

Needs Analysis of AI-Integrated Game-Based Multimedia for Programming Algorithm Material

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Abstract: Learning Programming Algorithms, which are abstract, logical, and sequential in nature, often pose challenges for students in understanding concepts optimally. In addition, the use of learning media that does not align with students' needs becomes an essential factor affecting the success of the learning process. This study aims to analyze the needs for developing gamified multimedia integrated with an AI Chatbot in Programming Algorithm materials that are relevant to students' learning needs. The research method employs a quantitative descriptive approach through questionnaires distributed to 11th-grade students and teachers at SMAN 1 Sembawa, SMAN 2 Sembawa, SMAN 1 Banyuasin III, and SMAN 2 Plus Banyuasin III. Data analysis was conducted by calculating the percentage of needs based on four aspects: students, teachers, learning media, and instructional design. The results show that the needs of students, teachers, learning media, and instructional design fall into a high category, with percentages of student needs (85.78%), teacher needs (91.85%), learning media needs (89.23%), and instructional needs (80.52%). These findings emphasize the necessity of developing interactive and adaptive learning media. Overall, the development of gamified multimedia integrated with an AI Chatbot is considered an appropriate alternative to address these needs, as it can provide instant feedback through the AI chatbot and enhance student engagement through gamification. This media is expected to help students understand abstract concepts in Programming Algorithms, increase motivation and engagement, and promote more meaningful learning.

Keywords: Chatbot; Gamification; Multimedia; Programming Algorithms

Introduction

The rapid development of information technology in the era of globalization has had a significant impact on various sectors, including education. (Afandi et al., 2020) argue that technological advancements influence the learning process, not only in terms of changes in curriculum content but also in driving the emergence of technology-based learning. Educators are therefore expected to adapt and develop their competencies to design digital learning media that are innovative, interactive, and aligned with students' needs (Howard et al., 2021; Shi et al., 2025). This is in line with the statement by (Azizi et al., 2024) that educators must be adaptive to technological advancements in order to

adjust the learning process in accordance with the progress of the times and curriculum developments.

Along with these developments, the use of artificial intelligence (AI)-based digital media has become increasingly important, as it enables personalized learning, enhances student engagement, and provides adaptive feedback that is difficult to achieve through conventional methods (Zou et al., 2025). However, various studies indicate that the effectiveness of digital media largely depends on how well it aligns with the needs of teachers and students in real classroom settings (Hermita et al., 2023; Hu et al., 2025). A mismatch between media design and user needs often results in suboptimal learning outcomes (Godsk & Louise, 2025). Therefore, needs analysis

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becomes a crucial step prior to the development of learning media.

Needs analysis serves to identify learning problems, evaluate the limitations of existing media, and explore users’ expectations for the media to be developed (Ika et al., 2020). In this context, needs analysis not only ensures the relevance of the media but also bridges the gap between theory and practice, ensuring that the developed media not only showcases technological sophistication but also aligns with learning objectives and user contexts (Demiral Uzan & Boling, 2024; Tawfik et al., 2024). The *Technological Pedagogical Content Knowledge* (TPACK) framework further emphasizes that the effectiveness of digital learning depends on the balanced integration of technology, content, and pedagogical strategies (Backfisch et al., 2024; Koehler & Mishra, 2023).

In the context of teaching Programming Algorithms at the secondary school level, the abstract, logical, and sequential nature of the material often poses challenges for students in understanding concepts optimally. This highlights the importance of developing AI- and gamification-based digital learning media that are not only innovative but also grounded in the actual needs of students and teachers. Therefore, needs analysis serves as an essential empirical foundation for designing learning multimedia that is effective, contextual, and aligned with the characteristics of the subject matter as well as students’ learning needs.

In this study, needs analysis was conducted across four main components—students, teachers, learning media, and instructional design—each examined through six key aspects: pedagogical, technical, cognitive, aesthetic, sociocultural, and evaluative dimensions (Abramenka et al., 2025; Gasevic et al., 2022; Wang et al., 2024). This multidimensional approach is grounded in the Dick and Carey model (Dick, W. & Carey, 2015) and principles of systemic instructional design (Branch, 2009), supported by the Cognitive Theory of Multimedia Learning (Mayer, 2024) and Constructivist Theory (Piaget, 1972; Vygotsky, 1978).

The student needs analysis focuses on aligning students’ cognitive characteristics, affective conditions, and social context with the design of the learning media. The teacher needs analysis emphasizes educators’ pedagogical readiness and technological competence to support digital learning—ranging from their ability to design communicative media, integrate local values, to facilitate reflective assessment. Meanwhile, the analysis of learning media ensures that the developed product is pedagogically effective and technologically efficient, including interactive visualization, aesthetic design, cultural inclusiveness,

and adaptive evaluation features. Finally, the instructional design needs analysis integrates all learning components by aligning goals, strategies, and assessment; ensuring flexible use of technology; fostering higher-order thinking skills; applying coherent visual design; supporting sociocultural relevance; and incorporating formative evaluation for continuous improvement.

Through the integration of these four components and six analytical aspects, the media design gains a solid conceptual foundation. This needs analysis serves as the basis for developing AI-chatbot-integrated gamified multimedia equipped with engaging visual design and grounded in principles of active learning (Branch, 2009; Mayer, 2024).

Method

This study employed a qualitative descriptive approach through the mapping of student needs, teacher needs, instructional design, and learning media (Raharjo & Safitri, 2024) for the Programming Algorithm material. The analysis focused on these four main components based on six key aspects: pedagogical, technical, cognitive, aesthetic, sociocultural, and evaluative. Needs analysis data were collected through observations, interviews, and questionnaires distributed to four senior high schools in Banyuasin Regency: SMAN 1 Sembawa, SMAN 2 Sembawa, SMAN 1 Banyuasin III, and SMA Plus Negeri 2 Banyuasin.

The qualitative data obtained were analyzed using the Miles and Huberman model (Miles et al., 2014), while the quantitative data were analyzed descriptively using percentages (Creswell, 2014; Sugihono, 2013). Technique and source triangulation were conducted to reduce bias and enhance the validity and credibility of the findings (Sun et al., 2023). The results of the needs analysis served as the basis for designing contextual learning media capable of addressing the gap between actual conditions in the field and the intended learning objectives.

Table 1. Needs Analysis Grid

Aspect	Students	Teachers	Media	Desain
				Instructional Statement Number
Pedagogical	1-4	1-4	1-4	1-4
Technical	5-8	5-8	5-8	5-6
Cognitive	9-12	9-12	9-10	7-10
Aesthetics	13-16	13-16	11-14	11-13
Socio-cultural	17-20	17-20	15-20	14-15
Evaluation	21-24	21-24	21-24	16-17

(Modified from (Raharjo & Safitri, 2024))

Table 2. Need Analysis Scale Categories

Score	Assessment Category
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

(Likert, 1932)

The data were analyzed using percentage techniques with Formula 1.

$$P = \frac{f}{N} \times 100 \% \tag{1}$$

Notes:

P = percentage

f = total score obtained

N = maximum possible score

The resulting percentage is then categorized according to the level of need (very low, low, medium, and high).

Table 3. Levels of Need

Percentage (%)	Need Category
0 - 25	Very Low
26 - 50	Low
51 - 75	Moderate
76 - 100	High

(Arikunto, 2020)

Result and Discussion

The needs analysis was conducted through observation, interviews, and questionnaires administered to 9 Informatics subject teachers and 346 students (115 male and 231 female). The collected data were analyzed using descriptive percentage techniques to determine the level of need for learning media. The results of the analysis are presented in Table 4.

Table 4. Needs Analysis Result

Aspect	Students	Teachers	Media	Desain Instructional Persentase
Pedagogical	87.52	95	88.33	81.67
Technical	88.06	92.22	89.44	78.89
Cognitive	83.38	86.11	93.33	82.22
Aesthetics	88.74	95.56	90.56	79.26
Socio-cultural	83.50	93.33	88.15	76.67
Evaluation	83.47	88.89	88.33	84.44

Student Needs Analysis

The results of the student needs analysis indicate that all aspects fall into the high category, with the highest percentage in the aesthetics aspect (88.74%), followed by the technical aspect (88.06%), pedagogical (87.52%), socio-cultural (83.50%), evaluation (83.47%),

and cognitive, which shows the lowest percentage (83.38%) yet still falls within the high-level needs category. These findings emphasize that students require learning media that are interactive and aligned with their learning needs.

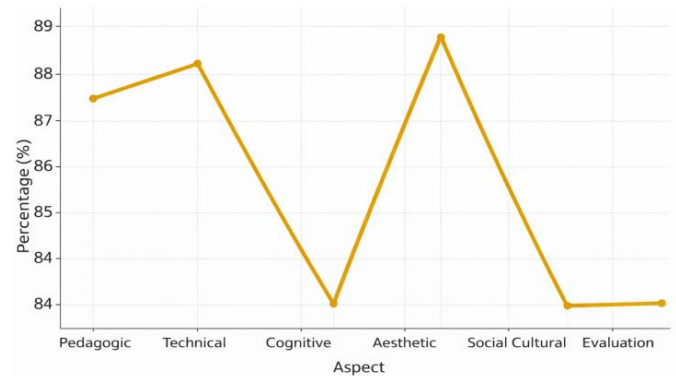


Figure 1. Results of Student Needs Analysis

Teacher Needs Analysis

The results of the student needs analysis indicate that all aspects fall within the high category, ranging from 86% to 96%. The Aesthetic aspect occupies the highest position with a percentage of 95.56%, followed by the Pedagogical aspect (95.00%), the Socio-cultural aspect (93.33%), and the Technical aspect (92.22%). Meanwhile, the Evaluation aspect (88.89%) and the Cognitive aspect (86.11%) show relatively lower percentages compared to the other aspects, yet they still remain in the high category. This indicates that teachers have a high need for developing active learning strategies, technological mastery, and the implementation of reflective evaluation.

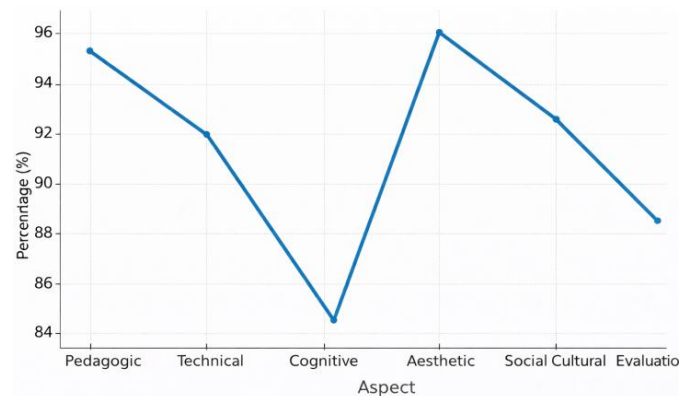


Figure 2. Results of Teacher Needs Analysis

Learning Media Needs Analysis

The results of the learning media needs analysis fall within the range of 88% to 93%, indicating that the need for the development of learning media across various aspects remains very high. The highest percentages are found in the cognitive aspect (93.33%)

and the aesthetics aspect (90.56%), highlighting the importance of developing media that support students' cognitive skills while being packaged with appealing visual designs. Meanwhile, the Technical, Pedagogical, Socio-cultural, and Evaluation aspects show percentages ranging from 88.15% to 89.44%. Although slightly lower than the other aspects, these four aspects still fall into the high category. This demonstrates that teachers continue to require improvements in media usage techniques that are pedagogically effective, aligned with students' socio-cultural contexts, and supportive of the learning evaluation process.

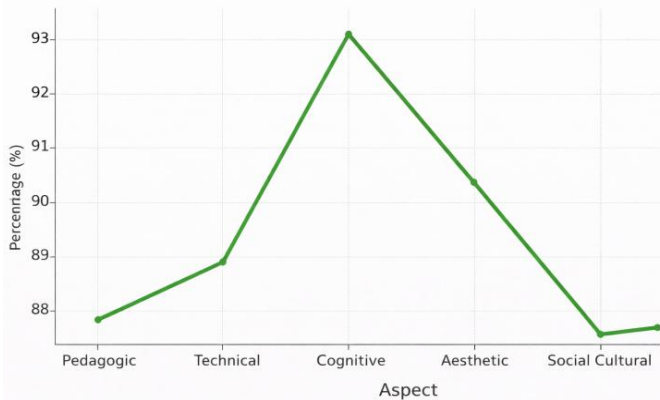


Figure 3. Results of Media Needs Analysis

Design Instructional Needs Analysis

The results of the instructional design needs analysis show that all aspects fall within the high category, with the highest percentages in the evaluation aspect (84.44%) and the cognitive aspect (82.22%). This highlights the importance of instructional design that includes clear formative evaluation mechanisms and is capable of fully facilitating students' cognitive processes. The pedagogical, aesthetic, technical, and socio-cultural aspects have percentages ranging from 76.67% to 81.67%, indicating that teachers still require strengthening in understanding pedagogical principles to develop instructional designs that are engaging, systematic, appropriately delivered, and relevant to students' socio-cultural backgrounds.

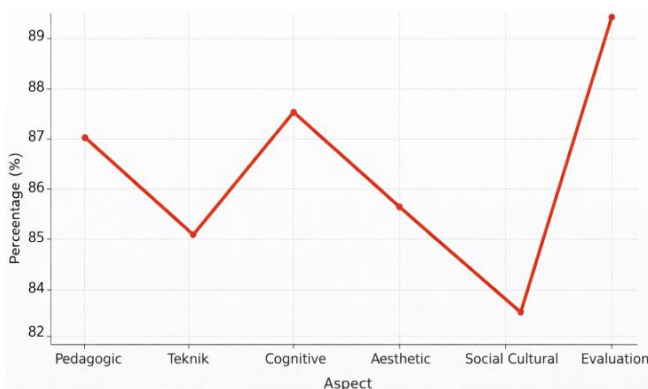


Figure 4. Results of Instructional Needs Analysis

The results of the needs analysis indicate that all measured aspects—students, teachers, media, and instructional design—fall into the high category, with student needs at 85.78%, teacher needs at 91.85%, media needs at 89.69%, and instructional design needs at 80.52%. The detailed distribution of each aspect is presented in the graph below (Figure 5).

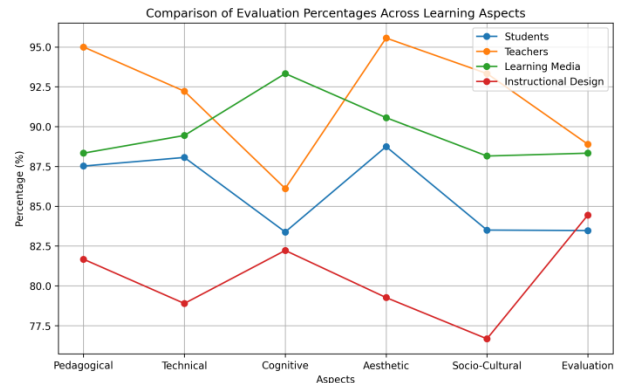


Figure 5. Results of Student, Teacher, Media, and Instructional Design Needs Analysis

The findings confirm that the learning process in Informatics, particularly on the Programming Algorithm topic, still faces various limitations in terms of the availability and quality of learning media. Both teachers and students agree that there is an urgent need for learning media that are more interactive, engaging, and personalized to support understanding of abstract concepts in Programming Algorithms.

From the students' perspective, the high percentage in the pedagogical aspect indicates that students consider the learning process, material presentation, and content relevance highly important in helping them understand the material and achieve learning objectives. The cognitive aspect also shows that students still struggle to grasp the material and require learning media that better support their learning. Students need clearer explanations, structured material presentation, interactive features, and media that match their learning needs. Traditional pedagogical approaches have not been sufficient to facilitate the understanding of abstract concepts in Programming Algorithms. This statement is supported by several studies (Figueiredo & Penalvo, 2022; Rodrigues & Monteiro, 2022), which state that teaching Programming Algorithms requires more interactive and technology-based pedagogical and cognitive approaches to help build computational thinking and improve conceptual understanding. The aesthetics aspect is also viewed as crucial in enhancing students' motivation and focus during learning. The evaluation

aspect reveals that students need more varied, easy-to-understand assessment formats that provide quick feedback to help them improve their understanding. Current evaluation practices have not fully met students' needs. Overall, students show a strong need for interactive and visually appealing media that are technically accessible, support cognitive understanding, are socially and culturally relevant, and include effective evaluation mechanisms. This highlights a strong theoretical and empirical foundation for the development of interactive technology-based learning media.

The teacher aspect obtained the highest need percentage at 91.85%. This high value indicates that teachers face challenges in teaching Programming Algorithms. Commonly, the strategies used are still dominated by conventional methods and do not accommodate the diverse readiness levels of students. (Susanti et al., 2024) state that learning strategies lacking engaging interaction cause students to feel bored, fatigued, and unmotivated. This condition shows that teachers need practical and accessible learning media capable of explaining abstract concepts simply while being adaptable to students' learning needs. (Soboleva et al., 2021) demonstrated that gamification in Programming Algorithm lessons improves students' understanding of abstract concepts by making them easier to grasp. This aligns with (Figueiredo & Francisco José García-Peñalvo, 2020), who state that using gamification can overcome learning difficulties in Programming Algorithms by promoting interaction and active participation, thereby increasing motivation and reducing failure rates in learning. These findings support the urgency of applying gamification to facilitate understanding of abstract concepts and enhance students' learning motivation in Programming Algorithm topics.

From the learning media perspective, the high need value of 89.23% indicates that current media do not fully meet the needs of either students or teachers. Learning media in schools remain limited, less engaging, not interactive, and lack support for diverse student learning needs. According to (Dale, 1969) more concrete learning experiences—such as visual, auditory, and direct activities—can enhance learners' understanding and retention, although later studies suggest that the commonly cited retention percentages should be interpreted with (Lalley & Miller, 2007; Subramony et al., 2014). Research by (Hafiedz & Nurhamidah, 2023) shows that interactive multimedia developed using Articulate Storyline can create an engaging and enjoyable learning experience by combining scenes and slides that integrate text, images, animations, videos, audio, and quizzes, allowing students to interact directly with the learning content.

In addition, integrating chatbots into learning media has proven to enhance student interactivity in exploring material according to their individual learning needs (Saluja et al., 2021). According to the official website of the Artificial Intelligence Center Indonesia (AICI), chatbots not only facilitate interactive communication but also support interactive learning, help students obtain deeper explanations, simplify complex concepts, and allow flexible and personalized learning. These findings reinforce the urgency of developing new learning media that are more engaging, interactive, and aligned with students' learning needs in Programming Algorithms.

Beyond student, teacher, and media aspects, the results also show that instructional design has a high need percentage of 80.52%. Teachers consider alignment between learning media, curriculum objectives, students' cognitive abilities, and classroom conditions essential. A well-structured instructional design helps teachers conduct effective lessons and supports students in achieving the expected competencies. The Dick and Carey instructional design model (2015) emphasizes the importance of strong relationships between needs analysis, learning objectives, instructional strategies, and evaluation. (Hellín et al., 2023) found that instructional designs integrating games into Programming Algorithm materials can enhance learning motivation and student engagement through elements such as points, levels, challenges, and leaderboards that make students more enthusiastic about learning. This is supported by (Ratinho & Martins, 2023), who show that incorporating gamification into instructional design can increase students' intrinsic motivation. Therefore, contextual, adaptive, and student-centered instructional design is crucial in creating more meaningful learning experiences.

Conclusion

Overall, the four aspects of the needs analysis—students, teachers, learning media, and instructional design—demonstrate complementary relationships and emphasize the urgency of developing new learning media. Students' need for interactive media, teachers' limitations in using conventional media, weaknesses in existing media, and the necessity for instructional design that aligns with the learning context all point to the need for innovative learning media capable of addressing these issues. One relevant solution is the development of gamified multimedia integrated with an AI chatbot. This type of media not only presents visually engaging content but also incorporates gamification elements that provide extrinsic motivation

through challenges and rewards, as well as integrates an AI chatbot that offers intrinsic support by providing a more personalized learning experience.

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Conceptualization; Methodology; Formal Analysis: R.S., M.R., F. Y.; Investigation: R.S.; Writing-Original Draft: R.S.; Writing-Review & Editing: R.S., M.R., F. Y.; Supervision: M.R., F.Y.

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Conflicts of Interest

The authors declare that there is no conflict of interest in this article

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