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Towards Innovative Science Learning: Needs Analysis for Developing Interactive Hypermedia to Foster Creative Thinking and Science Process Skills of Prospective Elementary School Teachers

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ABSTRACT

This study aims to analyze the dynamics of students' needs for the development of interactive hypermedia in science learning to foster creative thinking skills and science process skills among prospective elementary school teachers. This study employed a quantitative descriptive approach using a questionnaire as the primary instrument. The participants consisted of 241 students from 13 Primary School Teacher Education programs across Indonesia. Data were collected through an online survey and analyzed using an interactive analysis model involving data collection, data reduction, data display, and conclusion drawing. The findings reveal a very high level of need for the development of interactive hypermedia in science courses. Most respondents indicated that interactive hypermedia should integrate project-based learning tasks, brainstorming activities, inquiry training components, gamification elements, contextual materials aligned with the elementary school curriculum, and science literacy development. The results also indicate that although students strongly believe that interactive hypermedia can enhance creativity, communication skills, motivation, and engagement, its actual implementation in science lectures remains very limited. The novelty of this study lies in providing comprehensive empirical evidence regarding the specific design requirements of interactive hypermedia that systematically integrates creative thinking, science process skills, self-regulated learning, gamification, and contextual science literacy within a unified instructional framework for science education.

INTRODUCTION

The rapid advancement of information and communication technology has brought significant changes across various aspects of human life, including the field of education. This transformation has not only influenced how information is delivered but has also reshaped the ways learners' access, process, and construct knowledge. One technological innovation that has gained increasing attention in education is hypermedia, a system that integrates various media formats such as text, audio, video, graphics, animation, and interactive elements within a non-linear navigation structure. This structure enables users to explore learning materials flexibly according to their individual needs and learning preferences. (Alamri et al., 2018; Mwambe et al., 2020). In the contemporary educational context, hypermedia is no longer merely a supplementary tool but has evolved into an instructional medium capable of creating adaptive and interactive learning environments. This system offers personalized learning pathways through Adaptive Educational Hypermedia Systems (AEHS), which utilize algorithms to tailor content presentation based on learners' prior knowledge and learning preferences. Krouska et al., (2021).

This perspective aligns with global trends in educational technology that emphasize personalization, adaptive learning, and the integration of intelligent systems to enhance the learning experience. By examining students' needs within a contextual framework, this study contributes to the broader movement of digital transformation in education

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that is oriented toward learner-cantered learning. Such personalization is crucial, as research indicates that learners with diverse backgrounds and varying levels of prior knowledge derive different benefits from hypermedia-based learning environments (Alhajri et al., 2017; Paans et al., 2018). To contextualize these general advantages within specific educational settings, it is important to consider how hypermedia functions in relation to the unique characteristics, learning demands, and competency targets of particular learner groups. In this regard, the effectiveness of hypermedia is not solely determined by its technological sophistication, but also by its alignment with the pedagogical needs and professional expectations of its users. Within the context of primary teacher education (PGSD), the relevance of hypermedia becomes increasingly prominent. PGSD students are not only expected to master fundamental concepts in science education but also to develop adequate creative thinking skills and science process skills.

As future elementary school teachers, they are required to internalize not only content knowledge but also innovative instructional approaches that they can later implement in their own classrooms. Interactive hypermedia holds considerable potential as an effective medium for fostering these competencies. Studies indicate that adaptive systems are capable of accommodating diverse learning styles and cognitive capacities, thereby promoting greater learning engagement while simultaneously enhancing academic performance (Hamza & Tlili, 2018; Setyosari et al., 2024). One of the significant advantages of hypermedia lies in its capacity to support self-regulated learning (SRL). Through SRL, learners are able to manage their own learning processes, including setting goals, monitoring their progress, and evaluating their learning outcomes (Lau et al., 2017; Torrington et al., 2023).

A resource rich hypermedia environment encourages learners to develop metacognitive skills, enabling them to overcome common challenges frequently encountered in traditional learning settings, such as boredom or difficulties in managing information. Llorente et al., (2016). The flexibility to control and navigate the learning process provides learners with the opportunity to adjust the pace and sequence of materials according to their individual levels of understanding (Ajlouni, 2023; Manzanares et al., 2020). In science learning, this flexibility is particularly beneficial, as students are able to revisit challenging concepts, deepen their understanding of specific topics, or move directly to practical applications when they feel prepared. In this way, hypermedia not only facilitates the acquisition of factual knowledge but also fosters critical and creative thinking skills through independent exploration.

Interactive elements constitute a key feature that distinguishes hypermedia from conventional forms of instruction. Research indicates that features such as quizzes, simulations, virtual experiments, and multimedia resources can significantly enhance students' motivation and engagement (Barbosa et al., 2021;Frota et al., 2018). This interactivity not only makes the learning process more engaging and enjoyable, but also strengthens conceptual understanding by enabling learners to apply theoretical knowledge within practical contexts (Barhoumi et al., 2022; Engelmann et al., 2021). When these affordances are situated within the context of teacher education, particularly PGSD, their value becomes even more strategic, as they simultaneously support content mastery and pedagogical skill development. For example, in the topic of the respiratory system, hypermedia can provide 3D simulations that allow students to visually observe the mechanisms of inhalation and exhalation, manipulate certain

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parameters, and subsequently examine their effects. Such experiences stimulate curiosity, facilitate scientific reasoning, and strengthen science process skills, including observing, interpreting data, and drawing conclusions (Yuanita, 2018).

In the context of science learning, hypermedia offers several key advantages. First, it enhances student engagement and learning motivation by granting learners a high degree of control over their own learning processes (Opfermann et al., 2010; Ajlouni, 2023). Students are able to select content, determine their own navigation pathways, and access multiple forms of representation. Moreover, hypermedia supports complex learning processes such as problem solving and knowledge construction, which are essential in science education. Through the implementation of scaffolding, hypermedia can also assist learners who possess limited prior knowledge or insufficient self-regulation skills. Furthermore, the integration of hypermedia with project-based learning approaches has been shown to enhance literacy and comprehension skills (Sáiz-Manzanares et al., 2019). Despite these well-documented benefits, the translation of hypermedia into effective instructional practice within PGSD contexts requires careful consideration of contextual variables, including student characteristics, curriculum demands, and institutional readiness.

This integration provides opportunities for students to produce tangible outputs that are relevant to real-life contexts, thereby fostering creativity and science process skills simultaneously. Despite its considerable potential, the implementation of hypermedia also presents certain challenges. One of the primary concerns is the risk of cognitive overload, as non-linear navigation may lead to disorientation. Learners with limited metacognitive skills may struggle to determine appropriate learning pathways, which can ultimately hinder optimal learning outcomes (Azevedo & Jacobson, 2008). Another challenge lies in the significant individual differences among learners in terms of learning styles, prior knowledge, and preferences for using technology (Chen et al., 2006; Mayiwar, 2005). These challenges become more pronounced in teacher education contexts such as PGSD, where learners are expected to simultaneously engage with content, pedagogy, and technology. To address these challenges, hypermedia design must be adaptive, provide meaningful feedback, and support personalized learning experiences. From a development perspective, design complexity becomes a critical factor: overly simplistic hypermedia tends to promote mere factual memorization, whereas excessively complex designs risk confusing users. Creative thinking skills encompass dimensions such as fluency, flexibility, originality, and elaboration in generating ideas or solutions (Kurniawati, 2021). Meanwhile, science process skills include the ability to observe, formulate problems, develop hypotheses, design experiments, collect and analyze data, and draw conclusions (Rizal et al., 2022). Both of these skill sets are not only essential for science learning but also serve as a fundamental foundation for high-quality teaching at the elementary school level.

Interactive hypermedia, with its capacity to integrate multiple media formats and provide active learning experiences, represents an ideal medium for fostering both creative thinking skills and science process skills. Through simulations, virtual experiments, and problem-based case studies, students can simultaneously practice creative thinking and apply scientific methods within safe and flexible learning environments. Accordingly, this study holds significant relevance within the field of educational technology, as it offers both conceptual and practical foundations for the development of adaptive and interactive hypermedia tailored to learners' needs. The

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findings contribute to strengthening the body of literature on the application of digital technology to enhance the quality of science education, particularly in the context of primary teacher education. Although numerous studies have demonstrated the effectiveness of hypermedia in science learning, research specifically examining the needs analysis for developing interactive science hypermedia for Primary School Teacher Education students remains limited, particularly in Indonesia.

This condition highlights a research gap, namely the lack of studies emphasizing the integration of hypermedia with student characteristics, local curriculum demands, and the readiness of technological infrastructure in higher education institutions. Given that each educational institution possesses distinct student characteristics, technological infrastructure, and curricular orientations, conducting a comprehensive needs analysis prior to product development is essential. Such an analysis should encompass students' technological readiness and science literacy levels, preferences regarding media and interactive features, challenges encountered in science learning, the forms of scaffolding required to enhance creative thinking and science process skills, as well as issues related to learning engagement and the relevance of instructional materials to contemporary science education.

The results of this needs analysis can serve as a foundation for designing targeted and pedagogically effective interactive hypermedia capable of promoting mastery of creative thinking and science process skills. Through this approach, the development of interactive science hypermedia is expected to function not merely as a technological innovation but as a relevant, human-centered, and sustainable pedagogical solution for primary teacher education. By proposing a focused needs analysis framework for the development of interactive hypermedia tailored to Primary School Teacher Education students, this study has the potential to broaden understanding of effective instructional technology design. The findings are not only relevant for local curriculum development but may also enrich international discourse on how educational technology can be leveraged to cultivate 21st-century skills, particularly creativity and scientific literacy.

Based on the issues outlined above, this study is designed to formulate and address the following research questions: (1) What content components are required in the development of interactive hypermedia? (2) What features and interface design are preferred by students during science lectures? (3) How does interactive hypermedia contribute to the enhancement of creative thinking skills and science process skills? and (4) How does interactive hypermedia influence learning engagement and the relevance of instructional materials in science learning?

RESEARCH METHOD

This study was designed using a quantitative descriptive approach aimed at systematically and objectively portraying the phenomenon under investigation, particularly concerning students' needs and responses toward the development of interactive hypermedia in science learning. The purpose of descriptive research is to provide a systematic, objective, and accurate account of existing facts, the characteristics of a particular object or phenomenon, and the relationships among the variables examined, thereby offering a comprehensive and precise depiction of the conditions being studied (Rukajat, 2018). The instruments employed in this study were questionnaires and interviews, designed to comprehensively gather information

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regarding the development of interactive hypermedia in science learning aimed at enhancing creative thinking skills and science process skills among Primary School Teacher Education (PGSD) students. Prior to its implementation, the questionnaire instrument underwent validity and reliability testing to ensure the accuracy and consistency of the data collected.

Content validity was established through expert judgment involving two specialists in the fields of science education and instructional media. The experts evaluated each item of the instrument based on its relevance, clarity, and alignment with the research indicators. The results of this evaluation indicated that all questionnaire items were considered valid, with only minor revisions suggested in terms of wording and phrasing. The sampling technique used in this study was purposive sampling, in which participants were selected based on specific criteria relevant to the objectives of the research. The inclusion criteria for participants were clearly defined as follows: (1) students actively enrolled in Primary School Teacher Education (PGSD) programs, (2) students who had completed or were currently undertaking science-related courses, (3) students who had prior experience using digital learning media in lectures, and (4) students willing to participate voluntarily in the study. In addition, the selection of the 13 institutions was based on considerations of geographical representation, institutional diversity (public and private universities), and the availability of PGSD programs implementing science courses, in order to ensure broader data representation and enable replicability in similar research contexts.

The sample consisted of 241 students drawn from 13 PGSD study programs across various higher education institutions in Indonesia. The involvement of respondents from diverse institutions was intended to obtain broader and more varied data representation, thereby ensuring that the research findings were not partial in nature. The participating institutions included STKIP Siliwangi, Institut Pendidikan Indonesia, STKIP Purwakarta, Universitas Garut, Universitas PGRI Palembang, Universitas Bhayangkara Jakarta Raya, Universitas Borneo Tarakan, Universitas Langlangbuana, Universitas Majalengka, Universitas Muhammadiyah Lamongan, Universitas Muhammadiyah Tangerang, Universitas Pendidikan Indonesia, and Universitas Sriwijaya. The diversity of these institutions reflects variations in academic contexts, geographical settings, and learning cultures, thereby enriching the research data. The research procedure was conducted in accordance with the interactive data analysis model, which consists of four main stages: data collection, data reduction, data display, and conclusion drawing (Miles, M., Huberman, A., Saldana, 2016). At the data collection stage, the researcher distributed the questionnaire online through the Google Form platform. The use of this digital medium not only facilitated the distribution of instruments to respondents across various regions of Indonesia but also enhanced time efficiency and data processing accuracy. The questionnaire items were specifically designed to identify students' needs regarding the development of interactive hypermedia in science learning and its relevance to fostering creative thinking skills and science process skills.

The subsequent stage involved data reduction. In this phase, the researcher conducted processes of selection, categorization, summarization, and focusing on the collected data. In the context of quantitative data, this reduction process involved organizing the raw questionnaire responses, coding each item according to predetermined indicators, and grouping responses into relevant categories. Frequency

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counts and percentage distributions were then calculated to summarize the patterns of responses, allowing the researcher to focus on the most relevant indicators related to students' needs for interactive hypermedia development. Following data reduction, the data display stage was undertaken to organize the findings into systematic and comprehensible formats. The data were presented in tables, frequency distributions, and descriptive summaries illustrating trends in respondents' answers. Although the data originated from numerical questionnaire responses, the display stage functioned as an analytical step by visually presenting quantitative patterns that facilitated interpretation of students' perceptions and needs regarding the development of interactive hypermedia in science learning. The final stage was conclusion drawing.

Conclusions were formulated based on findings that had undergone systematic reduction and presentation. At this point, the researcher synthesized the main findings relevant to the research questions and aligned them with the initially established objectives. The conclusion-drawing process was conducted carefully and reflectively, grounded firmly in empirical data obtained from the respondents. Overall, this sequence of research procedures was designed to ensure that each stage proceeded logically, systematically, and accountably. Through a quantitative descriptive approach and an interactive data analysis model, this study is expected to provide a comprehensive portrayal of the needs for developing interactive hypermedia in science learning to enhance creative thinking skills and science process skills among Primary School Teacher Education students across higher education institutions in Indonesia.

RESULTS AND DISCUSSION

Results

Based on the research conducted regarding the development of interactive hypermedia which encompasses the need for hypermedia content, the features and interface design desired by students during lectures, the role of interactive hypermedia in enhancing creative thinking skills and science process skills, as well as student engagement and the suitability of learning materials in science instruction, the following findings were obtained:

1. The Need for Interactive Hypermedia Content

Table 1. Table of Need for Interactive Hypermedia Content

Statment	Percentage (%)	
	Yes	No
Students have difficulty understanding science material through learning media	49	51
Students need interactive hypermedia-based science learning media	97,9	2,1
The use of interactive hypermedia can help increase student creativity	99,2	0,8
Interactive hypermedia can improve students' communication skills in science learning.	95,4	4,6
A science lecture process has been carried out using interactive hypermedia as a learning medium	0	100

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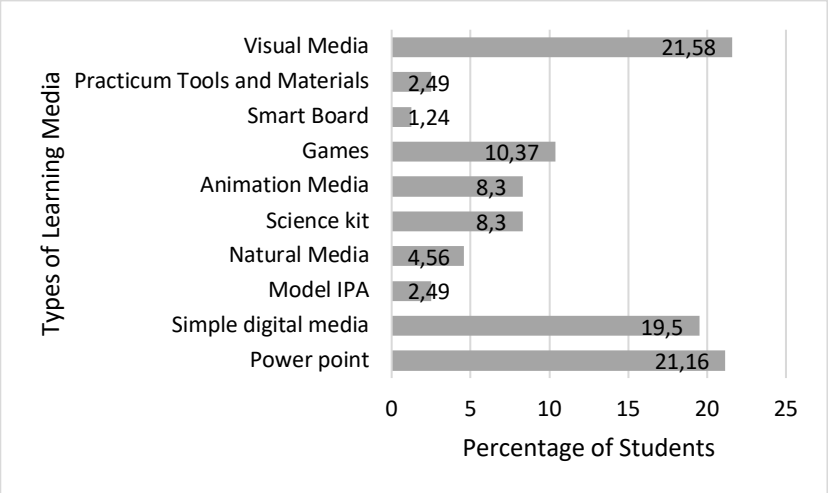

Figure 1. Learning Media that is often used in science learning

Figure 2. Science materials that require interactive hypermedia

2. Features and Interactive hypermedia display

Table 2. Interactive hypermedia features and Views table

Statment	Percentage (%)	
	Yes	No
Students need a learning video feature in interactive hypermedia science	99,6	0,4
Students need animation features in interactive hypermedia science.	97,5	2,5
Students need interactive simulations (virtual experiments) in the interactive hypermedia of science.	95	5
Students need problem-solving-based practice features in interactive hypermedia.	92,9	7,1
Students want there to be an online discussion feature or collaboration forum in interactive hypermedia.	89,6	10,4
Students need direct or automated feedback after working on an assignment in interactive hypermedia.	95,4	4,6
Students need interactive hypermedia that looks simple, engaging, and is easy to use.	99,6	0,4
Students need interactive hypermedia providing help buttons/instructions for use.	98,8	1,2
Students want interactive hypermedia to be accessible through various devices (cellphones, tablets, laptops).	98,8	1,2

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Statment	Percentage (%)	
	Yes	No
Students want flexible self-study features, such as being able to choose their own path or order of material.	88,4	11,6

3. Creative Thinking and Science Process Skills in Interactive Hypermedia

Table 3. Table of Creative Thinking and Science Process Skills in Interactive Hypermedia

Statment	Percentage (%)	
	Yes	No
Students need science case study/project-based assignments in science interactive hypermedia.	88,8	11.2
Students find it helpful to think creatively when there is a "brainstorming idea" feature in interactive hypermedia.	95,9	4,1
Students need interactive hypermedia to practice making inquiry questions, formulate learning hypotheses, identify investigation variables, and identify necessary tools.	95,4	4,6
Students need interactive hypermedia to practice Compiling experimental steps, to practice conducting experiments according to the experimental steps, to practice concluding the results of observations and to practice communicating the results of their observations at the end of each lecture in writing.	98,8	1,2

4. Learning Engagement and Material Fit

Table 4. Table of Learning engagement and material fit

Statments	Percentage (%)	
	Yes	No
Students will be more motivated if interactive hypermedia uses a gamification system (points, badges, leaderboard).	95	5
Students are more enthusiastic about learning if there is a small reward after completing an assignment in interactive hypermedia.	92,9	7,1
Students want science material in interactive hypermedia to be adjusted to the basic education curriculum (PGSD).	97,9	2,1
Students want science material to be connected to daily life to be more contextual.	97,5	2,5
Students need science materials that develop science literacy (understanding of concepts and their applications).	99,2	0,8
Students need the development of interactive hypermedia science in the lecture process	98,8	1,2

Discussion

1. The need for interactive hypermedia content.

The results of the analysis presented in Table 1 reveal important dynamics in the learning needs of prospective elementary school teachers (PGSD students) regarding the development of interactive hypermedia in science learning, which warrants further in-depth examination. Technology in education does not merely function as a supporting tool but also plays a crucial role in helping students understand complex or abstract scientific concepts in a more concrete and imaginable manner (Martínez-Freire et al., 2026). Through visualization, simulations, animations, and other interactive media, concepts that previously appeared abstract can be connected with real life contexts, making the learning process more meaningful, closer to students' experiences, and easier to comprehend (Rukayah et al., 2021). Although 51% of students reported

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that they did not experience significant difficulties in understanding science materials through the learning media currently used, 49% still indicated difficulties. This proportion suggests that nearly half of the prospective elementary school teachers have not been fully supported by existing instructional approaches. In the context of science education in teacher education institutions, this condition is often associated with the predominance of text-based learning resources and linear presentation formats such as PowerPoint slides, which tend to be less effective in visualizing abstract concepts, scientific processes, and contextual phenomena in science learning.

A particularly significant finding can be observed in the very high demand for interactive hypermedia-based science learning media, reaching 97.9% of respondents. This result indicates that prospective elementary teachers recognize the importance of more dynamic and integrated digital learning environments. This finding is consistent with the characteristics of current university students who belong to the digital-native generation and are accustomed to technology-rich, multimodal, and interactive learning environments (M. Fadillah et al., 2022). However, classroom practices in many Primary School Teacher Education programs remain dominated by conventional lecture-based instruction and limited discussion activities, with instructional media largely restricted to static text and images (Juhri et al., 2024). The fundamental finding of this study lies in the clear gap between students' high demand for interactive hypermedia (97.9%) and the complete absence of its implementation in science lectures, where 100% of respondents reported that they had never experienced science learning using interactive hypermedia. This gap highlights a critical mismatch between the learning needs of prospective elementary teachers and the instructional practices currently implemented in teacher education programs. The finding that 99.2% of students believe interactive hypermedia can enhance creativity supports previous research indicating that interactive multimedia learning environments can stimulate cognitive flexibility, idea elaboration, and the ability to generate alternative solutions. Hypermedia environments integrating text, animation, simulations, experimental videos, and nonlinear navigation structures enable students to explore scientific concepts more independently and deeply (Rukayah et al., 2021).

Previous studies in the field of educational technology have also shown that the use of interactive multimedia contributes positively to the improvement of higher-order thinking skills, including creativity and problem-solving (Putri & Ramdhani, 2024). Similarly, 95.4% of students stated that interactive hypermedia has the potential to improve communication skills in science learning. This is understandable because interactive hypermedia generally provides a space for discussion, reflection, presentation of exploratory results, and project-based collaboration. In science learning practice, scientific communication skills, both oral and written, are an important part of science process skills. A number of previous studies have reported that interactive technology-based learning can improve student active participation and the quality of academic interaction, especially when the media is designed with a student-centered learning approach (Mirayani, 2022).

Unlike many existing hypermedia frameworks that primarily emphasize multimedia integration and navigation flexibility, the findings of this study highlight the need for a more pedagogically integrated hypermedia design specifically tailored for prospective elementary teachers. The results suggest that effective interactive hypermedia should incorporate several essential components, including project-based

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learning tasks, brainstorming activities, inquiry-based exploration, gamification elements, contextual science content aligned with the elementary school curriculum, and structured opportunities for developing science process skills and creative thinking. This integrated design requirement represents a key contribution of the present study, as it bridges the gap between technological affordances of hypermedia and the pedagogical competencies required for future elementary school teachers. The absence of interactive hypermedia implementation in science lectures may be influenced by several factors, including lecturers' technological readiness, limited availability of appropriate digital infrastructure, and the lack of hypermedia learning products specifically developed for the pedagogical context of teacher education.

Therefore, the development of interactive hypermedia that aligns with the learning characteristics and professional needs of prospective elementary teachers becomes an urgent priority for improving the quality of science education in teacher preparation programs. The findings of this study have important implications for the development of science learning in Primary School Teacher Education programs, particularly in preparing prospective elementary teachers to face the challenges of technology-integrated classrooms. The high demand for interactive hypermedia indicates that future teachers require learning environments that not only deliver scientific content but also model innovative pedagogical practices that they can later apply in their own classrooms. Therefore, the development of interactive hypermedia should not merely focus on technological sophistication but must also integrate pedagogical elements that support the development of creative thinking skills, science process skills, and scientific communication abilities. From a design perspective, the results suggest that interactive hypermedia for teacher education should incorporate project-based learning activities, inquiry-based exploration, brainstorming spaces, gamification features, and contextual science problems aligned with the elementary school curriculum. Such an integrated design can serve as both a learning medium and a pedagogical model that demonstrates how digital technologies can support student-centered science learning. In addition, implementing interactive hypermedia in teacher education programs may help bridge the gap between theoretical knowledge of innovative learning strategies and their practical application in classroom settings. Consequently, integrating hypermedia-based learning into science courses for prospective elementary teachers may play a strategic role in improving the quality of science instruction in elementary schools in the future.

2. Features and Interactive hypermedia display.

Based on the diagram shown in figure 1, it is explained that the distribution of the types of learning media used in science lectures shows a tendency that is still dominated by conventional media based on presentations and static visuals. Data shows that PowerPoint (21.16%) and visual media (21.58%) occupy the highest percentage as the most frequently used media. These findings indicate that science learning practices in higher education still rely on linear presentation media that functions as a tool for delivering material, not as an interactive media that allows in-depth exploration of concepts. The use of simple digital media (19.5%) also shows a relatively high figure. However, this term generally refers to basic digital media that is not fully interactive or multimodal integrated. This condition shows that although digital transformation has begun to be adopted, the level of interactivity and integration of learning features is still

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limited. In contrast, more contextual and hands-on experience-based media such as science kits (8.3%), animation media (8.3%), and games (10.37%) showed a lower percentage.

In fact, various previous research results in the field of science education confirm that the use of simulation-based media, animation, and educational games can improve conceptual understanding, learning motivation, and cognitive involvement of students. This low percentage indicates that the exploratory and experience-based approach to science learning is still not optimally applied. Furthermore, the use of natural media (4.56%), science models (2.49%), and practicum tools and materials (2.49%) is very low. This fact is quite concerning considering the characteristics of science learning which ideally emphasizes on observation, experimentation, and science process skills (Muttaqin, M., 2022). The limited use of practicum tools and concrete models can have an impact on the lack of development of students' investigative abilities and scientific skills (A. Fadillah et al., 2025). This is in line with various research findings that state that science learning with minimal practice tends to produce memorized understanding, not conceptual.

Meanwhile, the use of smart boards (1.24%) is the lowest. This can indicate the limited facilities or the non-optimal use of interactive technology devices available in institutions. If it is associated with the results of the previous needs analysis which shows the high need of students for interactive hypermedia, then the data in this diagram further confirms the gap between the needs and learning practices in the field. Students expect more interactive and innovative media, but the reality is that learning is still dominated by conventional presentation media and has not made much use of interactive technology that is able to integrate text, animation, simulation, and nonlinear navigation in a single learning system.

Academically, these findings reinforce the urgency of developing interactive hypermedia as a strategic solution. Interactive hypermedia has the potential to integrate the advantages of visual media, animation, simulation, and even virtual practicum in one more systematic platform. Thus, the development of hypermedia-based media not only answers the needs of students, but also has the potential to improve science learning practices which have so far tended to be oriented towards delivering material, rather than on scientific exploration and strengthening science process skills. Overall, the diagram shows that the transformation of science learning towards a more interactive and technology-based approach is still in its early stages, so that innovation in the development of interactive hypermedia is a relevant, contextual, and empirical need-based step in the field.

Based on the data presented, the material that most students chose was Organ System (21.99%), followed by Scientific Research (18.26%). The dominance of *the topic of Organ Systems* shows that students have a high interest in material that is complex, integrated, and directly related to the understanding of systemic human body functions. This material requires the ability to analyze the relationships between organs and understand interrelated biological processes, so it requires learning media that is able to visualize structures and mechanisms dynamically. The high selection of *Scientific Research* topics also indicates that there is student awareness of the importance of understanding scientific processes and research methods as part of academic competence and science process skills. Overall, this trend shows that students tend to choose materials that are conceptual, systemic, and require interactive visualization

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support, thus further strengthening the urgency of developing interactive hypermedia to facilitate a deeper and contextual understanding.

3. Creative Thinking and Science Process Skills in Interactive Hypermedia.

The results of the analysis of table 3 show that the majority of students have a very high need for learning features that require creative thinking and science process skills in interactive hypermedia science. As many as 88.8% of students stated that they need a case study-based assignment or project that is integrated in hypermedia. These findings reflect the factual conditions in the field, where science learning in higher education is still relatively dominated by summarizing-based assignments or solving conceptual problems, while contextual and authentic project-based activities have not been fully integrated into the digital learning system. In fact, various previous studies have shown that case-based or project-based learning is effective in improving higher-level thinking skills, learning independence, and problem-solving abilities because students are directly involved in meaningful investigative processes (Safitri et al., 2026). Furthermore, 95.9% of students stated that it was helpful to think creatively if there was a "brainstorming idea" feature in interactive hypermedia. This data shows that students are aware of the importance of space for exploring ideas before entering the stage of problem-solving or scientific inquiry. In conventional learning practice, the idea exploration stage is often not systematically facilitated; Lecturers tend to direct to the correct concept or answer. Previous research in the field of creativity and educational technology confirms that a digital learning environment that provides a space for open exploration, reflection, and visual recording of ideas can stimulate thinking flexibility and originality Solutions (Sumartiningsih, 2025).

The need for science process skills training is also very dominant. As many as 95.4% of students stated that they need interactive hypermedia to train the preparation of investigation questions, hypothesis formulation, variable identification, and determination of the necessary tools. This fact indicates that students are aware of the importance of mastering the initial stages in the scientific method, which in practice often have not been practiced in depth. In the field, practicum activities are often "cookbook laboratory", where students only follow the procedures that have been available without being involved in problem formulation and experimental design. A number of previous studies have shown that an investigative approach that allows students to design their own questions and hypotheses significantly improves conceptual understanding and scientific thinking skills (Widayana & Malik, 2024). The strongest finding can be seen in the last statement, where 98.8% of students need interactive hypermedia to practice the preparation of experimental steps, the implementation of experiments according to procedures, drawing conclusions, and communicating the results of observations in writing at the end of lectures. This percentage confirms that students not only need media to understand concepts, but also to develop science process skills as a whole from planning to scientific communication. Conditions in the field show that limited time, laboratory facilities, and variations in students' abilities are often obstacles in the implementation of optimal practicum. Therefore, interactive hypermedia designed with experimental simulations, systematic step-by-step guidance, and digital reporting features has the potential to be an innovative solution.

4. Learning Engagement and Material Fit.

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The results in Table 4 show that the aspect of learning involvement and material suitability are very crucial factors in the development of interactive hypermedia IPA. Data shows that 95% of students say they will be more motivated if interactive hypermedia is equipped with gamification systems such as points, badges, and leaderboards. In addition, 92.9% of students stated that they were more enthusiastic about learning if there was a small award after completing an assignment. These findings indicate that students need an element of external appreciation and reinforcement in the learning process. Facts on the ground show that science learning in college still tends to be oriented towards completing tasks without an interesting and sustainable feedback mechanism.

These findings are consistent with international studies in educational technology and gamification, which demonstrate that the structured integration of game elements can enhance intrinsic motivation, engagement, and learning persistence (Nurcahyo et al., 2025). However, unlike many developed educational contexts where gamification has been systematically integrated into digital learning platforms, the Indonesian context reflected in this study indicates that such elements are still rarely implemented in actual classroom practices. This suggests that while students' expectations are aligned with global trends, the level of implementation remains relatively limited. In terms of material suitability, as many as 97.9% of students want science material in interactive hypermedia to be aligned with the basic education curriculum (PGSD). These findings show the professional awareness of students as prospective elementary school teachers who not only study science concepts theoretically but also require pedagogical relevance to the curriculum they will teach in schools. Factual conditions show that lecture materials in some universities are still conceptual and have not been fully integrated with the elementary school curriculum context, making it difficult for students to transfer knowledge into classroom practice. This condition contrasts with trends reported in international studies, where curriculum alignment and pedagogical coherence are often emphasized in teacher education programs through integrated digital learning systems. The findings of this study highlight that, in the Indonesian context, there remains a gap between theoretical instruction and practical curriculum application, indicating a need for more contextually aligned instructional media.

Furthermore, 97.5% of students want science material to be connected to daily life so that it is more contextual. This underscores the need for a *contextual learning* approach, where the concept of science is not understood as abstract knowledge, but as part of the reality of life. Previous research in science education has shown that contextual learning is able to improve conceptual understanding, long-term retention, and knowledge application ability (Romli, 2022). This finding aligns with global perspectives on contextual and meaningful learning, which emphasize the importance of connecting scientific knowledge to authentic real-world situations. Nevertheless, compared to international practices where contextual learning is often supported by advanced digital simulations and real-world data integration, the current findings suggest that such contextualization in Indonesian higher education remains largely conceptual and has not been fully supported by interactive digital environments. The most dominant finding can be seen in the need for science literacy development, where 99.2% of students stated that they need science materials that develop both conceptual understanding and its application. This figure shows the urgency of strengthening science literacy as a key 21st-century competency. Empirically, various international

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studies affirm that science literacy includes not only mastery of concepts but also the ability to interpret data, make evidence-based decisions, and relate science to social and environmental issues. While this emphasis on science literacy is consistent with global educational priorities, the findings indicate that its implementation in the Indonesian context is still at the level of expectation rather than practice. In many international settings, science literacy has been operationalized through inquiry-based digital environments and interdisciplinary learning designs, whereas in this study, such integration appears to be limited. Finally, 98.8% of students stated that they need the development of interactive hypermedia in science lectures. This very high percentage confirms the systemic need for learning media innovation. When compared with international trends, where interactive hypermedia and digital learning environments are increasingly embedded within instructional systems, the findings of this study reveal a significant gap between students' needs and current practices in Indonesia. This gap highlights not only the urgency of technological innovation but also the importance of aligning pedagogical design with global developments while remaining sensitive to local educational contexts.

CONCLUSION

This study reveals a fundamental finding that there is a significant gap between the very high level of students' need for interactive hypermedia in science learning and its minimal implementation in current instructional practices within Primary School Teacher Education (PGSD) programs. This gap indicates that prospective elementary school teachers require more interactive, contextual, and pedagogically integrated learning environments to effectively develop creative thinking skills, science process skills, and science literacy. The implication of this finding is that the development of interactive hypermedia should be positioned as a strategic pedagogical priority in teacher education, not only by integrating technological features but also by embedding essential instructional components such as inquiry-based learning, project-based tasks, gamification, and curriculum aligned content, so that it can function both as an effective learning medium and as a model for future technology-enhanced, student-centered science instruction. Further studies are recommended to develop and experimentally test interactive hypermedia designs based on the identified needs in order to evaluate their effectiveness in improving creative thinking skills, science process skills, and science literacy among prospective elementary school teachers in authentic learning environments.

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