting of five stages: Analysis, Design, Development, Implementation, and Evaluation. The validation instrument consists of a five-point Likert scale assessment sheet to measure the quality of the product from two main aspects: product design and content material. The validation results show that EKSIS received an average score of 5 for both assessed aspects, placing it in the "excellent" category. The product was deemed relevant to learning needs, supported curriculum achievements, and had an effective design that engaged students and enhanced their understanding of ecosystem materials. Based on these findings, EKSIS is considered suitable for use in the learning process. The use of this product is expected to help introduce the concept of ecosystems and provide an engaging and in-depth learning experience for students. This research significantly contributes to developing innovative learning media that align with educational needs in the digital era.

1.   Introduction

Education creates life situations that influence individual growth as a lifelong learning experience in all environments (Astuti, A., & Leonard, 2015). Education is one of the primary sources of information for developing human resources, particularly students' potential. Law No. 20 of 2003, Article 1, Paragraph 1, concerning the National Education System, states that education is a conscious and systematic effort to create a learning atmosphere and process that develops students' potential. This includes fostering spiritual and religious strength, self-control, personality, intelligence, noble character, and the skills needed by individuals, society, the nation, and the state.

Science education in elementary schools plays a crucial role in building students' foundational knowledge about the environment and the interconnections between natural components. One fundamental concept introduced in third grade is the ecosystem. An ecosystem includes the interaction between living organisms (biotic) and non-living components (abiotic) within an environment. Understanding ecosystems is essential for fostering students' awareness of their role in maintaining environmental balance. Learning assists students in learning more effectively (Suardi, 2018). Learning media makes the learning environment more engaging and enjoyable (Tobing et al.,

2021). Learning media is a vital component that serves as a teaching aid, facilitating educators in delivering material (Hikmah, 2022). It is an intermediary that enhances comprehension by transforming abstract concepts into concrete ones. Learning media development simplifies students' understanding, making learning more effective and enjoyable. Research is conducted to create valid, practical, and effective learning media to address students' learning challenges.

The role of learning media in education is one of the most essential components of the learning process. In today's era of globalization, teaching materials should be integrated with technology-based media to align with the advancements of the digital age. Learning is often assumed to be more effective when appropriate media are carefully selected. Learning media should be continuously developed to support the teaching process and help educators achieve their instructional objectives. Learning media can be designed and adapted to meet students' needs and learning environments, enhancing comprehension, motivation, and interest in learning.

Technology has become an inseparable part of human life, fulfilling daily needs. Technological advancements facilitate access to vast amounts of information, which can be retrieved at any time using a single electronic device, such as a smartphone (Fujianti et al., 2024). These technological developments positively impact various fields, including education (Maritsa et al., 2021). Educators must acquire technological skills, play a central role in learning, and keep pace with modern advancements. Learning must be designed to meet students' contemporary needs.

Transforming education is a highly appropriate approach to advancing science and technology in today's era (Nurkholis, 2013). Information and communication technology has become integral to daily life in the digital age. According to Susilawati and Rusdinal (2022), advancements in digital technology have led to a paradigm shift across various sectors. Education is one of the sectors significantly impacted by digital technology, fostering technology integration into the learning process (Aeni A. N et al., 2022). The rapid societal changes demand corresponding changes in the education system. As technology evolves rapidly, education must also advance. The digital era has gradually taken on a significant role in human life. Digital technology facilitates access to information and communication, even across long distances.

The rapid development of technology must be optimally utilized in education. One of the current phenomena is the close relationship between technology, particularly smartphones and Android devices, and students' daily lives. Handayani and Rahayu (2020) state that implementing learning through interactive Android-based multimedia can increase students' interest and enjoyment in learning. It also enhances students' motivation, allowing them to learn at their own pace. Teachers must innovate by developing technology-based learning media to make learning more engaging and accessible. This aligns with Ichsan et al. (2018), who argue that teachers must innovate by creating effective learning media in response to technological advancements.

One innovative approach is the development of EKSIS: an Ecosystem ebook, a learning medium that keeps up with technological advancements. Ebooks are digital versions of books that present information in text, images, or multimedia formats and can be accessed via laptops, computers, or smartphones. Ebooks require less storage space, are easy to update, and can be purchased and downloaded anytime. Using ebooks also reduces the need for paper, lowering printing costs and making them more portable (Octamela, Suweken, & Ardana, 2019). According to Nikmah et al. (2020), mobile-based media attract students' attention to learning. Moreover, ebooks offer several key benefits: They provide flexibility, as students can access them anytime and anywhere, eliminating time and location constraints in learning. They are more practical and require significantly less physical storage than printed books.

Based on the above discussion, the authors are interested in developing the EKSIS learning media to introduce the ecosystem concept in third-grade classrooms. In addition to keeping up with the digital era, this learning medium is expected to enhance student engagement and improve comprehension of ecosystem concepts. The key research questions addressed in this study are: How do design and content experts validate the EKSIS product? How does the EKSIS product facilitate students' understanding of ecosystem concepts?

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2. Literature Review

Ebooks are a form of digital learning media that can enhance students' accessibility to educational materials. According to Clark and Mayer (2021), interactive ebooks can potentially increase student engagement through multimedia features such as images, audio, and animations. In elementary education, ebooks can effectively introduce abstract concepts more visually and engagingly for young learners (Hannafin & Hooper, 2019). The use of technology in elementary education is rapidly evolving, especially in response to the challenges of the digital era, which demands innovative, flexible, and easily accessible learning resources. Therefore, the development of ebooks as a learning medium presents a promising solution to support third-grade students' understanding of ecosystem concepts.

The ecosystem is a fundamental topic in the Natural Sciences (IPA) curriculum at the elementary level. According to Novak and Gowin (2019), understanding ecosystems requires an approach that connects biotic and abiotic aspects within an environment. Elementary school children, particularly third graders, tend to grasp abstract concepts more easily through visual and interactive approaches (Piaget, 1952). Therefore, the presentation of ecosystem materials in ebooks should be carefully structured, considering children's cognitive characteristics and utilizing enjoyable and easily understandable teaching methods. A well-designed ebook can aid students in comprehending ecosystems through illustrations, simulations, and interactive narratives. Mayer (2020) emphasizes the importance of multimedia design principles in ebook development, such as dual-channel processing (the combination of text and images) and segmenting information to align with children's cognitive capacities.

Additionally, elements of gamification, such as interactive quizzes, ecosystem-based challenges, and engaging illustrated stories, can further enhance student motivation (Gee, 2008). A study by Tan et al. (2021) revealed that interactive ebooks significantly improve students' understanding of ecosystem components compared to traditional textbooks. Therefore, ebook development should incorporate pedagogical and interactive elements that promote constructive learning experiences.

Several well-established instructional design models are commonly used in ebook development for education, including the ADDIE Model (Analyze, Design, Develop, Implement, Evaluate), which is widely used in technology-based instructional design to ensure that ebooks are tailored to student needs (Gagne et al., 2018). Another framework, the TPACK Model (Technological Pedagogical Content Knowledge), integrates technology with effective teaching strategies for e-book-based learning (Mishra & Koehler, 2016). The SAM Model (Successive Approximation Model) is also valued for its flexibility and iterative process, allowing continuous content and design improvements based on user feedback (Allen, 2014). These models allow ebook development to be conducted more systematically and student-centered.

The integration of ebooks in ecosystem learning for third-grade students offers several advantages. Ebooks can increase student motivation through visually appealing and interactive features (Selwyn, 2020). They also facilitate ecosystem concept understanding using virtual experience-based approaches (Reigeluth, 2018). Furthermore, ebooks provide accessibility and flexibility, allowing students to learn anytime and anywhere (Hakkarainen et al., 2020). Additionally, ebooks help students develop critical and analytical thinking skills by presenting case studies of ecosystems in different environments, enabling them to explore the impact of environmental changes virtually (Wilson, 2017).

Despite its benefits, several challenges must be addressed in implementing ebooks in elementary education. Limited access to technology remains an issue in areas with inadequate digital infrastructure (Kirkwood & Price, 2019). Moreover, teachers require proper training to optimize the use of ebooks in the learning process (Anderson & Krathwohl, 2019). Ensuring content quality and relevance is also crucial to match third-grade students' comprehension levels (Clark & Mayer, 2021). Additionally, policy support from schools and governments is essential for ensuring technology's sustainable and effective integration into education (Selwyn & Facer, 2013). With proper instructional

design approaches and adequate technological support, ebooks can become an innovative and effective learning medium for introducing ecosystem concepts to third-grade students.

3. Method

In conducting research, it is essential to use the appropriate methodology to ensure that the study proceeds effectively. Research methodology is a scientific approach to obtaining valid data (A. N. Aeni, Juneli, et al., 2022). The research method employed in this study is Design and Development (D&D). This model is commonly used to examine designing, developing, and evaluating to establish an empirical foundation for creating products and tools for learning and non-learning activities and developing or improving models that regulate their progression. According to Fahrurrozi and Mohzana (2020), Design and Development (D&D) is a research method that is intentionally and systematically conducted to discover, refine, develop, produce, or test the effectiveness of products, models, methods, strategies, and techniques that are superior, new, effective, efficient, productive, and meaningful.

The D&D method has been widely used to develop and validate educational products, and many educators and practitioners have applied it in designing educational models and learning products (Aysyah Rengganis, 2022). Thomas & Rothman (cited in MIT, 2012) state that innovative activities are developed in several D&D research studies to generate practical solutions to problems. One such solution is the development of educational tools and products to enhance student learning outcomes, particularly in electronic-based learning media. Based on these perspectives, Design and Development (D&D) can be concluded as a research method that is systematically and deliberately conducted to refine existing products or develop new ones through testing, ensuring their validity and accountability.

Each research model follows a structured procedure from start to finish. The D&D research model features multiple procedural variations based on expert perspectives. The development model used in this study is ADDIE, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation (A. N. Aeni, Handari et al., 2022). The Analysis stage involves identifying problems and aligning research objectives. In the Design stage, the researcher determines the learning media's theme and creates its design. The Development stage focuses on building the learning media based on the researcher's ideas, followed by a validity test involving design and content experts. The implementation stage occurs after the learning media has been validated and applied in a third-grade elementary school classroom. Finally, the Evaluation stage assesses the product's feasibility and effectiveness.

This research was conducted at an elementary school in South Jakarta, with 29 students as the research subjects. The study employs a qualitative approach to describe the data obtained from the research object or subject (Maulani et al., 2022). The data collection technique involved expert judgment from media design and content specialists, while descriptive statistical analysis was used for data analysis. The tools used in product development included a laptop and a smartphone, with Canva software utilized for designing the learning media.

4. Results

Figure 1 illustrates the design of the EKSIS product, showcasing its structured and well-thought-out layout tailored to align with educational and ecosystem-related objectives. The design incorporates a harmonious blend of visual and textual elements, ensuring clarity and coherence when presenting the material. Key features include the strategic use of typography, which enhances readability and complements the ecosystem theme, and a carefully selected color palette that aligns with the subject matter, creating an engaging and visually appealing experience. The arrangement of elements within the design reflects a logical flow, facilitating ease of navigation and comprehension

for users. Overall, the design of EKSIS demonstrates a high level of intentionality and expertise, effectively integrating curriculum and ecosystem concepts into a cohesive and user-friendly format.

Figure 1. Design of EKSIS

The validation results from media design experts regarding the EKSIS product are presented in **Table 1**. The evaluation focused on five key components related to product design, each assessed on a rating scale from 1 to 5, where 5 represents the highest level of alignment or suitability. The first component examined the alignment of the EKSIS product with the curriculum used, which received a rating of 5, indicating excellent congruence. Similarly, the second component, which assessed the alignment of the EKSIS product's design with ecosystem material, also achieved a rating of 5, reflecting a strong match. The third component evaluated the alignment of the elements within the EKSIS product with ecosystem material, earning a rating of 4, suggesting a high level of compatibility. The fourth component, focusing on the alignment of typography used in the EKSIS product with ecosystem material, received a rating of 5, demonstrating exceptional harmony. Lastly, the fifth component, which analyzed the alignment of colors used in the EKSIS product with ecosystem material, was rated 4, indicating a very good fit. Overall, the expert validation highlights the EKSIS product's strong alignment with curriculum and ecosystem material, particularly in design, typography, and curriculum integration, with minor room for improvement in element and color alignment.

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Table 1. Media design expert validation

No	Component	Rating Scale				
		1	2	3	4	5
	Product Design					
1.	The alignment of the EKSIS product with the curriculum used.					v
2.	The alignment of the design of the EKSIS product with ecosystem material.					v
3.	The alignment of the elements in the EKSIS product with ecosystem material.				v	
4.	The alignment of the typography used in the EKSIS product with ecosystem material.					v
5.	The alignment of the colors used in the EKSIS product with ecosystem material.				v	

Table 2. Content expert validation

No	Component	Rating Scale				
		1	2	3	4	5
	Content of Product Material					
1.	The alignment of the EKSIS product with learning outcomes.					v
2.	The alignment of the material with the needs of the learners.					v
3.	The alignment of the presentation sequence with ecosystem					v
4.	The alignment of the use of scientific terminology with ecosystem				v	
5.	The ease of accessing the EKSIS product.				v	

The content expert validation results for the EKSIS product are presented in **Table 2**, focusing on five critical components related to the content of the product material. Each component was evaluated on a rating scale from 1 to 5, with 5 indicating the highest level of alignment or suitability. The first component assessed the alignment of the EKSIS product with learning outcomes, which received a rating of 5, demonstrating excellent congruence with educational goals. The second component evaluated the material's alignment with the learners' needs, also achieving a rating of 5, reflecting its strong relevance and appropriateness for the target audience. The third component examined the alignment of the presentation sequence with ecosystem material, earning a rating of 5, indicating a logical and well-structured flow. The fourth component focused on aligning scientific terminology with ecosystem material, which received a rating of 4, suggesting a high level of accuracy with minor room for refinement. Lastly, the fifth component, which assessed the ease of accessing the EKSIS product, was rated 5, highlighting its user-friendly and accessible design. Overall, the content expert validation underscores the EKSIS product's effectiveness in aligning with learning outcomes, learner needs, and ecosystem material while ensuring ease of use and accessibility.

5. Discussion
5.1 Analysis stage

The Analysis Stage is the first phase in the Design and Development (D&D) research model. In this stage, researchers identify the core problem that serves as the foundation of the study. Problem identification in research involves recognizing and understanding the key issue that requires resolution or deeper exploration. This step includes analyzing situations or conditions that need improvement or further understanding.

The first step in this process is identifying the underlying reasons or background for conducting the research. The researcher conducted a literature review on the rapid development of technology, which has significantly transformed the field of education. Learning media must evolve alongside technological advancements, including the shift from traditional textbooks to more practical and

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functional digital alternatives. According to Asyhari and Silvia (2016), conventional textbooks have several drawbacks, such as a lack of engagement, limited usability in dark environments, and a tendency to become monotonous. Furthermore, Ruddamayanti (2013) adds that textbooks are prone to damage, moisture, loss, tearing, and fading text over time.

In addition to the literature review, a field observation was conducted to examine the current learning conditions in science education (IPAS). It was found that the time constraints teachers face often hinder the development of diverse learning media in schools. Additionally, ebooks were not yet available, leading to a continued reliance on printed textbooks.

One potential solution to address these challenges is integrating digital technology into education. Digital learning media has proven highly effective in enhancing students' motivation and digital literacy skills (A. N. Aeni et al., 2023). The researcher found that ebooks offer a viable solution to these issues. Therefore, the primary objective of this research is to design and develop an ebook as a learning medium, specifically EKSIS (Ebook Ekosistem), for the science (IPAS) subject, focusing on the concept of ecosystems.

The specific objectives of this research are to evaluate expert validation of the EKSIS ebook's media design for introducing ecosystem concepts to third-grade elementary school students, to evaluate expert validation of the EKSIS ebook's content quality for introducing ecosystem concepts to third-grade elementary school students, and to determine the effectiveness of the EKSIS ebook in helping third-grade students understand the concept of ecosystems.

5.2 Design stage

The design process of the ebook began with the analysis phase, where the format was carefully planned to align with the presented content. The EKSIS ebook was created using Canva, incorporating appropriate themes, colors, typography, illustrations, and other design elements to match the subject matter. The content focuses on the fundamental concept of ecosystems for third-grade elementary school students. The material is presented in simple language, making it easily understandable for young learners, following the constructivist learning principles emphasizing meaningful learning experiences (Piaget, 1954).

The ebook's content was structured within pre-designed templates in Canva, ensuring an effective combination of colors, typography, and layout. According to Mayer (2009), in the Multimedia Learning Theory, the appropriate selection of visual elements can enhance students' comprehension by integrating verbal and non-verbal elements. To foster student engagement, the ebook was designed to be interactive, encouraging active participation in the learning process. Shiratuddin et al. (2003) highlight that ebook technology can improve interaction between educators and students while facilitating distance learning opportunities.

The EKSIS ebook underwent validation by two experts: A learning media design expert, who assessed the effectiveness of the design in engaging students—and a subject matter expert, who evaluated the accuracy and appropriateness of the content. The validation process was conducted to ensure that the content aligns with the learning objectives and that the design enhances student interest in learning.

The visual presentation of the EKSIS ebook developed by the researcher includes several key components. The ebook features a cover page, names of contributors, a foreword, a table of contents, and learning objectives and outcomes. The content covers fundamental ecosystem concepts, ecosystem components, and types of ecosystems, interspersed with engaging practice exercises designed to enhance students' understanding. Additionally, the ebook includes a bibliography and an author profile section, ensuring a comprehensive and structured learning experience.

5.3 Development stage

The developed product undergoes validation by an expert in learning media design before being tested in a third-grade elementary school classroom. This process helps determine the feasibility and effectiveness of the ebook as a learning tool.

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The ebook is validated by two experts in their respective fields: one specializing in media design and the other in content accuracy. The validation assessment focuses on both the product's design and the quality of its content. The media design validation is conducted by the head of a study program and a lecturer in digital learning, while the content validation is carried out by a third-grade homeroom teacher from the elementary school where the product trial is conducted.

Table 1 presents the results of the media design expert validation, with an average score of 4.6. According to the expert evaluation, the EKSIS ebook aligns with the curriculum and falls under the "excellent" category. The design of the ebook for ecosystem material was also rated as "excellent," while the selection of elements and colors was categorized as "good." Additionally, the typography used in the ebook was rated "excellent," ensuring readability and visual appeal.

The validation results indicate that the EKSIS ebook design meets high-quality standards, with an average score of "excellent" (4.6). Several key aspects were considered in the design process, including curriculum alignment, visual elements, typography, and engaging color choices. This aligns with Mayer's (2009) Multimedia Learning Theory, which emphasizes that effective visual design enhances students' cognitive processing by presenting concepts through multimodal approaches. Furthermore, Shiratuddin et al. (2003) highlight that digital media, including ebooks, can improve student interaction with learning materials.

The visual aspects of the EKSIS ebook were carefully designed to adhere to Multimedia Learning principles, incorporating text, images, and interactive elements to enhance students' learning experiences. Additionally, color selection, typography, and layout were designed based on user-friendly principles, ensuring students can easily access and comprehend the material.

Table 2 presents the content expert validation results, with an average score of 4.6. According to the expert evaluation, the EKSIS ebook aligns well with ecosystem learning objectives, receiving an "excellent" rating. The ebook was also rated "excellent" in meeting students' needs, the sequence of content presentation, and the accessibility of materials. Additionally, the scientific terminology used in the ebook was rated as "good," ensuring that the language is appropriate for third-grade elementary school students.

The content validation results confirm that the EKSIS ebook meets high-quality educational standards, with an overall rating of "excellent" (4.6). This assessment analyzed the alignment between content and learning objectives, student needs, and material structure. The EKSIS ebook was designed based on constructivist learning principles (Piaget, 1954), emphasizing meaningful learning experiences through concept-based instruction. The validation process also confirmed that the scientific terminology used in the ebook is appropriate and relevant to third-grade students, supporting findings by Satori and Komariah (2014), who stated that clear and structured terminology enhances deep conceptual understanding. Additionally, practice exercises in the ebook were designed to reinforce student learning through active engagement, aligning with Gagne's (1985) theory of instructional learning.

5.4 Implementation and evaluation stage

The EKSIS ebook was tested in a public elementary school in South Jakarta, specifically in a third-grade classroom with 29 students. The students found the ebook an engaging and enjoyable learning medium due to its visual elements, color combinations, typography, and well-structured content. The clear and concise material presentation further contributed to students' positive perceptions. This was evident during the product trial, where the researcher introduced the material and guided students through practice exercises embedded in the ebook. The results indicate that the EKSIS ebook is a viable learning tool, as it successfully captured students' interest and optimized the delivery of fundamental ecosystem concepts for third-grade students.

The product trial results further demonstrated that students were more engaged and enthusiastic about learning ecosystem concepts using EKSIS. The interactive and contextual presentation of the material significantly improved student comprehension. According to Hake (1999), the effectiveness of learning media can be measured by the difference in students' understanding before and after

using the media. In this study, students' understanding showed improvement, as reflected in test results and their responses to practice exercises in the ebook.

Moreover, technology integration in this product aligns with the Merdeka Curriculum, which emphasizes using technology in learning to improve accessibility and educational quality. Susilawati and Rusdinal (2022) highlight the importance of educational transformation through technology integration to meet the demands of digital-era learning. Additionally, research by Fathoni (2021) supports using digital books as an effective alternative for distance learning, reinforcing the Merdeka Belajar (Independent Learning) program. Furthermore, Shiratuddin, Landoni, Gibb, and Hassan (2003) discuss the benefits of ebooks in education, stating that ebooks enhance interaction between educators and students. The EKSIS ebook was developed to help students understand ecosystem concepts more easily and enjoyably, making learning accessible and engaging.

6. Conclusion and Implications

The results of this study indicate that EKSIS, as an ecosystem-based learning media, has been validated with excellent results. The validation process involved two key aspects: content quality and product design. From a content perspective, the validation process confirmed that EKSIS aligns with learning objectives, student needs, and the structured presentation of ecosystem materials. This finding suggests that the product was developed carefully considering the existing curriculum and real-world educational needs. Furthermore, the scientific terminology used in the product was deemed appropriate, which is expected to support students' conceptual understanding of ecosystems.

From a design perspective, EKSIS received high ratings for its visual elements, including overall layout, typography, and color selection. This evaluation demonstrates that the product is visually appealing and functionally relevant to the subject matter. Another notable advantage is its ease of access, which ensures that the product can be practically utilized in classroom learning environments. The average validation score of 5 places EKSIS in the "excellent" category. These findings confirm that the product meets the expected quality standards for educational media in both content and design. Therefore, EKSIS is considered ready for implementation as a learning tool to enhance students' understanding of ecosystem concepts, support learning objectives, and provide meaningful learning experiences.

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