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Development of Interactive Learning Multimedia for Primary Science Education: An Alessi and Trollip Model Approach

Partini[1*], Leni Pebriantika[2], Heni Rita Susila[3]
[1,2,3] *Universitas Baturaja, Indonesia*

Corresponding e-mail : bundakupartini@gmail.com

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ABSTRACT

Low learning outcomes in Natural and Social Sciences (IPAS) among fourth-grade students at SD Negeri 14 OKU prompted this study. The predominance of conventional teaching methods and inadequate use of interactive learning media had led to monotonous learning conditions, reduced student engagement, and less meaningful educational experiences. This study aimed to develop PowerPoint-based interactive learning multimedia for fourth-grade IPAS instruction that meets the criteria of validity and practicality as judged by expert validation and student response data. A Research and Development (R&D) method was employed, guided by the Alessi and Trollip instructional design model and Tessmer's formative evaluation framework. The development stages encompassed planning, design, production, expert validation, and sequential field trials including one-to-one evaluation, small group evaluation, and field testing. Data were gathered through expert validation sheets and student response questionnaires. Results indicated that the developed multimedia achieved strong feasibility levels: media expert validation reached 87.5%, materials expert validation 88.2%, and instructional design expert validation 84.4%, yielding an overall average of 86.7% (Excellent category). Student trial outcomes showed progressive improvement in perceived practicality: 85.6% in one-to-one evaluation, 87.6% in small group evaluation, and 89.4% in field testing, all within the good-to-excellent range. These findings confirm that the PowerPoint-based interactive learning multimedia is valid and practical, and shows strong promise for supporting student engagement and perceived comprehension in IPAS at the elementary school level. Future research employing pre-test and post-test designs is recommended to provide stronger evidence of direct learning outcome gains.

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INTRODUCTION

Education serves as the primary vehicle through which knowledge, skills, and values are transmitted across generations, equipping individuals to think critically and contribute meaningfully to society (Fau et al., 2023). Meaningful learning occurs when students actively construct knowledge rather than passively receive information, a process facilitated when instruction incorporates both verbal and visual channels principles supported by constructivist and dual coding theories (Iswara et al., 2025). These principles underscore the need for instructional media that is visually rich, interactive, and engaging qualities that are particularly vital for IPAS (Natural and Social Sciences) learning in Indonesian primary schools.

The emergence of digital technology has opened new possibilities for engaging and personalized learning experiences. Interactive multimedia, which integrates text, images, audio,

video, animation, and interactive elements into a unified learning environment, creates a two-way communication channel that enables learners to control the pace and direction of their learning journey (Sari et al., 2026; Setyaningsih, 2023). Azuai et al. (2025) found that technology-enhanced learning not only makes education more enjoyable but also strengthens cognitive skills, creativity, and critical thinking. Dewi (2024) similarly observed that the incorporation of digital technology significantly elevates the quality of learning experiences by providing vivid visualizations and interactive activities that static textbooks cannot replicate. Kamila et al. (2024) further highlight that well-designed multimedia can accommodate diverse learning styles, making education more inclusive and responsive to individual differences.

Despite these promising potentials, significant gaps persist between the theoretical ideal and classroom reality, particularly in Indonesian elementary schools. Many schools continue to rely predominantly on conventional teaching methods centered on teacher-led lectures, textbook reading, and rote memorization exercises (Rozi & Hafidz, 2024). The subject of Ilmu Pengetahuan Alam dan Sosial (IPAS), which integrates Natural Science and Social Science for elementary students, presents particularly acute challenges in this regard. IPAS encompasses a wide range of abstract and complex concepts relating to the natural world and social dynamics. Students at the concrete operational stage of cognitive development, typically between ages 7 and 11, require tangible, visual, and experiential support to grasp these concepts effectively (Pratama et al., 2025). When instruction relies solely on verbal explanation and printed text, students are likely to struggle with conceptual understanding and to lose interest in the subject.

Observations conducted at SD Negeri 14 OKU revealed a situation emblematic of this broader challenge. The fourth-grade IPAS classroom was characterized by a predominantly teacher-centered approach, with instruction delivered primarily through lectures and textbook exercises. Students were seldom given opportunities to engage actively with the subject matter, and the classroom environment was described by both students and teachers as monotonous. Compounding this problem was the underutilization of existing school infrastructure: while computers, projectors, and electrical facilities were available, they were rarely incorporated into instructional activities due to teachers' limited familiarity with technology-integrated pedagogy. Assessment data and teacher reports indicated that a significant proportion of students were unable to meet expected proficiency benchmarks in IPAS, particularly on items requiring conceptual reasoning and application of scientific knowledge. This constellation of challenges points to a clear and urgent need for pedagogical innovation in the form of engaging, interactive, and visually rich learning media.

Microsoft PowerPoint has emerged as a versatile and accessible platform for developing interactive learning multimedia, particularly in resource-constrained settings. Its capabilities have expanded dramatically to include animation, hyperlinks, embedded audio and video, interactive evaluation modules, and navigational buttons that enable non-linear exploration of content (Azmi et al., 2024). When thoughtfully designed with instructional principles in mind, PowerPoint-based multimedia can create learning experiences that are both visually compelling and pedagogically purposeful. Its accessibility and widespread availability on school computers make it a particularly practical choice for teachers and instructional designers in Indonesian elementary schools.

Several studies have confirmed the feasibility of PowerPoint-based interactive multimedia in educational contexts; for instance, Rahmawati et al. (2025) developed interactive PowerPoint multimedia for IPAS instruction and found it to be highly feasible, with materials expert validation reaching 83.1% and media expert validation at 100%. Ningsih et al. (2024) reported very high validity scores (95.46%) for similar media targeting ecosystem-related IPAS content at the fifth-grade level. Septikasari et al. (2025) reported statistically significant improvements in student learning outcomes attributable to interactive PowerPoint use, with t-test results confirming the

potential of the media. Putri et al. (2023) highlighted the flexibility of interactive PowerPoint in supporting both in-person and online learning modalities, a feature of increasing relevance in the post-pandemic educational landscape. Suhenda et al. (2024) observed that multimedia designed with interactive features significantly enhances student agency in the learning process, enabling learners to engage with content at their own pace. Khatimah et al. (2026) documented that well-crafted interactive multimedia exhibits multisensory, adaptive, and motivational characteristics that substantially improve both the quantity and quality of student engagement. Nur et al. (2024) noted that multimedia's capacity to present information simultaneously through visual and auditory channels facilitates faster and deeper comprehension compared to single-modality instruction.

The Alessi and Trollip instructional design model, which guides the development process in this study, provides a comprehensive and systematic framework for creating high-quality educational multimedia. The model encompasses three primary phases: planning, design, and development, each undergirded by continuous formative evaluation processes. This model is particularly well-suited to multimedia development because of its explicit attention to user needs, its iterative quality assurance processes, and its emphasis on producing media that is not only technically sound but also pedagogically purposeful. Complementing this, Tessmer's formative evaluation model prescribes a hierarchical sequence of evaluations beginning with self-evaluation, followed by expert review, one-to-one evaluation, small group evaluation, and field testing. The combination of these two frameworks creates a rigorous methodology that maximizes the quality and fitness-for-purpose of the final product.

Given the identified need for valid, practical, and pedagogically sound interactive multimedia at SD Negeri 14 OKU, this study undertakes the development of a PowerPoint-based interactive learning multimedia product for fourth-grade IPAS instruction, following the Alessi and Trollip development model and Tessmer's formative evaluation approach. The study seeks to produce a product that is demonstrably valid according to expert assessment and practical as judged by student user responses, with the findings informing future research on learning outcome effectiveness. By doing so, it contributes to the growing body of research on technology-enhanced learning in Indonesian elementary education and provides an accessible model for instructional innovation that can be adapted in comparable educational contexts.

METHOD

This study employed a Research and Development (R&D) methodology, which is specifically designed for producing validated educational products and evaluating their validity, practicality, and perceived usefulness within authentic educational settings (Sugiyono, 2024). R&D research bridges the gap between theoretical knowledge and practical application by generating usable artifacts such as instructional media, curricula, or assessment tools that are systematically tested and refined before being disseminated for broader educational use (Winaryati et al., 2021). This approach is particularly appropriate for the present study, which sought not merely to describe or explain educational phenomena but to create and evaluate a concrete instructional product.

The development of the interactive learning multimedia in this study followed the Alessi and Trollip instructional design model, which consists of three interconnected phases: planning, design, and development, each accompanied by ongoing formative evaluation activities. This model was selected because of its comprehensive attention to user needs, its systematic integration of quality assurance processes into every phase of production, and its explicit suitability for multimedia learning environments. The model's user-centered orientation ensured that decisions about content, structure, and interface design were consistently grounded in the characteristics and needs of the target learners.

The planning phase constituted the foundation of the entire development process. During this phase, a detailed needs assessment was conducted through classroom observation and semi-structured interviews with the fourth-grade IPAS teacher at SD Negeri 14 OKU. The purpose was to identify specific learning difficulties, characterize the existing instructional environment, and document the gap between current learning outcomes and the desired standards established by the national curriculum. Analysis of learner characteristics included consideration of students' cognitive developmental stage, prior knowledge, preferred learning modalities, and technological familiarity. The scope of the multimedia product was then defined to encompass selected IPAS topics from the fourth-grade semester two curriculum, specifically focusing on plant biology, covering roots, stems, leaves, flowers, and fruit, as well as their respective functions and classification. Instructional goals and learning objectives were articulated in measurable terms aligned with the curriculum's learning achievement targets.

The design phase involved the translation of the planning-stage analyses into a coherent instructional blueprint. Instructional objectives were specified at both the general and specific levels, ensuring alignment between content, assessment, and learning activities. A flowchart was constructed to map the navigational architecture of the multimedia, depicting the pathways through which users would move between sections such as the home page, competency overview, subject matter, video content, evaluation, and developer profile. A detailed storyboard was then developed for each slide and screen, specifying the precise arrangement of text, images, animation, audio elements, and interactive buttons. Instructional strategies were deliberately selected to promote active engagement, including interactive quizzes with immediate corrective feedback, embedded video demonstrations, and self-paced navigation that allows students to revisit content as needed.

The development phase involved the actualization of the storyboard designs using Microsoft PowerPoint as the production platform. Each slide was constructed according to the storyboard specifications, incorporating the full range of multimedia elements including text, original illustrations, background music, narration, instructional videos, and animated transitions. Hyperlinks and action buttons were programmed to enable non-linear navigation between sections, and the evaluation module was designed to provide immediate on-screen feedback for each student response. An internal usability review was conducted upon completion of the prototype to verify the functionality of all navigation features and interactive elements before proceeding to formal expert validation.

Product evaluation followed the formative evaluation model developed by Tessmer, which prescribes a progressive sequence of assessments designed to identify and address product weaknesses at each stage before exposing the product to a wider audience. The first evaluation stage was self-evaluation, during which the researcher critically reviewed the prototype against the established design criteria and made preliminary revisions. The second stage involved expert review by three specialists: a media expert, a materials expert, and an instructional design expert. The media expert evaluated visual design quality, typographic choices, navigational functionality, and the coherence of interactive features. The materials expert assessed content accuracy, appropriateness for the target age group, alignment with curriculum standards, and the quality of the evaluation tasks. The instructional design expert examined the clarity of learning objectives, the suitability of the instructional strategy, the effectiveness of the interactive structure, and the alignment between instructional activities and assessment items. Validation data were collected through structured questionnaires using a 100-point rating scale, and qualitative comments were gathered to guide specific revisions.

Following expert validation and product revision, three rounds of student trials were conducted. The first trial, one-to-one evaluation (evaluasi perorangan), involved three fourth-grade students representing high, average, and low academic ability levels as determined by prior

academic records. These students interacted individually with the multimedia and responded to a 14-item questionnaire covering aspects of content clarity, visual appeal, usability, and perceived benefit. The second trial, small group evaluation (evaluasi kelompok kecil), involved nine fourth-grade students and employed an 11-item questionnaire designed to capture richer data about content-evaluation alignment, motivational impact, and overall user experience. The third and final trial, field test (uji coba lapangan), involved all 22 fourth-grade students at SD Negeri 14 OKU and used a 6-item questionnaire focusing on practical usability, perceived comprehension support, visual attractiveness, engagement, affective response, and intention to use the media again. All student questionnaires were reviewed by the expert validators as part of the overall product review process. Specifically, validators assessed: (1) the relevance of questionnaire items to the defined evaluation indicators (practicality, usability, engagement, and perceived comprehension); (2) the clarity and simplicity of language for fourth-grade students; (3) the readability and age-appropriateness of each item; (4) the suitability of the four-point Likert response scale for young learners; and (5) the overall alignment between questionnaire constructs and the study's formative evaluation objectives. Validators' written comments were used to revise item wording before the questionnaires were administered in the trial stages.

Table 1. Instrument Blueprint for Student Response Questionnaires

No.	Indicator / Aspect	One-to-One (14 items)	Small Group (11 items)	Field Test (6 items)	Scoring
1	Content comprehension / clarity of subject matter	Items 1–2	Items 1–2	Item 2	Likert 1–4
2	Visual appeal and media design quality	Items 3–5, 7–9	Items 3–4, 9–10	Items 1, 3	Likert 1–4
3	Ease of use / navigability	Items 6, 11	Items 5–6	—	Likert 1–4
4	Motivational impact / engagement and interest	Items 10, 13–14	Items 7–8	Items 4–5	Likert 1–4
5	Perceived benefit / overall learning value	Item 12	Item 11	—	Likert 1–4
6	Reuse intention / desire to use again	—	—	Item 6	Likert 1–4
	Total Items	14	11	6	

Data analysis employed the percentage formula, whereby each instrument score was expressed as a proportion of the ideal maximum score for that instrument and converted to a percentage. The resulting percentages were then interpreted using the qualification criteria adapted from (Pebriantika et al., 2024) : scores in the range of 86%–100% were classified as Excellent (Baik Sekali) indicating no revision needed; 76%–85% as Good (Baik) indicating minor revision; 56%–75% as Adequate (Cukup) indicating substantial revision; and 10%–55% as Poor (Kurang) indicating extensive revision. Qualitative data from expert commentary and student feedback were analyzed thematically to identify patterns and inform targeted product improvements. The study was conducted at SD Negeri 14 OKU during the 2025/2026 academic year, with validation activities occurring in March 2026 and student trials conducted between late March and early April 2026.

RESULTS AND DISCUSSION

Results

The research findings are presented across three main domains: the product development outcome, expert validation results, and field trial evaluation results. Together, these domains provide a comprehensive account of the quality, feasibility, and perceived practicality of the developed interactive learning multimedia.

Product Development Outcome

The development process produced a fully functional interactive learning multimedia product built on the Microsoft PowerPoint platform, encompassing six major sections: a Home Page, Instructions Page, Competency Page, Subject Matter Section, Video Learning Section, Evaluation Section, and Developer Profile Page. The multimedia opens with an animated loading screen featuring a student character named 'Naya Sang Pengamat' who serves as a guide throughout the learning experience. The home page provides a welcoming introduction and a clearly labeled 'Start' button to initiate the learning sequence. The main menu page presents six clearly distinguished navigation buttons corresponding to each major section, complemented by audio control and exit buttons.

The Instructions Page provides comprehensive guidance on operating the multimedia, explaining the function of each navigational button. The Competency Page outlines the learning objectives that students are expected to achieve. The Subject Matter Section contains five sub-topics covering plant biology: roots (akar), stems (batang), leaves (daun), flowers (bunga), and fruit (buah). Each sub-topic opens with a cover slide featuring the topic title and a relevant illustration, followed by content slides presenting explanations of the plant part's structure and function. Every content slide is equipped with navigation controls including back, home, exit, previous, next, and audio buttons.

The Video Learning Section offers embedded instructional videos aligned with each of the five plant biology sub-topics. The Evaluation Section provides interactive multiple-choice quizzes for each sub-topic, accessible through a menu system. Each evaluation question presents answer options as clickable interactive buttons that provide immediate on-screen feedback: incorrect responses display a 'Wrong Answer' screen with a retry button, while correct responses display a 'Correct Answer' screen with the right answer highlighted and a 'Next' button to proceed. The Developer Profile Page closes the multimedia with standard navigation controls.

Expert Validation Results

Three expert validation sessions were conducted between March 3 and March 7, 2026. Table 2 summarizes the validation results from all three expert panels.

Table 2. Summary of Expert Validation Results

Expert Panel	Validator	Score (%)	Category
Media Expert	Anggraini Agustin Muris, M.Kom.	87.5%	Excellent
Materials Expert	Natri Kirana, M.Pd.	88.2%	Excellent
Instructional Design Expert	Dr. Juhaidatur Rahmi, M.Pd.	84.4%	Good
Overall Average		86.7%	Excellent

Media expert validation was conducted on March 3, 2026 by a media specialist from Baturaja University. The evaluation covered 15 indicators spanning visual design, typography, navigation, and interactive feature functionality. The overall validation score was 1,313 points, yielding a percentage of 87.5%, placing the product in the 'Excellent' category. The validator observed that the multimedia's visual layout was well-proportioned, color combinations were harmonious, font types and sizes were appropriate for fourth-grade students, narration intonation was clear, and animations were proportionally presented. The evaluator recommended that instructional videos ideally be produced by the classroom teacher to enhance contextual relevance. The overall judgment was that the product was usable without major revision.

Materials expert validation was conducted on March 5, 2026 by the principal of SD Negeri 04 OKU, who holds expertise in IPAS instruction. The evaluation covered 13 indicators addressing content alignment with learning objectives, material accuracy, systematic presentation, and linguistic appropriateness. The total score was 1,147 points, yielding a percentage of 88.2%, classified as 'Excellent.' The evaluator commended the clarity with which learning objectives were reflected in the multimedia's design, the systematic progression from foundational to more

complex concepts, the accuracy of scientific information, and the contextual relevance of examples and illustrations.

Instructional design expert validation was conducted on March 7, 2026 by a faculty member of Baturaja University. The evaluation examined 16 indicators encompassing goal clarity, strategy-content alignment, interactivity, and assessment design. The total score was 1,351 points, yielding a percentage of 84.4%, categorized as 'Good.' The evaluator's suggestion to expand the evaluation module to ensure comprehensive coverage of all presented sub-topics was adopted. Following revision, the evaluation section was enhanced to include assessment items corresponding to each plant biology sub-topic, ensuring full alignment between instructional content and assessment.

Field Trial Results

Student trials were conducted across three successive evaluation stages between March 31 and April 4, 2026. Table 3 presents a summary of results across all three trial stages. All scores reported in the "Total Converted Score" column represent the sum of individual item scores after each raw Likert response (1–4) was converted to a percentage-based score prior to aggregation; these values therefore exceed the raw Likert score range and should be interpreted as cumulative converted scores rather than raw totals.

Table 3. Summary of Student Trial Results

Trial Stage	Participants	Total Converted Score	Mean (%)	Category
One-to-One Evaluation	3 students	3,598	85.6%	Good
Small Group Evaluation	9 students	8,674	87.6%	Excellent
Field Test	22 students	11,811	89.4%	Excellent

The one-to-one evaluation was conducted on March 31, 2026 with three students representing high (NPZ), average (ID), and low (AAZ) academic ability levels. These students interacted individually with the multimedia and completed a 14-item response questionnaire. The total score across all items was 3,598, yielding a mean percentage of 85.6%, classified as 'Good.' Item-level analysis revealed that perceived comprehension of materials (items 1 and 2) and perceived benefit (item 12) received the highest individual scores of 259 each (86.3%), both categorized as 'Excellent.' The lowest-rated items were visual appeal (item 8, 85%) and the motivational impact of images (item 10, 85%), though these scores still fell within the 'Good' range. Students' verbal responses during the evaluation indicated that they found the multimedia substantially easier to follow than their regular lessons, and expressed particular appreciation for the interactive quiz feature.

The small group evaluation was held on April 2, 2026 with nine students. A revised 11-item questionnaire was employed, addressing perceived content comprehension, instructional design coherence, motivational factors, visual and interactive qualities, and the multimedia's overall benefit. The total score was 8,674, yielding a mean percentage of 87.6%, classified as 'Excellent.' The highest-rated item was the clarity of usage instructions (item 5, 89.4%), indicating that students found the navigational guidance particularly helpful. The majority of items were rated as 'Excellent,' with only two items classified as 'Good': illustrative image clarity (item 10, 85.6%) and animation quality (item 11, 86.3%). Students in this group expressed enthusiasm about the video learning section and noted that the interactive evaluation helped them self-identify and self-correct conceptual misunderstandings.

The field test was conducted on April 4, 2026 with all 22 fourth-grade students. A 6-item questionnaire addressing practical usability, perceived comprehension support, visual attractiveness, engagement, affective response, and reuse intention was administered after students had experienced the multimedia in a full classroom setting. The total score was 11,811, yielding a mean percentage of 89.4%, classified as 'Excellent.' Notably, the highest score was recorded for item 2, concerning students' perception that the multimedia supported their comprehension of the subject matter (achieving a cumulative converted score of 1,998, or 90.8%).

The second-highest score was for item 6, measuring desire to use similar media again (1,989 points, 90.4%), indicating high user satisfaction and motivational value. The lowest score, though still rated 'Excellent,' was item 3 on visual attractiveness (1,945 points, 88.4%), suggesting that while the multimedia was regarded as visually appealing, this dimension offered the greatest room for further enhancement.

Across the three evaluation stages, a clear progressive improvement trajectory was observed: from 85.6% in one-to-one evaluation, to 87.6% in small group evaluation, and finally to 89.4% in field testing. This pattern reflects the effectiveness of the iterative refinement process guided by Tessmer's formative evaluation framework. It is important to note that all student trial scores are derived from perception-based response questionnaires rather than pre-test and post-test achievement measures. Accordingly, these data are best interpreted as evidence of the multimedia's validity and perceived practicality, rather than as direct indicators of cognitive learning gains. The data as a whole provide strong support for the conclusion that the developed interactive learning multimedia is valid and practical, and shows substantial promise for supporting IPAS learning engagement at the fourth-grade elementary level.

Discussion

The results of this study provide promising evidence that the PowerPoint-based interactive learning multimedia developed through the Alessi and Trollip model indicates potential as a viable instructional resource for fourth-grade IPAS education. The overall expert validation score of 86.7% and the progressive improvement in student trial outcomes from 85.6% to 89.4% across successive evaluation stages collectively demonstrate that the product meets the core criteria of validity and practicality that define a successful instructional media development initiative. It is important to emphasize that, because the study design does not include pre-test and post-test learning assessments, the results should be understood as indicators of strong perceived usefulness, high engagement, and robust formative-evaluation ratings rather than as direct evidence of causal learning gains.

The media validation score of 87.5% reflects the success of the design process in producing a product that is visually coherent, technically functional, and appropriately tailored to the aesthetic and cognitive characteristics of elementary-age learners. Visual design plays a critical role in learning multimedia for young students, as their engagement is heavily influenced by the attractiveness, clarity, and age-appropriateness of the interface. Abdullah and Budiman (2025) specifically highlight that elementary students are drawn to bright, dynamic, and contextually familiar visual elements, and that multimedia products meeting these criteria tend to generate stronger motivational responses and deeper engagement with content. The validation results confirm that the multimedia developed in this study broadly satisfies these criteria, though the evaluator's feedback regarding video production by the classroom teacher points to a valuable future enhancement.

The materials validation score of 88.2% underscores the importance of careful attention to content quality and alignment with curriculum standards. Instructional content that is accurate, systematically organized, and linguistically appropriate for the target age group is essential for ensuring that multimedia-based learning supports its pedagogical objectives. Ningsih et al. (2024) similarly found that high materials validity was associated with positive learning indicators, noting that when content is both scientifically accurate and accessibly communicated, students are able to build understanding without undue cognitive burden. The materials validator's commendation of the multimedia's systematic progression from foundational to more complex concepts reflects adherence to Ausubel's principles of advance organizers and meaningful learning.

The instructional design validation score of 84.4%, while slightly lower than the other two expert assessments, remains solidly within the 'Good' category and confirms that the

multimedia's pedagogical architecture is fundamentally sound. The validator's observation that the evaluation section required additional items to cover all presented sub-topics represents a constructive instance of the formative evaluation process identifying a meaningful gap and prompting targeted improvement. Saputra et al. (2024) on interactive media for IPAS instruction similarly identified evaluation comprehensiveness as a critical design element, finding that well-aligned assessment activities significantly enhance students' ability to consolidate and verify their learning.

The student trial results tell a coherent story of progressive improvement across evaluation stages. The 85.6% outcome at the one-to-one stage reflects a product that was already performing well in terms of usability and perceived benefit at the individual level. The observation that visual appeal received relatively lower scores at this stage is consistent with findings from Rosyada et al. (2025), who noted that elementary students have highly specific aesthetic preferences. The progression to 87.6% at the small group stage and 89.4% at the field test stage suggests that the multimedia's perceived usefulness was amplified when experienced in a social learning context, where students could discuss content together and benefit from the structured classroom environment.

The field test result of 89.4% is particularly noteworthy because it reflects the multimedia's performance under authentic classroom conditions, with the full diversity of learner characteristics and the inherent complexity of classroom dynamics. Syarifah and Sunanto (2025) found comparable patterns in their development of PowerPoint-based interactive multimedia for IPAS, observing that field test outcomes consistently exceeded preliminary evaluation scores due to the synergistic effects of social interaction, peer learning, and teacher facilitation. The finding that perceived comprehension support and reuse intention received the highest scores in the field test indicates that the multimedia was strongly welcomed by learners and shows substantial potential for supporting IPAS instruction. Asyiqah and Widagdo (2025) conducted a systematic literature review confirming that interactive PowerPoint-based media consistently produces positive outcomes for student motivation and active participation in elementary education, and the present study's findings are aligned with this broader evidence base.

From the perspective of novelty, this study makes a distinctive contribution by combining the Alessi and Trollip instructional design model, which is rarely applied in Indonesian elementary IPAS multimedia development research, with Tessmer's layered formative evaluation framework. Most comparable studies in the Indonesian context employ ADDIE or 4D development models, and the use of Alessi and Trollip's model introduces a more explicitly user-centered and quality-assurance-intensive approach that yielded consistently high validation scores across all expert panels. Furthermore, the deliberate integration of embedded video content, a character-based navigational guide, and per-topic interactive evaluation modules within a single PowerPoint-based environment represents a more comprehensive and pedagogically sophisticated product than is commonly described in the existing literature on elementary IPAS multimedia.

In terms of research contribution, this study advances understanding of how accessible, widely available software platforms such as Microsoft PowerPoint can be meaningfully employed as interactive instructional environments when guided by sound instructional design principles. This finding has practical implications for teacher professional development and educational technology policy in Indonesia, where resource constraints often limit access to specialized multimedia authoring software. The study provides promising evidence and a practical model for educational innovation. The product shows potential to be adapted in similar elementary school contexts, although broader trials are needed before wider generalization can be made. The research also reinforces the value of systematic, multi-stage formative evaluation as a mechanism for ensuring that instructional media is thoroughly refined before being deployed at scale.

CONCLUSIONS

This study successfully developed a PowerPoint-based interactive learning multimedia for fourth-grade IPAS instruction, guided by the Alessi and Trollip instructional design model and evaluated through Tessmer's formative evaluation framework. Expert validation confirmed that the multimedia is valid, with an overall average score of 86.7% (Excellent) across media, materials, and instructional design dimensions. Student response data from three successive trial stages showed progressive improvement from 85.6% to 89.4%, indicating that the multimedia is practical and positively received by fourth-grade learners.

This study does not provide direct evidence of learning achievement improvement, as no pre-test and post-test design was employed. The findings are therefore best understood as indicators of validity and perceived practicality rather than causal learning gains. The study was also limited to a single classroom at one school, which constrains generalizability. Future research should employ experimental or quasi-experimental designs with objective learning outcome measures across larger and more diverse samples to build a stronger evidentiary base for this type of instructional multimedia.

This study suggests that principled application of widely available tools such as PowerPoint, when guided by the Alessi and Trollip model and Tessmer's formative evaluation, can yield valid and practical instructional media. This offers a replicable model for schools with limited access to specialized authoring software. This study suggests that principled application of widely available tools such as PowerPoint, when guided by the Alessi and Trollip model and Tessmer's formative evaluation, can yield valid and practical instructional media. This offers a replicable model for schools with limited access to specialized authoring software.

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AUTHOR CONTRIBUTION STATEMENT

P. served as the principal researcher and was primarily responsible for conceptualization, methodology, investigation, data collection, multimedia development, data analysis, and preparation of the original manuscript. L.P. and H.R.S. contributed through supervision, methodological guidance, validation of the research process, critical review, and refinement of the manuscript. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for the integrity of the work.

AI DISCLOSURE STATEMENT

Generative artificial intelligence (AI) tools were used during several stages of manuscript preparation to assist with language refinement, textual organization, clarity, and academic presentation. AI-generated suggestions were critically reviewed, verified, and revised by the authors to ensure their accuracy and consistency with the original research data and findings. AI tools were not considered authors and did not replace the authors' intellectual judgment or responsibility for the research. All authors take full responsibility for the accuracy, originality, interpretation, and final content of the manuscript.

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