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Interactive Powerpoint Media Integrated with the Problem Based Learning Model to Facilitate the Strengthening of Critical Reasoning and Independence Dimensions of Grade IV Elementary School Students

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ABSTRACT

The implementation of Problem Based Learning (PBL) in elementary schools is often limited by the lack of interactive learning media, resulting in suboptimal development of students' critical reasoning and learning independence. This gap highlights the need for instructional media that effectively supports PBL while actively engaging students in meaningful learning processes. This study aims to develop an interactive PowerPoint media integrated with PBL syntax that is valid, practical, and effective in enhancing students' critical reasoning and learning independence. The study adopts the Lee & Owens development model, which includes analysis, design, development, implementation, and evaluation stages. Data were collected through observation, interviews, questionnaires, tests, and documentation. Data were analyzed using descriptive statistics and N-Gain to determine effectiveness, while qualitative data were analyzed using an interpretative approach based on Stake (1995). The results show that the developed media meets validity criteria based on expert judgment and demonstrates high practicality in both teacher and student responses. In terms of effectiveness, the media improves students' critical reasoning skills, as indicated by a high N-Gain value (0.73). In addition, students' learning independence reaches a high level, with most students categorized as highly independent. The novelty of this study lies in the integration of structured PBL syntax into interactive PowerPoint media to simultaneously enhance critical reasoning and learning independence in elementary school contexts. Overall, the developed media is feasible, practical, and effective for supporting PBL-based learning in elementary education.

Keywords: Interactive Powerpoint; Problem Based Learning; Critical Reasoning; Independence

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1. INTRODUCTION

21st-century education emphasizes the development of critical thinking skills and independent learning as essential competencies for students. In the context of the development towards Society 5.0, learning is not only oriented towards knowledge mastery, but also on students' ability to solve problems and learn independently through the meaningful use of technology ((Fullan, 2016; Harahap et al., 2023; Redhana, 2024). In Indonesia, these demands are emphasized in graduate competency standards, which place critical reasoning and independence as essential components of the graduate profile (Untari et al., 2022). However, the implementation of learning that supports these skills remains suboptimal. The integration of technology, pedagogy, and content, as outlined in the TPACK framework, is often not implemented effectively, resulting in teacher-centered learning that lacks active student engagement (Koehler & Mishra, 2009; Lutfiana et al., 2023; Mutiani et al., 2021). This situation impacts students' low critical thinking skills and learning independence (Novita & Fitria, 2023; Rionaldi et al., 2025a). Furthermore, the use of interactive digital media in elementary schools is still limited, thus limiting students' opportunities to understand concepts in depth (Montessori & Zainil, 2024).

This problem is evident in Pancasila Education learning in fourth-grade students at SDN Mojolangu 5. Based on an assessment of one class of 24 students, the average score was 64.09, with 83.3% of students not achieving learning mastery. This data indicates that students' critical thinking skills are still low. Observations also indicate that students' learning independence has not developed optimally, indicated by low initiative, responsibility, and engagement in learning. The learning process is still dominated by lecture methods, while the media used is limited to conventional, one-way PowerPoint presentations.

One relevant approach to addressing this problem is Problem-Based Learning (PBL), which emphasizes contextual problem-solving to foster critical thinking skills and learning independence. Various studies have shown that PBL and interactive digital media contribute positively to the development of higher-order thinking skills and student independent learning (Abelia & Yuliana, 2025; Handayani, 2022; Nasikin et al., 2025; Rionaldi et al., 2025b). However, the effectiveness of PBL depends heavily on the support of learning media that can facilitate active student engagement. In this context, PowerPoint has practical advantages over other media because it is easily accessible, familiar to elementary school teachers, and flexible enough to be developed into interactive media through the integration of various multimedia elements without requiring complex technical expertise. Therefore, developing interactive PowerPoint is a realistic solution to support the implementation of technology-based PBL in elementary schools.

However, previous research generally separates the use of learning models and media, or has not integrated PBL syntax directly into the design of learning media. No previous study has specifically developed interactive PowerPoint media that explicitly integrates PBL syntax to simultaneously enhance

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students' critical reasoning and learning independence in elementary school contexts, particularly in Pancasila Education.

Based on this gap, this study offers a novelty in the form of developing interactive PowerPoint media that integrates Problem Based Learning (PBL) syntax in an integrated learning design. Theoretically, this study contributes to the development of PBL-based digital media studies in elementary schools. Practically, the media developed in HTML5 format is expected to be easily accessible and used by teachers to support more interactive and meaningful learning. Therefore, this study aims to develop interactive PowerPoint media integrated with PBL that is valid, practical, and effective in improving critical thinking skills and learning independence of fourth-grade elementary school students.

2. METHOD

2.1. Types of research

This study employed a Research and Development (R&D) approach using the Lee & Owens model, which consists of five stages: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation (Lee & Owens, 2004). This model was selected due to its systematic structure and suitability for multimedia-based learning development (Akbar, 2016; Ariyanti, 2022).

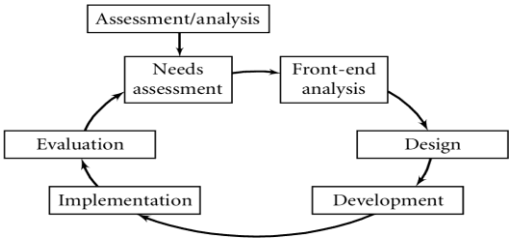

Figure 1. Types of Research

In the analysis stage, observations and interviews were conducted to identify learning problems, student characteristics, and instructional needs. These data were analyzed qualitatively using an interpretative approach to determine the basis for media development. In the design stage, the structure of the interactive PowerPoint media and the integration of Problem Based Learning (PBL) syntax were planned, including learning objectives, content organization, and interactive features. In the development stage, the media product was created and validated by material and media experts using questionnaires. Quantitative data from validation were analyzed using percentage-based descriptive statistics to determine the level of validity, while qualitative feedback from experts was analyzed descriptively to guide product revision. In the implementation stage, the developed media was tested through small-scale and large-scale trials involving students and teachers. Practicality data were collected using questionnaires and analyzed using descriptive percentages to determine the level of

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usability and user response. In the evaluation stage, the effectiveness of the media was measured through pretest and posttest results. Quantitative data were analyzed using descriptive statistics and N-Gain analysis to determine the level of improvement in students' critical reasoning. In addition, student learning independence was assessed through observation and analyzed qualitatively to interpret behavioral changes during the learning process.

2.1. Research Design

The research was conducted at SDN Mojolangu 5, Malang City, in 2025. The subjects included material experts, media experts, teachers, and fourth-grade students. Material and media experts were involved to evaluate the validity of the product, while teachers and students participated in assessing its practicality and effectiveness in enhancing students' critical reasoning and learning independence.

2.2. Data Collection Techniques

Data collection techniques included observation, interviews, questionnaires, pretest-posttest, and documentation. Overall, data were analyzed using both qualitative and quantitative approaches, ensuring that each stage of the development process contributed systematically to the research findings.

2.3. Data Analysis Techniques

Data analysis was conducted using qualitative and quantitative approaches. Qualitative analysis was used to assess suggestions and input from experts and users as a basis for product revisions, using an interpretive approach based on Robert E. Stake (Stake, 1995). Meanwhile, quantitative analysis was used to process questionnaire data and test results to obtain objective measures of the media's validity, practicality, and effectiveness. Learning effectiveness was analyzed using descriptive statistics and N-Gain calculations.

3. RESULTS & DISCUSSION

3.1. Results

The initial stage of this research and development aimed to identify problems, needs, and real-world conditions. Data was obtained through observation, documentation, and interviews in fourth-grade classes at Mojolangu 5 Elementary School as the basis for designing learning media that meet student needs and curriculum requirements. Observations indicate that Pancasila Education instruction has not fully implemented the contextual learning principles outlined in the Independent Curriculum. Teachers still predominantly use lecture, question-and-answer, and assignment methods, with limited media utilization of blackboards and textbooks. Although digital resources are available, their use is not optimal.

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The results of HOTS-based summative assessment documentation indicate that students' critical reasoning skills remain low. Of the 24 students, the average score was 64.09, with 20 students (83.3%) not reaching the Minimum Competency (KKM) of 75. Most scores fell between 60 and 70, and only a few students scored above 80. These findings indicate that students' critical reasoning skills have not developed evenly. Observations of independent learning showed suboptimal results. In terms of responsibility, initiative, and adaptability, the majority of students still rely on teacher guidance and are unable to manage their learning independently. Interviews with fourth-grade teachers corroborate these findings. The teachers reported that the implementation of student-centered learning models, such as PBL, has not been optimal due to low student participation, limited confidence in expressing opinions, and a lack of interactive learning media. The media used is still conventional PowerPoint presentations, which do not support contextual problem exploration and meaningful learning. Based on observations, documentation, and interviews, it can be concluded that learning is not fully contextual and interactive, students' critical reasoning skills are still low, independent learning has not developed optimally, and the learning media used do not effectively support PBL-based learning.

3.2. Design

The media design stage includes three main steps: (1) preparing the hardware and software used in media creation, (2) compiling a storyboard containing the navigation flow, slide structure, visual elements, and PBL syntax integration, and (3) designing development instruments that include instruments for validity, practicality, and effectiveness.

3.2.1. Preparing Hardware and Software

The hardware used in the media development process consists of a computer or laptop with specifications that support the installation of Microsoft PowerPoint and iSpring Suite 11. The primary software used is Microsoft PowerPoint, while iSpring Suite 11 serves as supporting software integrated as an add-in to expand PowerPoint's capabilities, particularly in creating interactive components in the media.

3.2.2. Developing the Storyboard

Preparing a storyboard facilitates the media design process by presenting initial sketches of the content on each slide. This design includes determining the content, navigation flow, and function of each slide before the media is developed into a prototype. The complete storyboard is presented in the Appendix.

3.2.3. Designing Research Instruments

The instrument development aimed to obtain quantitative and qualitative data to analyze the validity, practicality, and effectiveness of the Integrated Interactive PowerPoint Media with the PBL Model. The instruments developed consisted of three types: a validity instrument given to subject matter experts and media experts to assess the media's suitability; a practicality instrument aimed at teachers

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and students to determine the media's practicality; and an effectiveness instrument given to students to measure the media's effectiveness in strengthening critical reasoning and independence in fourth-grade elementary school students.

3.3. Development

The development stage includes three main parts, namely (1) media preparation, (2) preparation of usage guidelines, and (3) validation testing by material experts and media experts. This stage focuses on realizing the design that was previously formulated conceptually into a media product that can be operationalized in learning activities. The development process was carried out using Microsoft PowerPoint combined with iSpring Suite 11 so that all interactive features, navigation, and learning content can be implemented according to the design that has been prepared. The initial product produced is a media prototype in the form of an interactive slide that displays Problem-Based Learning (PBL) syntax systematically. After all components are composed, the prototype is exported into HTML5 format to ensure more flexible accessibility through various devices. In addition to developing the media, this stage also includes the development of user guidelines for teachers and fourth-grade students. These guidelines contain important information regarding product descriptions, media structure, and user instructions to assist users in operating the media during the learning process. The user guidelines are provided separately in PDF format.

In the final development stage, the resulting media prototype was validated by subject matter and media experts using a pre-designed validation instrument. This validation aimed to assess the media's feasibility before field testing during the implementation phase. Validation results by subject matter experts indicate that the quality of media content is assessed based on five aspects: curriculum suitability, language suitability, PBL model implementation, and the media's ability to facilitate critical reasoning and encourage student learning independence.

Table 1. Summary of the assessment results

No.	Assessment Aspects	Total Score
1.	Compliance curriculum	12
2.	Compliance language	9
3.	Implementation of the PBL model	27
4.	Facilitate the reasoning process article	17
5.	Encouraging independence study	13
Total Score		**78**
Maximum Score		**92**
Average		**84.78%**
Category		**Valid**

Source: Researcher Processing (2025)

Based on the assessment results presented in the table, it can be seen that the media obtained a total score of 78 out of a maximum score of 92, with an average percentage of 84.78%. The percentage value achieved indicates that the material in the media is classified as valid, because it is in the classification range of 70.01–85.00. Suggestions and input obtained from material experts for product

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improvement are the need to adjust the language and word choice to be more appropriate to the abilities of children aged grade IV of elementary school. Thus, it can be concluded that the learning media is declared suitable for use with minor revisions according to the assessment results by material experts.

Validation results by media experts indicate that media quality is assessed based on seven main aspects, including media display and presentation design, media functionality and operation, language, user interaction and involvement, PBL model implementation, critical reasoning facilities, and independence facilities. A summary of the assessment results for each aspect is presented in the following table.

Table 2. Summary of the assessment results for each aspect

No.	Assessment Aspects	Total Score
1.	Media display and presentation design	19
2.	Media functionality and operation	18
3.	Linguistics	8
4.	User interaction and engagement	12
5.	Implementation of the PBL model	8
6.	Critical reasoning facilites	23
7.	Independence fasilites	11
Total Score		**99**
Maximum Score		**104**
Average		**95.19%**
Category		**Very Valid**

Source: Researcher Processing (2025)

Based on the assessment results presented in the table, it can be seen that the media obtained a total score of 99 out of a maximum score of 104, with an average percentage of 95.19%. The percentage value achieved indicates that the Integrated Interactive Powerpoint media with the PBL Model is classified as very valid, because it is in the classification range of 85.01-100. Thus, it can be concluded that the Integrated Interactive Powerpoint media with the PBL Model can be used without revision.

3.4. Implementation

Implementation activities were carried out through product trials in grade IV of SDN Mojolangu 5, consisting of small-scale trials dan large-scalls trials. Both trials were conducted face to face for two days to obtain an overview of the practically and effectiveness of the media. Practically assesments were conducted by teachers and students are users. Before the trial began, students were given a pretest to determine their initial abilities, and after the trial was completed, they filled out a practicality questionnaire and completed a posttest to see changes in critical reasoning abilities. The implementation results are presented in two parts, namely (1) practicality results and (2) effectiveness results. The practicality assessment of the Integrated Interactive PowerPoint Media PBL Model was carried out by the grade IV teacher as a practitioner on November 27, 2025. The assessment process included 6 aspects, including material suitability, language suitability, display design quality, text presentation feasibility, ease of use, and the level of media practicality. The results of the practicality assessment by the teacher are presented in the following table.

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Table 3. The results of the practicality assessment

No.	Assessment Aspects	Total Score
1.	Material suitability	12
2.	Language compatibility	7
3.	Display design quality	7
4.	Suitability of text presentation	12
5.	Ease of use	11
6.	Practicality of media	8
Total Score		**57**
Maximum Score		**60**
Average		**95%**
Category		**Very Practical**

Source: Researcher Processing (2025)

Based on the recapitulation of the results of the media practicality test with users in the table above, it can be seen that the media obtained a total score of 57 out of a maximum score of 60, with an average percentage of 95%. The percentage value achieved shows that the media is classified as very practical, because it is in the classification range of 85.01 - 100.00. Thus, it can be concluded that the Integrated Interactive Powerpoint Media PBL Model is stated to be very practical, can be used without revision. The practicality assessment by students was conducted in two stages: a small-scale trial and a large- scale trial. The small-scale trial involved six students with low, medium, and high cognitive abilities, and was conducted for one day on November 27, 2025. At this stage, each student used the developed media, then completed a questionnaire to assess the level of practicality of the media and provided descriptive responses and suggestions. The responses and suggestions provided in this small-scale trial served as the basis for improvements before the product was tested on a large scale. Subsequently, a large-scale trial was conducted involving 17 students on November 28, 2025, with the same procedure: media use followed by filling out a practicality questionnaire and submitting responses. A summary of the practicality assessment results from both trial stages is presented in the following table.

Table 4. Summary of the practicality assessment results

No.	Statement Items	Scale Small	Large Scale
1.	I can understand instruction method use media learning	6	17
2.	I can operate media learning easily	5	17
3.	Material in media displayed with clear so that I easy understand it	6	17
4.	Material in media served in a way massage so that easy to follow	6	17
5.	Material learning in media displayed interestingly	4	15
6.	Combination color in media seen harmonious	6	16
7.	Type And size letter in the media easy read	4	16
8.	Language Which used in media easy I understand	4	15
9.	Media learning allows existence interaction two- way direction	5	15
10.	I find it easier to understand the material by using media learning PowerPoint interactive	5	16
11.	I feel more enthusiastic when Study using interactive PowerPoint learning media	5	17
12.	I hope so that media learning PowerPoint interactive can implemented on material other	5	16
	Total Score	60	194

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Maximum Score	72	204
Average	84.72%	95.10%
Category	Quite Practical	Very Practical

Source: Researcher Processing (2025)

The practicality assessment results showed an improvement from the small-scale trial to the large- scale trial. In the small-scale trial, the media obtained a score of 60 out of 72 with a percentage of 83.33%, which is in the fairly practical category. This finding indicates that the media is usable, but still requires improvements based on identified obstacles, including minor errors in the navigation flow, the use of foreign terms that are not fully understood by fourth-grade students, and the level of product appeal that is affected by the media's use in groups. These obstacles were then used as the basis for revisions before the trial on a larger scale.

After revisions were made, a large-scale trial showed an increase in the quality of practicality. The media obtained a score of 194 out of 204 with a percentage of 92.91%, which is included in the very practical category. At this stage, students gave positive responses to the Integrated Interactive PowerPoint media with the PBL Model, including that the media was considered interesting, the presentation of the material was clear and easy to understand, and helped strengthen conceptual understanding. Several students also expressed the hope that similar media could be used for other materials. These findings confirmed that the media had optimally met the practicality aspect and could be implemented without requiring further revision.

The effectiveness of Integrated Interactive Powerpoint media PBL Model in strengthening critical reasoning was measured by administering pretests and posttests to fourth grade students to see changes in ability before and after media use. The pretest was conducted on November 27, 2025 before the media trial, while the posttest was administered on November 28, 2025 after the entire learning series was completed. Both tests used an instrument in the form of five essay questions that assessed critical reasoning indicators. Ability improvements were analyzed using the N-Gain Score calculated from the difference in pretest and posttest scores, with high ($g \geq 0.70$), medium ($0.30 \leq g < 0.70$), and low ($g < 0.30$) categories. The summary of the pretest, posttest results, and N-Gain values that describe the level of media effectiveness in strengthening critical reasoning dimensions are presented in the following table.

Table 5. The level of media effectiveness in strengthening critical reasoning dimensions

Critical Reasoning Indicators	Small Scale		Large Scale	
	Question Items	Average	Question Items	Average
Have a sense of curiosity	3	52.08	1	88.54
Able to think logically and analytically	4	51.04	2	81.25
Able to analyze and solve problems	1	48.96	3	87.50
	2	47.92	4	79.17
Arguing logically based on literacy and numeracy	5	36.46	5	78.13

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Number of Students	23	23
Minimum Score	45	80
Maximum Score	60	95
Average	49.78	86.52
Standard Deviation	4.38	5.10
N-Gain Score	70.19	

Source: Source: Researcher Processing (2025)

The pretest results of 23 fourth-grade students showed that their critical reasoning ability was still in the low category with an average score of 49.78. This condition indicates that before learning using media, students did not have adequate critical reasoning competencies. After the implementation of the media, there was a significant strengthening in all indicators. The average posttest score increased to 86.52, with indicator achievements much higher than the pretest. The magnitude of this strengthening was reinforced through the calculation of the N-Gain Score using the formula $N\ Gain = \frac{86{,}52-49{,}78}{100-49{,}78} = \frac{36{,}74}{50{,}22} = 0{,}73$. The N-Gain score of 0.73 or 70.19% is in the high category, which indicates that the increase in students' critical reasoning abilities took place substantially. Thus, the Integrated Interactive PowerPoint media PBL Model can be declared effective in strengthening the critical reasoning abilities of fourth-grade students.

The effectiveness of the media in strengthening student independence was measured using an independence instrument by observing the behavior of fourth-grade students during learning activities. The results of the observations were analyzed to describe the level of student independence during the implementation of the Integrated Interactive Powerpoint media with the PBL Model. The following table presents the results of the total score, percentage, and category as a representation of the level of independence of fourth-grade students.

Table 6. Level of independence.

No.	Student Name	Total Score	Percentage	Category
1.	ADZ	39	96.67%	Very Independent
2.	OH	38	93.33%	Very Independent
3.	AMS	38	93.33%	Very Independent
4.	AQF	39	96.67%	Very Independent
5.	BPA	35	83.33%	Very Independent
6.	CANK	38	93.33%	Very Independent
7.	EFP	36	86.67%	Very Independent
8.	FKPM	39	96.67%	Very Independent
9.	GSPH	39	96.67%	Very Independent
10.	HAS	39	96.67%	Very Independent
11.	MHPB	38	93.33%	Very Independent
12.	MQT	39	96.67%	Very Independent
13.	MAHS	38	93.33%	Very Independent
14.	MRAP	36	86.67%	Very Independent
15.	MRIP	36	86.67%	Very Independent
16.	NNR	35	83.33%	Very Independent
17.	OBS	35	83.33%	Very Independent
18.	RAP	36	86.67%	Very Independent
19.	RZA	36	86.67%	Very Independent

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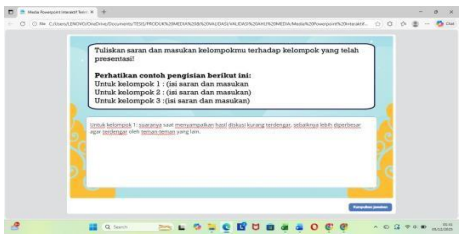
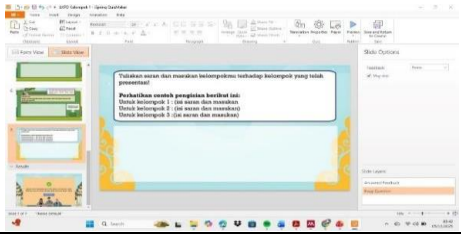
20.	RSS	32	73.33%	Independent
21.	SAAK	36	86.67%	Very Independent
22.	Natural Resources	35	83.33%	Very Independent
23.	TAA	36	86.67%	Very Independent
	Average		83.33%	Very Independent

Source: Researcher Processing (2025)

3.5. Evaluation

The evaluation was conducted through a series of improvements to the Integrated Interactive PowerPoint Media with PBL Model. These improvements were based on suggestions, input, and findings obtained from expert validation tests and from the media's implementation in the field. Product improvements included the integration of LKPD (Learning Worksheet) and suggestion-input features into a single set of activities and the replacement of foreign terms with Indonesian. A description of these improvements is presented in the following section to provide an overview of the changes resulting from the evaluation process.

Table 7. Overview of the changes resulting from the evaluation process.

Aspect revisions	Before revision	After revision
Integration of LKPD and suggestion imput features into one series of activities	The LKPD and suggestion-input features are separate so that the usage flow is less efficient and students cannot return to access or correct the discussion results after submitting answers. 	LKPD and suggestion-input features are integrated into one series of activities, so that the workflow is more integrated and the presentation group can re-access the discussion results before the presentation. 
Replacing foreign terms with Indonesian	Statements that appear before students collect answers using English	The statement that appeared before students collected the answers was changed into Indonesian.
	Statements that appear during the sending process quiz is ”Sending quiz results.. ”	The statement that appears during the quiz sending process is “Sending quiz results..”

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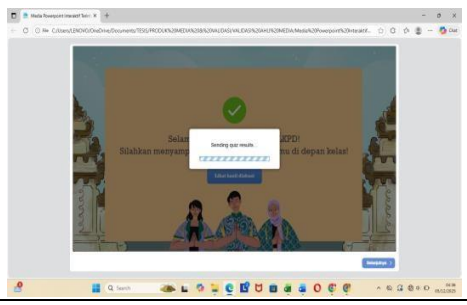

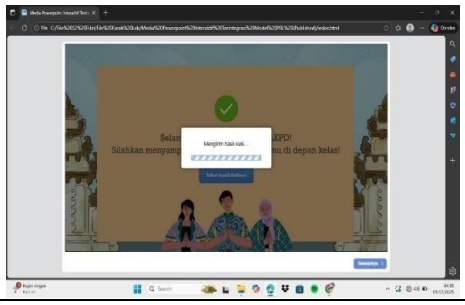

Source: Source: Researcher Processing (2025)

3.6. Discussion

3.6.1. Media Validity Assessment

The suitability of the Integrated Interactive PowerPoint Media using the PBL Model was determined through validation by subject matter experts and media experts. The assessment focused on curriculum alignment, language appropriateness, visual design quality, interactivity, implementation of PBL syntax, and the media's ability to facilitate critical reasoning and learning independence. The validation results showed that the media achieved 84.78% from material experts (valid category) and 95.19% from media experts (very valid category), indicating a high level of validity.

The media is considered valid because it demonstrates strong alignment between learning objectives, content, and student characteristics. This alignment is essential in supporting effective learning processes (Gagné et al., 2005). In addition, the use of communicative language appropriate to students' cognitive development enhances comprehension, as supported by Berutu & Margana (2023). Compared to previous studies, these findings reinforce the importance of aligning instructional components, while also demonstrating a more structured approach through the integration of PBL syntax directly within the media design. This indicates that integrating pedagogical models into media design can strengthen not only content delivery but also the learning process itself, which aligns with the principles of the TPACK framework (Koehler & Mishra, 2009).

The validity is further supported by the systematic integration of PBL syntax, including problem orientation, organizing learning, investigation, communicating results, and verification. This structure enables students to actively construct knowledge through problem-solving activities (Barrows & Tamblyn, 1980). Unlike prior studies that applied PBL mainly at the instructional level, this study embeds PBL syntax within the media itself, ensuring that students consistently engage in each stage of the learning process. This finding contributes to the literature by demonstrating that the effectiveness of PBL can be enhanced when its syntax is explicitly embedded into interactive learning media rather than relying solely on teacher facilitation

Moreover, the media facilitates meaningful interaction through exploration activities, discussions, and reflection features. These elements support participatory learning environments and promote student engagement (Bates & Vancouver, 2019). Interactive media that enable exploration and reflection have

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been shown to enhance learning independence (Rosbina et al., 2025). Therefore, the developed media not only meets validity criteria but also provides practical value for teachers by offering a structured yet accessible approach to implementing interactive and student-centered learning.

3.6.2. Media Practicality Assessment

The practicality of the Integrated Interactive PowerPoint Media with the PBL Model was assessed by teachers and students through small-scale and large-scale trials. The results showed very high practicality, with teacher responses reaching 95%, small-scale trials 83.33% (moderately practical), and large-scale trials 95.10% (very practical). These findings indicate that the media is easy to use and suitable for classroom implementation without requiring significant revision.

The media is considered practical due to its ease of operation, balanced integration of text and visuals, communicative language, and its ability to support student understanding. Ease of use and accessibility are key factors influencing the adoption of learning media (Bates & Vancouver, 2019). Compared to other studies that utilize more complex digital platforms, this study demonstrates that highly practical learning media can still be developed using familiar tools such as PowerPoint. This makes the media more feasible for real classroom contexts, particularly in elementary schools where teachers may have limited technological expertise.

The structured presentation of content based on PBL stages also contributes to its practicality. Information is presented in smaller segments, allowing students to process it more effectively (Mayer, 2002). This reduces cognitive overload and supports deeper understanding (Rey et al., 2019). In contrast to conventional PowerPoint presentations that are often linear and one-directional, this media provides interactive navigation and staged learning activities that enhance student engagement. This finding implies that effective technology integration does not necessarily depend on sophisticated tools, but rather on how well pedagogical design is embedded within accessible technology, thereby strengthening the practical implementation of TPACK in classroom settings.

3.6.3. Media Effectiveness Study

The effectiveness of the Integrated Interactive PowerPoint Media with the PBL Model was evaluated through tests of critical reasoning and observations of student learning independence. The results showed a significant improvement in students' critical reasoning skills, with scores increasing from a pretest average of 49.78 to a posttest average of 86.52. The N-Gain value of 0.73 indicates a high level of effectiveness.

This result is higher compared to previous research by (Ananti & Anggraini, 2023), which reported a moderate N-Gain of 0.69. This suggests that the integration of PBL syntax directly into the media design contributes to a more substantial improvement in critical reasoning skills. The structured guidance embedded within the media allows students to systematically engage in higher-order thinking processes, including problem identification, analysis, and solution development. These findings not only reinforce previous studies on the effectiveness of PBL and interactive media, but also demonstrate that

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embedding pedagogical structures within digital media can produce more consistent and significant learning outcomes.

In terms of learning independence, the results show that most students achieved a very high level of independence, with an average percentage of 91.52%. This finding confirms previous research (Handayani, 2022) on the role of interactive media in fostering independent learning. However, this study shows a stronger impact due to the integration of specific features such as self-navigation, time monitoring, and structured instructions. These features enable students to regulate their learning processes, including planning, monitoring, and evaluating their performance, in line with the concept of self-regulated learning (Lazorak et al., 2021).

Furthermore, the availability of integrated learning resources within the media supports flexible and responsive learning (Setiawan & Sudrajat, 2018). This indicates that interactive media not only functions as a tool for delivering content but also as a learning environment that facilitates student autonomy. From a broader perspective, these findings contribute to the development of PBL-based learning in elementary education by demonstrating that the integration of interactive media and pedagogical models can simultaneously enhance cognitive and metacognitive skills. This also provides practical implications for teachers, showing that accessible tools such as PowerPoint can be optimized to support innovative, student-centered learning without requiring complex technological expertise.

Based on the overall results of the effectiveness study, it can be concluded that the Integrated Interactive PowerPoint media with the PBL Model is effective in strengthening critical reasoning and independence of fourth-grade students. This effectiveness is seen through the improvement of higher-order thinking skills facilitated by the PBL stages, as well as the development of student self-regulation in managing time, monitoring the learning process, and completing assignments independently. Learning media, ideally, not only functions as a means of conveying information, but also plays a role in shaping students' understanding as a whole (Labibah et al., 2025).

Despite the positive findings, this study has several limitations that should be considered when interpreting the results. First, the study was conducted in a single class within one elementary school, which may limit the generalizability of the findings to broader educational contexts. Second, the research design did not include a control group, making it difficult to compare the effectiveness of the developed media with other instructional approaches. Third, the duration of the implementation was relatively short, as it was conducted over a limited number of learning sessions, which may not fully capture the long-term impact of the media on students' critical reasoning and learning independence. In addition, the measurement of learning independence relied primarily on observational instruments, which may be subject to observer bias despite the use of structured indicators. Therefore, future studies are recommended to involve a larger and more diverse sample, apply experimental designs with control groups, extend the duration of implementation, and incorporate more varied assessment methods to obtain more comprehensive and generalizable findings.

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4. CONCLUSION

This study shows that interactive PowerPoint media integrated with the Problem Based Learning (PBL) Model effectively strengthens students' critical reasoning and independent learning. Significant improvements in pretest-posttest results and independence observation achievements confirm that this media is able to facilitate students in analyzing problems, developing arguments, and managing their learning process independently. These findings support PBL theory and constructivist learning principles that emphasize the active role of students in constructing knowledge. Furthermore, the alignment of the research results with *Multimedia Learning theory* reinforces that visual-interactive media can help students understand information more effectively. Thus, this study contributes to emphasizing that the integration of interactive media and PBL can be an appropriate learning strategy for developing higher-order thinking skills and independence in elementary school students.

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