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The development of Linktree-assisted e-module based on CTL to improve IPAS learning outcomes

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Abstract: Students' low learning outcomes on the topic of "Magnetic Force" were caused by conventional teaching methods and limited availability of innovative and contextual teaching materials. The objective of this study is to develop and evaluate the feasibility and effectiveness of a Linktree-assisted CTL-based e-module in improving the learning outcomes of fourth-grade students in the Natural and Social Sciences (IPAS) subject. A Research and Development (R&D) approach was utilized in this research, following the adaptation of the Borg and Gall model consisting of ten systematic stages in product development. The research subjects included a materials expert, a media expert, a classroom teacher, and students. To collect data, a combination of questionnaires, documentation, and interviews was used. To analyze the collected data, several techniques were utilized, including descriptive analysis, normality tests, t-tests, and N-Gain tests. The design validation results showed a very feasible category from material experts (87%) and media experts (98%). The analysis of the response questionnaires yielded scores of 96.61% for students and 97.50% for teachers, placing both within the "very feasible" range. The effectiveness of the e-module was demonstrated by the t-test results (p-value = 0.000), leading to the rejection of H0 and the acceptance of Ha, as well as an N-Gain value of 0.5489, which was considered "moderate". Thus, the Linktree-assisted CTL-based e-module was a highly feasible and effective digital teaching material innovation that improved the learning outcomes of fourth-grade students in the IPAS subject, particularly on the topic of "Magnetic Force". Furthermore, the developed e-module serves as a highly effective digital innovation that aligns with modern educational needs. In the context of elementary school education, the development of this e-module provides an alternative learning medium that can support the implementation of student-centered learning. This research also has implications for the role of teachers, who not only function as material deliverers but also as facilitators who can use technology to create innovative learning experiences.
Keywords: e-module, Linktree, CTL, learning outcomes

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Introduction

High-quality education is the primary factor in developing human resources that are competitive and adaptable to the times. In the current era of globalization and digitalization, the education system must continuously transform to enhance learning effectiveness (Gunawan et al., 2023). The use of technology in the teaching and learning process is a key example of this transformation. This aligns with Haleem (2022) and Prykhodkina (2025), who argued that technological advancements play a significant role in enhancing the effectiveness of the educational system. This role can be carried out in various ways, including developing the latest interactive teaching methods and personalizing learning activities to students' needs.

During the primary stage of education, the subject of Natural and Social Sciences (IPAS) is essential in building students' understanding of natural phenomena and the social life around them. This means that effective science learning not only emphasizes knowledge aspects but also critical thinking

skills and the ability to relate concepts to real-life situations (Darmawati & Mustadi, 2023; Verawati & Sarjan, 2023). However, in practice, IPAS (Science and Social Studies) learning, especially in the science content, still faces various challenges. These challenges include students' low interest in learning, the continued use of conventional teaching methods, and the limited availability of engaging, contextually relevant learning media.

This problem was also found at Muhammadiyah Weleri Elementary School. Based on the initial data collection, students' learning outcomes on "Magnetic Force" remain low. Of the students who participated in the learning, only a small number met the established criteria for completeness. This was caused by learning activities that are still dominated by lecture-based methods, as well as the reliance on teaching resources that fail to bridge the gap between academic content and students' everyday lives (Asbah et al., 2025; Ayuningtyas & Widodo, 2026). As a result, students' motivation to learn decreases, and their understanding of concepts weakens.

Theoretically, learning will be more effective if students engage directly in synthesizing and building their own knowledge through meaningful learning experiences. One of the teaching models that can be used is Contextual Teaching and Learning (CTL), a pedagogical approach prioritized on bridging the gap between instructional content and its practical application (Perales & Ulla, 2025). Through the use of this model, students are expected to understand concepts more deeply as they learn through direct experience, observation, and reflection. Additionally, the use of technology-based learning media, such as e-modules, can help improve the quality of education. E-modules offer advantages by presenting interactive, flexible material that allow learners to engage with the content at their convenience, whenever and wherever they choose (Dermawan et al., 2025; Purwanti et al., 2023). The integration of e-modules with platforms like Linktree makes it even easier for students to access various learning resources through a single, organized link.

Several previous studies have shown that developing e-modules grounded in CTL significantly improved the quality of science education in elementary schools. Widiastuti (2021) found that e-modules with a contextual approach in science education are highly feasible, with an average validation score of 89.06%, and can increase students' interest and understanding of the material. In line with this, Widyaningrum and Parmiti (2024) also developed a digital science worksheet based on CTL for fourth-grade students and obtained very good validation results from media, material, and learning experts, thus considered highly suitable for use as teaching materials. Additionally, the research by Firdaus et al. (2024) confirmed that interactive digital-based e-module have a significant impact on students' conceptual understanding, with a significance value of 0.030 (< 0.05), indicating a meaningful improvement in learning outcomes.

Although various studies have shown that CTL-based e-modules are effective and feasible for learning, research integrating e-modules with digital platforms, such as Linktree, as a central access point for learning resources remains limited. To enhance learning outcomes in IPAS for fourth-grade students at Muhammadiyah Weleri Elementary School, this study aimed to develop an e-module based on CTL, supported by Linktree. Additionally, the researcher sought to validate its feasibility and effectiveness in improving fourth-grade students' IPAS learning outcomes at Muhammadiyah Weleri Elementary School.

This study contributes to the development of technology-integrated instructional materials by demonstrating how a CTL-based e-module can be organized via Linktree to provide students with more accessible, structured, and contextually relevant learning resources. Unlike previous studies that mainly focus on the feasibility of e-modules as standalone digital materials, this research emphasizes the use of a simple digital platform as a centralized learning gateway that connects texts, images, videos, exercises, and other supporting resources in one accessible space. Therefore, the findings of this study are expected to enrich the literature on digital learning media in elementary education, particularly in IPAS learning, and provide practical guidance for teachers in designing contextual, flexible, and student-centered learning materials.

Methods

This study was grounded in the Research and Development (R&D) method, as defined by Sugiyono (2019) as a systematic scientific process for exploring, creating, and testing the validity of a

developed product. In this instance, the study specifically used the Borg and Gall development model, which comprises 10 systematic steps in product development. Figure 1 shows the research stages based on the Borg and Gall model, which include: (1) analysis of potential and problems, (2) data collection, (3) product design, (4) design validation, (5) design revision, (6) product trial, (7) product revision, (8) trial usage, (9) final product revision, and (10) mass production.

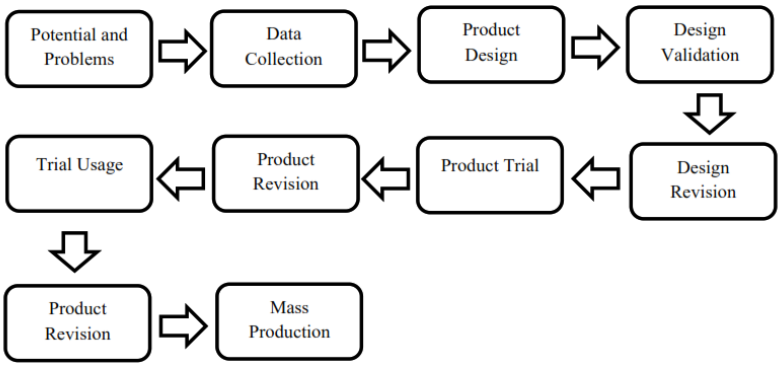

Figure 1. Stages in Borg and Gall's Development Model (Sugiyono, 2019)

Figure 1 shows the stages of development research, adapted from the Borg and Gall model (Sugiyono, 2019). The first stage was potential and problems, which involved identifying issues in IPAS learning in fourth grade at Muhammadiyah Weleri Elementary School, particularly low student learning outcomes and limited teaching media used by the teacher. The second stage was data collection, conducted through interviews, documentation, and questionnaires to obtain information on teachers' and students' needs for digital learning media. The third stage was product design, which involved designing a Linktree-assisted e-module based on CTL tailored to the characteristics of elementary school students. Next, the design validation stage was conducted by material and media experts to assess the feasibility of the developed product. After receiving feedback from the validators, the design revision stage was carried out to address the product's limitations before testing.

The next stage was the product trial, which involved testing the e-module with a small group of students to assess the product's response and practicality. The trial results are then used as the basis for the product revision stage to refine the e-module. After the revision was completed, a trial run was conducted with a larger group to assess the e-module's effectiveness in improving students' learning outcomes. Subsequently, the product revision stage was carried out based on the usage test results to further optimize the product. The final stage was mass production, which involved disseminating and broadening the product's use as an IPAS learning medium in elementary schools. Thus, the Borg and Gall model was used in this study to ensure that the Linktree-assisted CTL-based e-module developed meets the aspects of validity, practicality, and effectiveness.

This research was conducted at Muhammadiyah Weleri Elementary School. The subjects in this study included a material expert, a media expert, a classroom teacher, and fourth-grade students. To test the effectiveness of the Linktree-assisted CTL-based e-module, this study used a one-group pretest-posttest design across both the product trial and usage test stages. The study population consisted of all fourth-grade students at Muhammadiyah Weleri Elementary School. The research sample consisted of 32 students, which divided into 8 students in the product trial and 24 students in the usage test.

Based on the background and research objectives, the hypotheses proposed in this study were as follows. The null hypothesis (H_0) stated that there is no significant improvement in students' learning outcomes following the use of the Linktree-assisted CTL-based e-module. Meanwhile, the alternative hypothesis (H_a) proposed that the Linktree-assisted CTL-based e-module effectively enhances the IPAS learning outcomes of fourth-grade students at Muhammadiyah Weleri Elementary School.

Data for this study were gathered through two primary techniques: test and non-test methods. Non-test data were compiled specifically from interviews, documentation, and questionnaires. Interviews with classroom teachers and documentation in the form of grade archives, teaching materials, and other supporting data were carried out to obtain initial data. Meanwhile, questionnaires were used

to analyze the needs of students and teachers, test the feasibility by validators, and assess the experiences of students and classroom teachers as users of the e-module.

Test data were obtained through pretest and posttest instruments administered before and after the use of the Linktree-assisted CTL-based e-module for fourth-grade students. The test instruments have been tested for its reliability and received a score of 0.922, which falls into the very high category. The test items were categorized into three difficulty levels: easy, medium, and difficult. Based on the results of the discriminatory power test, 25 items were considered suitable for use as pretest and posttest instruments because they met the criteria of being very good and good.

Next, descriptive statistics were employed to analyze the data gathered during the study in order to describe students' learning outcomes, normality tests to determine data distribution, t-tests to analyze whether there is a significant difference in students' learning outcomes before and after using the e-module, and N-gain tests to measure the improvement in students' learning outcomes after using the e-module. The N-gain values were classified based on the criteria presented in Table 1.

Table 1. N-gain Value Criteria

N-Gain Value	Criteria
N-gain ≥ 0.70	High
0.30 < N-gain < 0.70	Moderate
N-gain ≤ 0.30	Low

As presented in Table 1, the N-gain values are grouped into three main categories. First, N-gain values ≥ 0.70 are classified as high (High). Second, N-gain values between 0.30 and 0.70 are categorized as moderate (Moderate). Last, N-gain value ≤ 0.30 are included in the low criteria (Low). This classification serves as a reference for analyzing the extent of improvement in students' learning outcomes during the study.

Results and Discussion

Results

The primary output of this Research and Development (R&D) study was an e-module on CTL for the IPAS subject, with a science content focus, for fourth-grade elementary school students. The product development was carried out by following the Borg and Gall model stages, which include: (1) potential and problems, (2) data collection, (3) product design, (4) design validation, (5) design revision, (6) product trial, (7) product revision, (8) trial usage, (9) final product revision, and (10) mass production. The result of this research was a Linktree-assisted CTL-based e-module on the topic of "Magnetic Force". The e-module consisted of several components, including an attendance list, the e-module content, experimental videos, and exercises, all integrated into a single Linktree link.

Potential and Problems

The first stage began with an analysis of potential and problems conducted through the documentation and interviews with fourth-grade teachers at Muhammadiyah Weleri Elementary School. The needs analysis questionnaire was also distributed to the students and teachers to obtain more comprehensive data regarding learning needs. Based on the results of the needs analysis survey, students preferred learning with visual media and practical activities related to daily life, as these facilitate understanding of the material, increase engagement, and impact learning outcomes. Although they already had a textbook, some students felt it was not sufficiently engaging or accessible, so they were interested in using an engaging, easily accessible e-module. From the teacher's perspective, there was a need for more innovative, interactive, and contextually relevant teaching materials to enhance student engagement and learning outcomes. However, there was potential in the availability of digital devices and the teacher's readiness to utilize technology in learning, which could serve as a foundation for developing digital-based learning media.

Data Collection

Afterward, the data collection stage was conducted to obtain more in-depth information to support the product development process. The data were collected through interviews, documentation, and questionnaires. The analysis revealed that IPAS learning, particularly on magnets, continues to face numerous challenges. Students tend to find science subjects difficult and uninteresting, which caused their low academic performance. This was proven by data showing that out of 24 students, only 4 students achieved the Learning Mastery Completion Criteria (*Kriteria Ketercapaian Tujuan Pembelajaran*) of 75. Additionally, the learning process was still dominated by lecture-based methods and teaching materials that lacked context, making it difficult for students to relate the material to everyday life. The data collection results also showed that the teacher needs interactive, contextually relevant, and easily accessible teaching materials. Furthermore, students also need engaging learning media that is not monotonous and can help them understand abstract concepts through visualization. Therefore, developing a Linktree-assisted e-module based on CTL was considered relevant to support the learning process. Based on these results, a Linktree-assisted e-module was developed as a solution to integrate various learning resources into a single, easily accessible platform.

Product Design

Following the results of the needs analysis and data collection, the development of the CTL-based e-module began with drafting a storyboard to guide the design process. The design contained the systematics of the e-module, the flow of material presentation, and the visual design of each learning component. The developed e-module was organized into three main sections: introduction, content, and conclusion. After preparing the storyboard, the process moved to transforming the design into an actual e-module in Canva. In the development process, the product design was created by considering several principles of e-module development, including providing clear usage instructions, incorporating learning objectives (*Tujuan Pembelajaran*) and learning outcomes (*Capaian Pembelajaran*), being tailored to students' needs, having a user-friendly interface, being interactive, including material summaries, and supporting self-assessment. All of these e-module development principles are reflected in this product design, as shown in Figure 2 below.

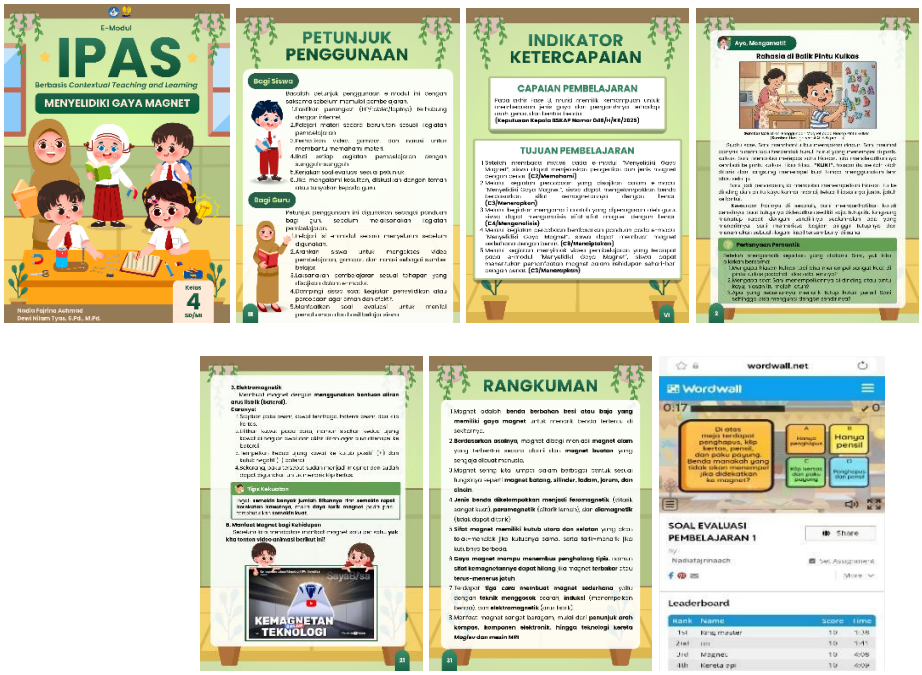

Figure 2. Implementation of the Seven Principles of E-Module Development

Figure 2 shows the implementation results of the seven principles of e-module development. The design of the e-module was also equipped with visual elements and illustrations relevant to the learning material. Upon completion of the development phase, the product (e-module) was then transformed into

a digital book format using the Heyzine platform. Subsequently, the e-module links and other learning resources were linked via Linktree to provide students with centralized access to the material.

Design Validation

A materials expert and a media expert then validated the developed product design. Material validation aimed to assess the suitability of the e-module content based on curriculum aspects, material presentation, completeness, evaluation, and language. Meanwhile, the e-module underwent media validation to assess its viability, with a focus on its visual design, linguistic clarity, and seamless integration with Linktree as a supporting medium. The e-module's content and design were validated as "very feasible" by both material and media experts. The material expert assigned a score of 87/100 (87%). This result indicates that the material in the e-module was fully aligned with the curriculum, had strong conceptual accuracy, and could systematically integrate the CTL model. Similarly, media validation yielded a "very feasible" rating with an even higher score of 98/100 (98%). This result suggested that the developed e-module had an attractive visual design quality, a systematic presentation, and very good content clarity. Detailed figures for these assessments are provided in Table 2.

Table 2. Design Validation Results from Material Expert and Media Expert

No.	Feasibility Aspect	Percentage (%)	Category
1.	Material Expert	87%	Very feasible
2.	Media Expert	98%	Very feasible

Table 2 shows that the design validation results from both material and media experts received high evaluations and fall into the "very feasible" category. The assessment from the material expert yielded a 87% score, while the evaluation from the media expert yielded an even higher 98%. Although the results obtained were already considered good and categorized as "very feasible", both validators proposed several suggestions for improvement, summarized in Table 3 below.

Table 3. Comments and Suggestions for Improvement from Material Expert and Media Expert

Validator	Validator Comments	Suggestions for Improvement
Material Expert	The e-module is quite good and feasible. It can be used in trials.	Add references to the images used.
Media Expert	Linktree and layout can still be improved.	1. Ass clearer instructions for using Linktree so it can be easier to understand. 2. Position the cover page at the end according to the e-module structure.

Table 3 presents the comments and suggestions for improvement from the material expert and media expert, serving as the basis for revising the product design before proceeding to the trial stage. Based on the table, the material expert commented that the e-module is quite good and feasible, and can be used in trials, with the suggestion to add references to the images used. Meanwhile, the media expert commented that the use of Linktree and the layout could still be improved. Furthermore, the media expert's suggestions for improvement include adding clearer instructions for using Linktree to make them easier to understand and placing the cover page at the end, in line with the e-module's structure.

Design Revision

Following validation results from material and media experts, the researcher implemented revisions to the e-module design based on the feedback and recommendations received. This revision aimed to refine the Linktree section, content layout, and e-module structure, making the e-module easier to use and more visually appealing. The material expert suggested adding references to the images used. Meanwhile, the media expert recommended adding usage instructions for Linktree to make them clearer and easier for users to understand, and positioning the cover page at the end, in line with the e-module systematics. Figure 3 below shows the changes to the Linktree and e-module designs after the revisions.

Figure 3. Linktree and E-Module Design After Revision

Product Trial

After revising the product, the researcher conducted a test consisting of items to obtain valid and reliable questions that met the criteria for discrimination power and level of difficulty. The items that met these criteria were then used as instruments for the pretest and posttest in the product trial stage to measure students' IPAS learning outcomes. To ensure the assessment tool's accuracy, each item underwent a validity test. These findings are detailed in Table 4 below.

Table 4. The Results of Item Validity Test

Number of Items	Criteria	Item Numbers
50	40 Valid Items	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 24, 27, 28, 30, 31, 32, 34, 36, 37, 38, 40, 41, 42, 46, 47, 48, 49, 50
	10 Invalid Items	23, 25, 26, 29, 33, 35, 39, 43, 44, 45

According to Table 4, 40 test items demonstrated sufficient validity, while the remaining 10 were declared invalid. The valid items were then tested for reliability to assess the instrument's consistency. The data confirmed that the instrument used in this study was highly reliable, thereby confirming its stability and consistency for use throughout the study.

Subsequently, the discriminatory power test was conducted to determine each test item's ability to distinguish between high- and low-ability students. This analysis was used to assess the quality of the items and students' understanding of the material. The outcomes of the discriminatory power test for each item have been compiled and are displayed in Table 5.

Table 5. The Results of Item Discriminatory Power Test

Category	Item Numbers
Very Good	10, 12, 18, 20, 21, 22, 24, 27, 31, 32, 34, 36, 37, 38, 41, 42, 50
Good	1, 2, 3, 4, 5, 6, 8, 9, 11, 13, 14, 15, 16, 17, 19, 28, 30, 40, 46, 47, 48, 49
Fair	7
Poor	0

Based on the analysis results in Table 5, out of 40 tested items, there is one item categorized as fair. The items used in this study were those categorized as very good and good, totaling 39 items. After that, each test item in the assessment was subjected to a difficulty test to determine its specific level of complexity. In this analysis, the items were grouped into three categories: easy, medium, and difficult. Table 6 illustrates the distribution of difficulty levels across the individual assessment items.

Table 6. The Results of Item Difficulty Level Test

Category	Item Numbers
Easy	1, 2, 3, 4, 6, 9, 14
Medium	5, 8, 10, 11, 12, 13, 15, 18, 19, 20, 21, 22, 24, 27, 28, 30, 31, 32, 34, 36, 37, 38, 40, 41, 42, 29, 50
Difficult	16, 17, 46, 47, 48

Based on the analysis results in Table 6 above, 25 of 39 items were selected as the research instrument. Items in the easy category consisted of numbers 1-4, 6, 9, and 14, totaling 7 items. Items in the medium category included 8, 10, 12, 15, 19-21, 24, 28, 31-32, 37, and 40, totaling 13 items. Meanwhile, the difficult category consisted of numbers 16-17 and 46-48, totaling 5 items.

The research then proceeded to a preliminary trial with a small group of students to assess its feasibility, effectiveness, and student response to the e-module before it was implemented on a larger scale. This trial involved 8 fourth-grade students from the Tahfidz program at Muhammadiyah Weleri Elementary School, with diverse ability characteristics. A small-scale trial was conducted in one learning session. Before using the e-module, students took a pretest to determine their initial abilities. After that, students and the teacher used the e-module in learning activities. The researcher observed students' participation and experiences in using the e-module. Then, students took a posttest to determine their scores after using the e-module, and later both students and the teacher completed a feedback questionnaire to assess the e-module's feasibility, interest, and ease of use.

The data from the small-scale trial were subsequently analyzed to determine the effectiveness of using the e-module. The analyses included descriptive analyses, normality tests, t-tests, N-gain tests, and results from student and teacher response questionnaires. Students' learning outcomes were analyzed descriptively to compare performance levels before and after the use of the module. These results are systematically presented in Table 7.

Table 7. The Results of Small-Scale Pretest and Posttest

Data	Mean	Lowest Score	Highest Score
Pretest	67	52	80
Posttest	81	72	92

As shown in Table 7, the analysis indicated a notable improvement in student achievement in IPAS subjects following the implementation of the CTL-based e-module. Following the descriptive analysis of the pretest and posttest results, a normality test was conducted to verify the distribution of the student learning data. The Shapiro-Wilk test method was selected due to the small sample size ($N < 50$). The resulting statistics are summarized in Table 8 below.

Table 8. The Results of Small-Scale Normality Test

Class		Shapiro-Wilk		
		Statistic	df	Sig.
Results	Pretest (Small Group)	.963	8	.837
	Posttest (Small Group)	.959	8	.801

Based on the normality test results in Table 8 above, the significance values for the pretest and posttest are greater than 0.05, indicating that the data were normally distributed. Once the normal distribution of the pretest and posttest scores was confirmed, the analysis proceeded with a t-test. The t-test was essential to determine if the observed changes in student performance after using the CTL-based e-module were statistically significant. The results of the t-test are presented in Table 9 below.

Table 9. The Results of Small-Scale T-Test

Action	Mean	t	Sig. (2-tailed)
Pretest (Small Group) Posttest (Small Group)	-14.00000	-5.584	.001

As presented in Table 9, the results of the paired sample t-test for the small-scale trial yielded a significance value (Sig. (2-tailed)) of $0.001 < 0.05$. Consequently, the null hypothesis (H_0) was rejected

in favor of the alternative hypothesis (H_a). This indicated a statistically significant difference between pretest and posttest scores, indicating an improvement in students' learning outcomes after using the Linktree-assisted e-module based on CTL. In other words, the developed e-module was effective in the small-scale trial stage.

Following confirmation of both data normality and significant performance gains, the researcher conducted an N-gain analysis to determine the specific level of improvement in students' learning outcomes after using the CTL-based e-module. The overview of the N-gain analysis is summarized in Table 10 below.

Table 10. The Results of Small-Scale N-Gain Test

	N	Minimum	Maximum	Mean	Std. Deviation
N-Gain	8	.17	.71	.4166	.17164
Valid N *(listwise)*	8				

Table 10 shows that the N-gain calculation yielded a mean score of 0.4166. Based on Richard R. Hake's N-gain interpretation criteria, this value falls within the range $0.30 \leq g \leq 0.70$, which is categorized as medium. This indicated that the use of the CTL-based e-module improved students' learning outcomes by a moderate amount.

The analysis of students' and teachers' responses to the CTL-based e-module was conducted after the learning process was completed. Questionnaires were distributed to both students and teachers to collect data. Table 11 below presents the results of the analysis of students' and teacher' responses.

Table 11. The Results of Small-Scale Response Questionnaire

No.	Respondents	Percentage	Category
1.	Students	95.94%	Very Feasible
2.	Teacher	93.75%	Very Feasible

The results in Table 11 above indicated that the developed CTL-based e-module falls into the "very feasible" category. Thus, the e-module can serve as a learning medium to support classroom instruction.

Product Revision

Based on feedback from both student and teacher response questionnaires collected during the small-scale trial stage, further revisions were made to refine the e-module. The previous trial results indicated that the e-module met the feasibility criteria and could be used for learning, therefore not many revisions were made. However, the fourth-grade Tahfidz teacher suggested adding a game-based quiz to encourage students' interest and active participation in learning, so the researcher added a link to the game-based quiz on the e-module's Linktree page.

Trial Usage

The usage trial stage was conducted on a larger group of students. During this phase, the e-module was integrated directly into the classroom instruction across two separate sessions. The initial meeting involved administering a pretest to establish a baseline for the students' prior knowledge. At the subsequent meeting, after completing the instructional process using the CTL-based e-module, a posttest was administered to assess the learning outcomes. The data collected from this large-scale implementation were then subjected to a comprehensive statistical evaluation, including descriptive analysis, normality testing, t-tests, N-gain calculations, and an assessment of student and teacher response questionnaires. To illustrate the impact of the e-module at scale, a descriptive analysis was conducted on students' pretest and posttest scores. The comparative findings from this assessment are summarized in Table 12.

Table 12. The Results of Large-Scale Pretest and Posttest

Data	Mean	Lowest Score	Highest Score
Pretest	66.25	48	84
Posttest	84.83	72	100

According to Table 12, the pretest mean of 66.25 rose to a posttest mean of 84.83. This upward trend confirms a measurable enhancement in student performance following the use of the CTL-based e-module. Next, a normality test was conducted to determine whether the pretest and posttest data from the large-scale usage trial were normally distributed. The results of the normality test are presented in Table 13.

Table 13. The Results of Large-Scale Normality Test

Class		Shapiro-Wilk		
		Statistic	**df**	**Sig.**
Results	Pretest (Large Group)	.932	24	.107
	Posttest (Large Group)	.958	24	.399

Based on the results of the normality test in Table 13, the significance values of the pretest (0.107) and posttest (0.399) were both greater than 0.05. Therefore, it can be concluded that the pretest and posttest data in the large group were normally distributed and meet the requirements for further analysis. Subsequently, a paired-samples t-test was performed to assess the significance of the shift in student performance before and after the implementation of the CTL-based e-module. The findings from this statistical test are detailed in Table 14.

Table 14. The Results of Large-Scale T-Test

Action	Mean	t	Sig. (2-tailed)
Pretest (Large Group) Posttest (Large Group)	-18.58333	-10.795	.000

Table 14 shows that the paired-samples t-test for the large-scale trial yielded a significance value (Sig. (2-tailed)) of 0.000 < 0.05, leading to the rejection of the null hypothesis (H_0) and the acceptance of the alternative hypothesis (H_a). This outcome showed that the difference between the pretest and posttest scores is statistically significant, indicating an overall improvement in students' learning. The results further validated that using a Linktree-assisted e-module based on CTL effectively supported and improved the IPAS learning outcomes of fourth-grade students at Muhammadiyah Weleri Elementary School.

After that, the N-gain calculation was used to determine the level of improvement in students' learning outcomes following the CTL-based e-module during the large-scale usage trial. The results of the N-gain test are presented in Table 15.

Table 15. The Results of Large-Scale N-Gain Test

	N	Minimum	Maximum	Mean	Std. Deviation
N-Gain	24	.23	1.00	.5489	.19662
Valid N *(listwise)*	24				

According to Table 15, the results of the N-gain calculation on a large scale showed an average (mean) value of 0.5489. According to the gain classification, this value falls within the 'moderate' category, confirming that the use of the CTL-based e-module successfully enhanced students' learning outcomes. Student and teacher response questionnaires were distributed at the end of the learning process to assess their responses to the CTL-based e-module following its large-scale implementation. Table 16 below presents the results of the analysis of student and teacher response questionnaires.

Table 16. The Results of Large-Scale Response Questionnaire

No.	Respondents	Percentage	Category
1.	Students	96.61%	Very Feasible
2.	Teacher	97.50%	Very Feasible

Based on the survey results in Table 16 above, the percentage scores were 96.61% for students and 97.50% for teachers, both of which fall into the "very feasible" category. The results indicated that the CTL-based e-module developed has a very high level of feasibility for use in IPAS learning.

Final Product Revision

At the final product revision stage, no improvements were made to the developed e-module. This was due to the fact that no criticism or suggestions for improvement were found during the usability testing phase, from either students or the teacher. In addition to the positive shifts in learning outcomes, the survey data from students and teachers reached the "very feasible" threshold, validating the e-module's suitability for educational use. Based on these findings, the developed e-module is deemed appropriate for implementation. The following images show the finalized design of the e-module, ready for mass production.

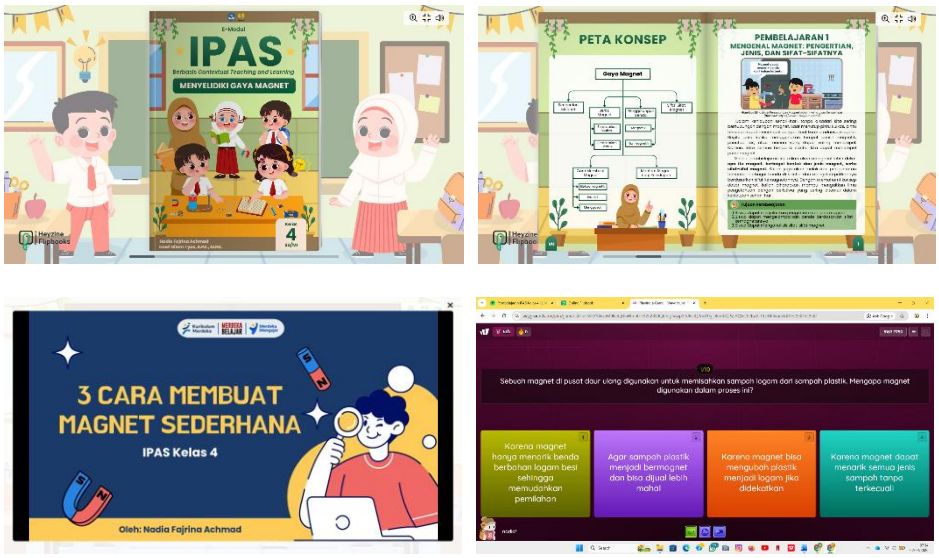

Figure 4. Final Appearance of the E-Module

Mass Production

The final product, a Linktree-assisted e-module based on CTL, which has been deemed feasible and effective, can be mass-produced by distributing the Linktree link to students and the classroom teacher. This product can be used by the teacher as an alternative interactive and contextual digital learning media and can be accessed by students flexibly anytime, anywhere via the Linktree link to support independent and sustainable learning.

Discussion

This research analyzes the design development, design feasibility, and effectiveness of the Linktree-assisted e-module based on CTL in improving learning outcomes in the IPAS subject for fourth-grade students at Muhammadiyah Weleri Elementary School. Based on the research results, the developed e-module was deemed highly suitable for use in learning. This can be confirmed by validation results from material and media experts, which fall into the "very feasible" category and cover aspects of content, layout, language, and appearance. The high level of feasibility indicated that the e-module had been designed in accordance with the principles of systematic, engaging, and appropriate digital learning material development for elementary school students. These findings are in line with previous research, which found that technology-based learning media developed in an organized manner tend to achieve high validity and are suitable for educational use (Liani & Tyas, 2025; Wulansari & Tyas, 2025).

The Development of Linktree-Assisted E-Module Based on Contextual Teaching and Learning Design

The first stage in the development of the e-module design was the analysis of potential and problems to obtain an overview of the learning conditions at Muhammadiyah Weleri Elementary School. The development of the Linktree-assisted e-module based on CTL in this study was conducted in response to the low students' learning outcomes, with only 4 out of 24 students achieving the KKTP

(*Kriteria Ketercapaian Tujuan Pembelajaran*) of 75. This condition indicated that previous learning was still dominated by the use of textbooks and lecture methods. Such methods frequently lead to student disengagement, making it challenging for them to internalize concepts that lack a concrete or visual basis. The problem aligns with the finding that low science learning outcomes in elementary schools are caused by the underuse of engaging, contextually relevant learning media (Sariwedani et al., 2025). In accordance with the concrete operational stage of development, elementary school learners require learning that presents direct experiences, visualization, and connections to everyday life to make learning easier to understand (Ayuningtyas & Widodo, 2026; Nurmasari et al., 2023; Schoenherr et al., 2024).

The second stage involved data collection on student characteristics, teachers' and students' needs regarding learning materials, and the content to be developed for the e-module. The data collection results showed that students were more interested in learning that used visual and multimedia materials, such as images, videos, and animations, than in text-based learning alone. This indicated that students need interactive and varied learning media to enhance their motivation and engagement in learning. The findings are consistent with the existing literature, which posits that digital learning materials, such as e-modules, can enhance learning interest because they present content in engaging, non-monotone multimedia (Wahyuni & Arnyana, 2022).

Following the initial needs analysis, a CTL-based e-module was developed, with Linktree as a supporting medium, constituting the third stage of its development. The E-module was chosen because it has interactive, flexible, and easily accessible characteristics, and it supports independent learning through multimedia integration (Purwanti et al., 2023; Sidauruk et al., 2025). These characteristics also align with the concept of e-modules as digital teaching materials that enable students to learn independently through a systematic, interactive layout and content, as well as multimedia elements such as images, videos, and animations (Feri & Zulherman, 2021; Widiastuti, 2021). Additionally, the e-module was designed to facilitate higher-order thinking through inquiry- and problem-solving-based tasks, which have been proven to enhance students' critical thinking skills (Yusuf et al., 2020).

The e-module was systematically organized into three main sections: introduction, content, and conclusion, thereby creating a structured and user-friendly learning flow. The e-module's design also integrates CTL principles that emphasize the connection between the material and students' real-life experiences by incorporating seven fundamental elements of CTL: constructivism, questioning, inquiry, learning community, modeling, reflection, and authentic assessment (Fauziah & Nurita, 2019). This learning model allows students to actively and meaningfully construct knowledge, as contextual learning can enhance understanding by enabling students to learn through real experiences (Mahmuti et al., 2025; Perales & Ulla, 2025; Rahayu & Firdaus, 2025).

In its development, the e-module also considered important principles, such as self-instruction, self-containedness, user-friendliness, interactivity, and support for self-assessment through integrated exercises and evaluations (Lasala, 2023). These principles align with the characteristics of an effective e-module in supporting independent learning and enhancing conceptual understanding more concretely (Widiastuti, 2021). Additionally, integrating the Linktree platform enables the aggregation of various learning resources into a centralized hub, making it easier for students to access materials, videos, and exercises in a practical, organized way (Andika & Yudiana, 2022). Thus, the development of Linktree-assisted CTL-based e-module in this study not only addressed the need for more interactive and contextual learning but also supported the development of 21st-century skills through the integration of technology and student-centered learning models.

The Feasibility of Linktree-Assisted E-Module Based on Contextual Teaching and Learning

After the product design was completed, a validation process was conducted by a material expert and a media expert to determine the feasibility of the developed e-module. The validation results showed that the e-module received a percentage of 87% from material experts and 98% from media experts, both of which fall into the "very feasible" category. Overall, the Linktree-assisted CTL-based e-module was considered highly feasible because it met the content, media, language, and layout requirements appropriate for elementary school students. This high degree of feasibility is corroborated by the findings of Aprianti et al. (2023), who reported percentages of 85% from material experts and 82% from media experts. These findings are in line with the research of Feri and Zulherman (2021), which emphasized that technology-based e-modules are highly feasible.

From a material perspective, the e-module was organized systematically and communicatively, in accordance with the learning objectives and student characteristics, thereby facilitating concept comprehension. This aligns with Yulia and Suttrisno (2024), who state that effective teaching materials must have a clear structure and a systematic presentation. In addition, the material was presented in a contextually relevant way, aligning with CTL principles and connecting with students' real lives. From a media perspective, attractive visual displays, the use of illustrations and videos, and a systematic layout have been shown to enhance students' attention and understanding, as reported by Abdulrahaman et al. (2020) and Qing et al. (2024).

The integration of Linktree into e-modules also provides easy access to various learning resources on a single platform, thereby increasing efficiency and ease of use. This aligns with Nafis and Nuryanto (2025), who stated that Linktree-based media has high feasibility and is easy to use. In addition, the e-module adheres to the principles of user-friendliness and self-instruction, which support students' independent learning, as emphasized by Idayanti & Suleman (2024). Nevertheless, the validators have made some minor improvement suggestions, such as layout enhancements and the addition of image references, which have been addressed through product revisions. Thus, the developed e-module has met the feasibility criteria both theoretically and empirically, making it suitable for use in IPAS learning in elementary schools.

The Effectiveness of Linktree-Assisted E-Module Based on Contextual Teaching and Learning

The effectiveness of the e-module in this study was validated by the positive shift in academic results, which remained consistent throughout the progressive stages of testing, from initial small-scale trials to broader large-scale application. In the small-scale trial, the average pretest score increased from 67 to 81, while in the large-scale usage trial, it increased from 66.25 to 84.83. This improvement indicated that the Linktree-assisted CTL-based e-module was capable of helping students understand the concept of magnets, which was previously abstract, through material presented with images, videos, and contextual examples. This aligns with Fauziah & Nurita (2019) and Pratiwi et al. (2024), who highlighted that contextual learning supported by interactive media can enhance student engagement and understanding. In addition, the results of the statistical tests showed a significance value of 0.001 on a small scale and 0.000 on a large scale (<0.05), which means that the use of e-modules was effective in improving students' IPAS learning outcomes.

This effectiveness was also reinforced by the N-gain analysis, which showed a moderate category, namely 0.4166 on a small scale and 0.5489 on a large scale. Although it had not yet reached a high level, the results still showed a fairly good improvement in learning outcomes. This variation in improvement was influenced by several factors, including differences in students' initial abilities, the limited time spent on e-module use, and students' experience with digital media, as stated by Kharomah et al. (2024). Nevertheless, these results indicated that the e-module has the potential to optimally enhance learning outcomes if used continuously.

Aside from the cognitive aspect, the effectiveness of the e-module was also evident from the high response rates of students and classroom teacher. In a small-scale trial, the student response reached 95.94% and the teacher response 93.75%, while in a large-scale trial, they reached 96.61% and 97.50% respectively, all of which fall into the "very feasible" category. This showed that the e-module was not only effective in improving learning outcomes but also engaging, easy to use, and suitable for the learning needs of elementary school students.

The findings of this study are in line with previous studies that show that technology-based and contextually relevant e-modules are effective in improving learning outcomes. Firdaus et al. (2024) showed that interactive e-modules significantly affect student understanding, while Susilawati et al. (2025) found that technology-based CTL has a significant impact with a value of 0.004 (<0.05). Additionally, Suwandi et al. (2023) demonstrated that e-modules can enhance students' science literacy, while Saptono (2023) stated that digital media can increase learning motivation. These results are also supported by Liani and Tyas (2025) and Wulansari and Tyas (2025), who showed that digital learning media are effective, with a moderate N-gain. Other research by Zaniyati and Rohmani (2024), Widyaningrum & Parmiti (2024), and Desnita et al. (2022) also confirmed that CTL-based e-modules are deemed valid, practical, and effective in improving student learning outcomes.

Learning is fundamentally related to the context in which knowledge is constructed, and knowledge inseparable from the specific contexts and actions that define it. Therefore, the use of CTL

in learning is believed to enhance students' learning experiences and outcomes (Perales & Ulla, 2025). Thus, the Linktree-assisted CTL-based e-module has proven effective in improving learning outcomes in the IPAS subject for fourth-grade students. The integration of interactive e-module design influenced this effectiveness, the application of contextual learning models, and the use of digital technology to support more active, meaningful, and student-centered learning.

Conclusion

Following the completed research and development process, it is suggested that the Linktree-assisted e-module based on CTL on the topic "Magnetic Force" of IPAS subject was proven to be very feasible and effective in improving the learning outcomes of fourth-grade students. The feasibility of this media can be seen from validation results from a material expert (87%) and a media expert (98%), as well as from survey responses from a classroom teacher (97.50%) and students (96.61%). Its effectiveness was demonstrated by a significant improvement in student learning outcomes, with a t-test value of 0.000 and an average N-gain of 0.5489. Thus, this e-module can serve as an innovative digital teaching resource that facilitates more practical, engaging, and effective learning for elementary school students.

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