

Developing a Book Creator-Based Interactive E-Module to Enhance Numeracy and Green Economy Awareness Among Elementary Students

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ABSTRACT

Integrating sustainability themes into mathematics education can enhance both cognitive and environmental competencies. This study aimed to develop and evaluate an interactive e-module using *Book Creator* that combines fraction-ordering concepts with green economy themes to improve elementary students' numeracy skills and environmental awareness. The module was developed using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) and featured multimodal content including text, visuals, video narration, and interactive tasks designed for fifth-grade learners. A limited trial was conducted with 75 students from a public elementary school in Indonesia. Expert validation and a pretest–posttest design were used to assess feasibility and learning outcomes. Expert validation indicated excellent feasibility in content (97.9%), media (96%), and language (98%). Student responses showed high engagement and perceived usefulness (average score: 88.6%). Quantitative analysis revealed a moderate increase in numeracy skills, with an average N-gain of 0.597. Qualitative observations indicated improved understanding, enthusiasm, and active participation. The findings demonstrate that interactive, contextually relevant digital modules can effectively support numeracy development and environmental education. Grounded in Piagetian and Vygotskian principles, the module encourages concrete operational thinking and social learning. Its digital format allows for flexible integration in both blended and remote learning settings. The Book Creator-based module offers promising pedagogical value for integrating mathematics and sustainability in primary education. Future studies should investigate broader application and long-term impacts on student learning and behavior.

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1. INTRODUCTION

The demands of 21st-century education highlight the importance of equipping students with both numeracy skills and awareness of sustainable economic practices. Numeracy is a core competency that enables learners to interpret data, reason logically, and solve real-life mathematical problems—skills essential for lifelong learning and active citizenship (O’Flaherty & Liddy, 2018; Kopnina, 2020). Simultaneously, green economy awareness—students’ understanding of sustainability-oriented economic behavior—has become a key competency to support global sustainable development efforts (Pavlova, 2019; Murga-Menoyo, 2014; Da Matta et al., 2025). Integrating both numeracy and sustainability in early education aligns with the Sustainable Development Goals (SDGs), promoting contextual learning that responds to current environmental and economic challenges.

Despite this urgency, numeracy skills among elementary students in Indonesia remain low, with studies reporting difficulties in solving even moderately complex mathematical problems (Farida et al., 2023; Yetti, 2024; Sari et al., 2024). In parallel, the incorporation of green economy concepts into elementary learning is still minimal, although research emphasises the importance of instilling sustainability values from a young age (Pratiwi et al., 2025; Satriawan et al., 2025). This indicates a critical gap in the development of integrated educational resources that simultaneously foster numeracy and environmental responsibility in children.

Emerging digital technologies offer promising solutions. Interactive media have been shown to enhance students’ engagement and understanding of math concepts (Engelbrecht et al., 2020; Hwa, 2018), while gamified digital platforms can effectively promote environmental awareness (Ricoy & Sánchez-Martínez, 2022). In particular, tools such as Book Creator have enabled the integration of interactive mathematics content with environmental themes (Daskolia et al., 2018; Milman & Carlson-Bancroft, 2014). However, few studies have specifically explored the development and effectiveness of Book Creator-based e-modules in improving both numeracy performance and green economy awareness at the elementary level.

This study aimed to: (1) Develop an interactive e-module using Book Creator focused on ordering fractions integrated with green economy themes, and (2) Evaluate the effectiveness of the e-module in improving elementary students’ numeracy skills and green economy awareness. By addressing the dual challenge of low numeracy and insufficient sustainability education, this research seeks to contribute an innovative instructional tool grounded in contextual and transformative learning approaches.

2. METHODS

This study employed a Research and Development (R&D) approach using the ADDIE development model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. This model was chosen because it provides a structured and systematic sequence of stages to design, develop, and evaluate learning products that are valid, practical, and effective. The consistent application of the ADDIE model in instructional media development has been shown to improve the quality of learning and support the enhancement of students’ critical thinking, problem-solving abilities, and creativity (Rahayu et al., 2020; Pramono & Lestari, 2021; Febrianto et al., 2023; Hidayat & Putra, 2022; Setiawan & Mustaji, 2020).

Book Creator is selected as a learning tool due to its capability to integrate text, images, video, and interactive elements into a single digital platform accessible via web and tablet. It features a child-friendly interface and offers flexibility for teachers to independently develop contextual content. In the context of green economy and sustainability-based learning, interactive media platforms like Book Creator provide students with active exploration opportunities, supported by narrative and multimedia integration that enhance conceptual understanding (Makransky & Mayer, 2022; Bus et al., 2020). Digital learning tools based on multimodal principles significantly increase engagement and support students’ digital literacy and critical thinking skills (Alobaid, 2020; Vu et al., 2021). Furthermore, multimodal learning approaches enrich the learning experience by combining various symbolic systems and media into a coherent

instructional flow (Lee & Hwang, 2022). This is especially relevant to contextual education aligned with green economy principles, where technology is creatively used to build immersive and sustainable learning environments (Marcon & Sehnem, 2024; Bellocchi et al., 2025).

The researcher obtained official permission from the school and received written consent from both teachers and students. All data were kept anonymous and confidential, in accordance with the principles of educational research ethics. The development process of the e-module using the ADDIE model is illustrated in Figure 1.

2.1 Research Design

The research procedure began with a needs analysis stage, which involved identifying students' difficulties in understanding numeracy and exploring the potential for integrating green economy themes into classroom learning. The results of this stage served as the basis for developing the e-module framework and content structure.

In the design stage, the researcher created a storyboard and organized the content structure of fraction materials contextualized with green economy practices. The development stage involved creating the e-module using the Book Creator application. The module was designed to be interactive, incorporating text, illustrations, videos, and exploratory learning activities.

In the implementation stage, a limited trial was conducted with fifth-grade students to assess the practicality of the module and gather student feedback. Finally, in the evaluation stage, expert validation and pretest-posttest assessments were conducted to measure the effectiveness of the e-module in improving students' numeracy skills. The complete research flow using the ADDIE model is illustrated in Figure 1.

The e-module content covered the topic of ordering fractions, contextualized with examples of daily activities related to green economy practices, such as saving electricity, waste management, and efficient water use. The research instruments included expert validation sheets for content and media, student response questionnaires to assess the practicality of the e-module, and numeracy tests in the form of pretest and posttest questions.

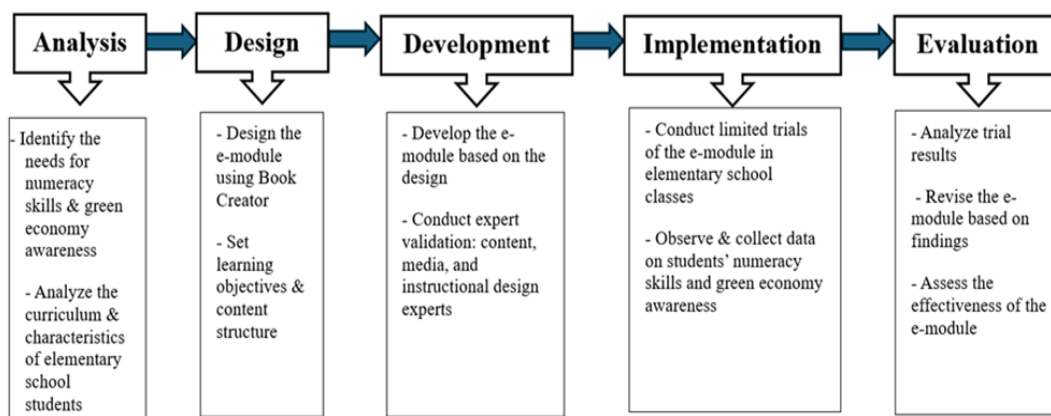


Figure 1. Research Flow

2.2 Population and Sampling Technique

The research subjects were fifth-grade students at a public elementary school in Bogor City, Indonesia, consisting of three parallel classes: 5A, 5B, and 5C, with a total of 75 students. All three classes were involved in the study and participated in the limited trial of the e-module to evaluate its practicality and effectiveness. The participants were selected using purposive sampling, based on the availability of teachers, school readiness, and alignment with the research objectives.

In addition, the study involved five validation experts, including three product validators: a content expert (elementary education), a media expert (informatics), and a language expert (Indonesian language education), as well as two evaluation experts responsible for validating the numeracy test instruments contextualized with green economy awareness.

2.3 Data Collection Instruments

Data were collected using five techniques and instruments: interviews, classroom observations, expert validation, student response questionnaires, and numeracy tests. Each instrument served a specific purpose and was analyzed using appropriate qualitative or quantitative methods.

Interviews were used primarily during the needs analysis phase, aiming to explore students' difficulties in understanding numeracy content and to identify opportunities for integrating green economy themes into instruction. Interviews were conducted with fifth-grade teachers and students. The data were analyzed thematically, and the resulting insights were used to guide the development of the e-module content and learning objectives.

Classroom observations were conducted at two stages: during the needs analysis and the implementation. During the needs analysis, observations focused on student learning styles, current teaching strategies, and media usage. During implementation, observations evaluated student engagement, interaction with the e-module, and overall learning behavior. Observational data were analyzed descriptively and triangulated with other findings to enrich the interpretation.

Expert validation was carried out to evaluate the e-module's quality from three aspects: content, media design, and language. Three experts (content, media, and language) assessed the e-module using a structured evaluation rubric based on a 4-point Likert scale (1 = not appropriate, 4 = highly appropriate). The quantitative scores were averaged to determine the overall feasibility, while qualitative feedback was used for product revision. A minimum feasibility score of 75% was used to classify the product as "feasible" or "highly feasible."

Student response questionnaires were distributed after the learning session to assess perceptions of the e-module's practicality, clarity, and engagement. Responses were rated on a 4-point Likert scale, converted into percentage scores, and interpreted as follows: $\geq 85\%$ = Highly Feasible; 70–84% = Feasible; and $< 70\%$ = Needs Improvement. The average score from all three classes was used to assess overall student acceptance of the e-module.

Numeracy tests were administered as pretests and posttests to evaluate students' mastery of ordering fractions within a green economy context. The test items were developed based on PISA-style indicators, covering three cognitive domains: understanding, application, and reasoning, and distributed across three complexity levels.

Before being administered to students, the test instrument was validated by two evaluation experts to assess its relevance, clarity, and alignment with the learning objectives. To assess the content validity of the numeracy test items, Aiken's V coefficient (Aiken, 1985) was employed. This index measures expert agreement regarding the relevance of each item to the construct being assessed. Aiken's V ranges from 0 to 1, with general interpretation values as follows: ≥ 0.80 indicates very high validity, 0.60–0.79 is valid, and < 0.60 is less valid. In this study, two experts rated the items using a 4-point Likert scale, and the analysis results showed that all items were within the valid to highly valid category (Baybayan & Lacia, 2024; Irdiyansyah et al., 2024).

Student performance was analyzed using the gain score formula (N-gain). The results were interpreted using Hake's classification: > 0.7 = High; 0.3–0.7 = Medium; and < 0.3 = Low. This analysis was used to measure the effectiveness of the e-module in improving students' numeracy skills.

2.4 Expert Validation

2.4.1. E-modul

To ensure the quality of the developed e-module, an expert validation process was conducted. This step aimed to assess the module's content accuracy, media design quality, and language clarity before implementation. Three experts were involved, each representing a specific area of expertise:

1. A content expert (lecturer in Primary School Teacher Education)
2. A media expert (lecturer in Informatics)
3. A language expert (lecturer in Indonesian Language and Literature Education)

Each expert assessed the e-module using a structured validation rubric tailored to their respective domains. The evaluation focused on three main aspects:

1. Media Aspect: usability, intuitive navigation, visual design quality, device compatibility, accessibility, and support for independent learning.
2. Content Aspect: completeness and coherence of material, stand-alone functionality, adaptability to student differences, and user-friendliness.
3. Language Aspect: clarity of message, communicative level appropriate to elementary students, and compliance with Indonesian language norms.

Each item in the rubric was rated using a 4-point Likert scale: 1 = Not Appropriate, 2 = Less Appropriate, 3 = Appropriate, 4 = Highly Appropriate. The complete criteria for each aspect are presented in the tables below.

Table 1. Media Expert Validation Rubric

No.	Criteria	Description
1	Usability	Ease of use of the e-module for elementary school students.
2	Navigation System	Clarity and intuitiveness of menu structure and navigation features.
3	Visual Design	Quality of illustrations, appropriate color schemes, and layout for young learners.
4	Device Compatibility	Functionality across various devices (laptops, tablets, smartphones).
5	Accessibility	Accessibility for all students, including those with special needs.
6	Support for Self-Instructional Learning	Ability of the e-module to guide students in independent learning.

Table 2. Content Expert Validation Rubric

No.	Criteria	Description
1	Completeness and Coherence	Content is complete and logically structured (self-contained).
2	Independence (Stand-alone)	Module can be used independently without requiring additional resources.
3	Adaptability	Content accommodates differences in students' abilities (adaptive learning).
4	User-Friendliness	Ease of understanding and implementation by both students and teachers.

Table 3. Language Expert Validation Rubric

No.	Criteria	Description
1	Clarity	Language used is clear and directly conveys the intended meaning.
2	Communicative Level	Language is easily understood by elementary students (age-appropriate language).
3	Linguistic Accuracy	Conforms to Indonesian language rules and academic writing standards.

2.4.2 Test Validation

The test instrument used in this study consisted of mathematics questions designed according to the types of PISA questions. In Indonesia, PISA-type questions have been adapted into questions for

assessing national numeracy skills through the Minimum Competency Assessment (AKM). The mathematics questions developed focused on the topic of ordering fractions for fifth-grade students. The test consisted of 2 multiple-choice questions, 3 complex multiple-choice questions, 3 true-false questions, and 2 short-answer questions. The use of varied question types aimed to familiarize students with AKM numeracy questions and, globally, with the PISA question format. A characteristic feature of PISA or AKM numeracy questions is the use of contextual scenarios. Therefore, in constructing the test, the contexts used were related to the green economy, including topics such as waste recycling, electricity usage, energy conservation, paper consumption, renewable energy use, plastic bottle usage, and urban greening programs.

The criteria used in the test validation included adherence to item-writing guidelines, alignment with the subject matter domain, and the presence of novelty in the questions. Validation was carried out by two experts: one evaluation expert and one elementary mathematics expert. The data from the validation process were tabulated and subsequently analyzed using Aiken's V formula (Azwar, 2012; Retnawati, 2016). The calculated validity scores were then compared against the predetermined criteria, which classified items as highly valid, valid, less valid, or invalid. The validation results indicated that the numeracy test instrument contextualized with green economy themes fell into the "Valid" category, as presented in Table 4.

Table 4. Tes Validation

Question Type	Number of Items	Aiken's V Value	Description
Multiple Choice	3	0,83	Highly Valid
Complex Multiple Choice	2	0,67	Valid
True-False	3	0,83	Highly Valid
Limited Essay	2	0,67	Valid
Total/ Average Overall	10	0,75	Valid

2.5 Product Revision and Testing

Following the expert validation process, the developed e-module was systematically revised based on both the qualitative feedback and the scores provided by the three expert validators. The revisions focused on improving several key aspects, including clarity of content delivery, visual and interactive design quality, language readability and age appropriateness, and alignment with the cognitive and emotional development of elementary school students.

After the revisions were completed, the improved e-module underwent a limited field trial with fifth-grade students and their mathematics teacher. The purpose of this trial was to evaluate the practicality of the e-module in real classroom conditions and to examine its effectiveness in enhancing students' numeracy skills and awareness of green economy practices.

During the trial implementation, the researchers conducted direct classroom observations to monitor student engagement, interaction patterns, and ease of use of the module. In addition, the teacher provided structured feedback through guided interviews and observation checklists, focusing on whether the module supported learning objectives, classroom interaction, and independent learning. All data obtained from these observations and teacher feedback were analyzed descriptively to determine whether further revisions were needed before the module could be implemented on a broader scale.

3. FINDINGS AND DISCUSSION

3.1 Needs Analysis

Based on observations and interviews with fifth-grade teachers and students at SDN Julang, several problems in numeracy instruction were identified. Students showed low understanding of

abstract concepts, such as fraction operations and data interpretation. This issue was attributed to monotonous teaching methods and the use of conventional, non-contextual materials. Teachers confirmed that although the Merdeka Curriculum was in place, it did not yet integrate green economy themes, limiting opportunities to foster environmental awareness through numeracy learning.

An audience analysis of three parallel classes—5A (27 students), 5B (24 students), and 5C (24 students)—revealed diverse mathematical abilities. In class 5A, for instance, 7 students were classified as very good, 8 as good, 11 as fair, and 1 student required special assistance. Most students exhibited audio-visual learning styles, indicating a need for media enriched with images, videos, and animations. One student was diagnosed with ADHD, requiring interactive learning materials to help sustain focus.

Based on these findings, a specific instructional objective was formulated: Students are expected to solve fraction problems with a minimum accuracy rate of 80% after participating in learning using the Book Creator-based e-module.

3.2 Product Design and Development

The The Book Creator-based interactive e-module was designed in alignment with the Merdeka Curriculum and built upon digital pedagogical principles to support numeracy and sustainability education. The e-module provided a multisensory learning environment by combining text, images, videos, narration, and interactive tasks to foster deep learning and engagement. The design and development process included:

1. A detailed storyboard, mapping learning objectives with content flow, incorporating interactive and green economy-related content;
2. Visual and audio elements, such as colorful illustrations, narration, and animations;
3. Practice questions modeled on PISA and AKM formats (multiple choice, complex choice, true/false, limited response), and reflective activities connecting math to environmental action;
4. The use of Canva for visual layout and Book Creator for interactivity and platform integration;
5. Accessibility design features, including dyslexia-friendly fonts and audio narration for early readers.

The final e-module was rendered in A4 format for compatibility with both digital and print usage.

3.3 Validation Process

3.3.1 Quantitative Findings

The experts completed a structured rubric evaluation using a 4-point Likert scale (1 = Not appropriate, 4 = Highly appropriate). The overall average expert validation score reached 97.9%, placing the e-module in the “Highly Feasible” category, as presented in Table 5.

Table 5. Expert validation score

Expert Type	Validation Score (%)	Feasibility Category
Media Expert	96.0	Highly Feasible
Content Expert	97.9	Highly Feasible
Language Expert	98.0	Highly Feasible
Average	97.9	Highly Feasible

3.3.2 Qualitative Findings

The e-module validation process was carried out by involving three experts: a media expert, a content expert, and a language expert, to ensure the quality of the product from various aspects. The structured rubric applied in the e-module validation process included several important evaluation criteria covering the media, content, and language aspects.

1. For the media aspect, the criteria assessed included usability, or the ease of use of the e-module by students; an intuitive navigation system; visual design, including the quality of illustrations, color schemes, and layout appropriate for elementary school students' age; compatibility with various

- devices; accessibility for all students, including those with special needs; and the module's capability to support self-instructional learning.
2. For the content aspect, the rubric assessed the completeness and coherence of the material (self-contained), the ability of the e-module to function independently without relying on other sources (stand-alone), the adaptability of the material to accommodate differences in students' abilities (adaptive), and ease of use (user-friendly).
 3. For the language aspect, the criteria evaluated included clarity in delivering the material, the communicative level of the language so that it is easily understood by students, and compliance with proper Indonesian language conventions.

3.4 Implementation

At the implementation stage, the researcher conducted a direct classroom trial of the Book Creator-based e-module to evaluate its practicality and students' engagement in numeracy learning with a green economy theme. The implementation was carried out in three classes, namely fifth-grade classes at SDN Julang. The mathematics teacher led the lesson using the selected topic, ordering fractions, which is a relevant numeracy topic that often poses difficulties for students. The implementation was conducted in April 2025.

3.5 Evaluation

3.5.1 Quantitative Findings

Before using the e-module, students took a pretest consisting of 10 questions designed to measure their basic understanding of numeracy material on the topic of ordering fractions and its relation to green economy concepts, such as scenarios involving energy conservation or waste management linked to numerical problems. After the e-module was used in classroom learning, they were given an evaluation tool in the form of AKM-type questions. These questions served as the test instrument to determine the effectiveness of the e-module's use. The calculation results of the N-gain from the pretest and posttest for each class showed that class 5A achieved an N-gain of 0.56, class 5B achieved an N-gain of 0.61, and class 5C achieved an N-gain of 0.62. The detailed results can be seen in Table 2.

Table 6. N-gain Data for e-Module Implementation

No.	Class	N-gain	Category
1	5A	0.56	Medium
2	5B	0.61	Medium
3	5C	0.62	Medium
Average		0.597	Medium

After the evaluation was completed, students were given a response questionnaire. The students completed the provided response instrument. Based on the calculations, which were then converted using the conversion table, the student response questionnaire results showed scores of 89% for class 5A, 90% for class 5B, and 87% for class 5C. These results indicate that, according to the students, the e-module is highly feasible.

Table 7. Data on Student Response Questionnaire Results

No.	Class	Response Questionnaire	Category
1	5A	89%	Highly Feasible
2	5B	90%	Highly Feasible
3	5C	87%	Highly Feasible
Average		88.6%	Highly Feasible

3.5.2 Qualitative Findings

Qualitative observations during the trial revealed a high level of student engagement. Students appeared enthusiastic and curious while exploring the features of the e-module, such as illustrative videos, interactive animations, and engaging practice exercises. Some students initially required guidance in using the digital devices, especially those who were not yet familiar with operating computers, but after brief instructions, they quickly adapted. By the second activity, most students were able to operate the e-module independently, navigate between pages, listen to explanatory narration, and confidently answer practice questions.

Students responded positively, particularly to the videos and contextual animations depicting environmentally friendly activities, such as sorting waste, conserving water, and avoiding electricity waste. For example, in one interactive activity, students were asked to select the correct answer in a story problem about energy conservation, and the majority successfully chose the right response after watching the video and listening to the audio explanation. Teachers also noted an improvement in students' ability to recall the steps for solving fraction problems contextualized with daily activities, as observed during class discussions following the trial.

Discussion

The effectiveness of the e-module was supported by an overall N-gain score of 0.597, categorized as moderate improvement. This result aligns with prior studies that emphasize the effectiveness of digital learning tools in improving mathematical understanding. Mamolo (2022) found that mobile-based interactive media significantly enhanced students' engagement and conceptual grasp in mathematics. Similarly, Rico et al. (2021) and Caridade (2024) highlighted the role of sustainability-integrated numeracy learning in fostering environmental consciousness from an early age.

In this study, contextual tasks such as fraction comparisons using examples of water usage or waste sorting helped make abstract numerical concepts more relatable. These real-world applications not only made mathematics more engaging but also laid a foundation for long-term awareness of sustainable living. Furthermore, multimedia components such as video, narration, and visual animation created an immersive environment, confirming the idea that multimodal resources can enhance 21st-century competencies (Türkeli & Schophuizen, 2019; Demidov et al., 2020).

The learning design was grounded in Piaget's theory of cognitive development, particularly the concrete operational stage (ages 7–11), in which children learn best through concrete objects and visual representations. The e-module's use of diagrams, step-by-step illustrations, and real-life contexts allowed students to construct understanding through concrete mental models. This theoretical foundation is consistent with findings from Mamolo (2022) and Rico et al. (2021), which advocate for visual and interactive tools in early mathematics learning.

Complementing this, Vygotsky's sociocultural theory provided the framework for learning support strategies. The implementation of the module incorporated scaffolding by teachers, interactive peer discussion, and the use of digital narration to promote learning within students' Zone of Proximal Development (ZPD) (Vygotsky, 2019). This aligns with findings from Caridade (2024) and Demidov et al. (2020), which emphasize collaborative environments in building knowledge and supporting metacognition.

Beyond theoretical alignment, this study contributes empirically and pedagogically in several important ways. It offers a practical model for integrating numeracy with sustainability themes in primary education—a domain that remains underdeveloped in many national curricula. It also demonstrates the potential of Book Creator as a design tool for building structured, accessible, and engaging learning resources, which is an area seldom addressed in existing literature. Furthermore, the study presents both quantitative and qualitative evidence of the module's impact, validating its effectiveness in supporting not only cognitive outcomes, such as improved problem-solving, but also

affective outcomes, such as environmental awareness—goals that are aligned with the United Nations Sustainable Development Goals (SDGs).

Despite promising results, this study has several limitations: It was conducted in a single school with 75 students, limiting its generalizability across diverse educational settings (Sari et al., 2024). The intervention lasted only a few sessions, which restricts insight into long-term retention or behavior change. Some students struggled initially with navigation, suggesting a need for introductory digital training or embedded tutorials (Febrianto et al., 2023).

The e-module presents a scalable solution for contextualized mathematics instruction. Its flexible digital format enables distribution and implementation across schools regardless of their technological infrastructure. Teachers can integrate the module into various instructional modes—blended, in-person, or remote—while parents are afforded greater opportunities to participate actively in home-based learning. Beyond its practical application, the module supports broader educational goals by nurturing environmentally responsible behavior through mathematical reasoning.

The implications of this study for education are significant. First, it highlights the importance of designing instructional materials that not only build core competencies like numeracy but also instill values aligned with sustainable development. Second, it shows how digital innovation can be effectively harnessed to personalize learning experiences, accommodate diverse student needs, and enhance engagement through multimodal content. Lastly, the successful integration of curriculum content with environmental awareness through an interactive medium offers a replicable model for future curriculum development—particularly in contexts where holistic, interdisciplinary education is increasingly emphasized.

4. CONCLUSION

The findings of this study provide compelling evidence that an interactive e-module developed using Book Creator can serve as an effective tool for enhancing elementary students' numeracy skills, particularly in learning fraction concepts within the context of green economy practices. By integrating multimodal features—text, visuals, videos, and interactive tasks—the module successfully translated abstract mathematical ideas into meaningful and engaging experiences for young learners.

Three key takeaways emerge from this research. First, the module's alignment with students' cognitive and social development (drawing on Piagetian and Vygotskian principles) contributed to improved understanding and sustained engagement during lessons. Second, the high feasibility ratings from both experts and students indicate that such digital media are not only pedagogically sound but also accessible and motivating for learners. Third, the results demonstrate the potential for merging numeracy with sustainability themes in early education, providing a scalable model for integrating core skills with global competencies.

While the scope of this study was limited by sample size and duration, its implications are clear: digital modules that combine interactivity with contextual relevance can play a pivotal role in advancing educational innovation. Future research should explore broader implementations and long-term effects, particularly in diverse school settings, to validate and expand upon these promising results.

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