

Needs Analysis for Developing Educational Demonstration System (SEPA) Media Integrated with Augmented Reality for Human Digestive System Learning

Dianjar Duwi Ringgiani ^{1*}, Kharisma Eka Putri ¹, Sulistiono ¹

¹ Universitas Nusantara PGRI Kediri, Indonesia

* Author Correspondence

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Abstract

Science and Social Studies (IPAS) learning, particularly on the topic of the human digestive system, remains challenging because many concepts are abstract and difficult for elementary school students to understand. A needs analysis revealed that 96.55% of students experienced difficulties in learning the topic, while 93.10% supported the use of Augmented Reality (AR)-based learning media. This study aimed to analyze the need for developing SEPA (Educational Demonstration System) learning media integrated with Augmented Reality for fifth-grade elementary school students. A descriptive qualitative approach was employed, involving one fifth-grade teacher and 29 students from SD Negeri Sukorame 2. Data were collected through observations, interviews, and student needs questionnaires and analyzed using descriptive percentage analysis. The findings showed that the teacher mainly used one-way instructional videos, which limited student engagement and interaction. Therefore, more interactive learning media are needed to facilitate students' understanding of abstract concepts. The novelty of this study lies in integrating an educational Monopoly-based game with QR code-supported Augmented Reality to present three-dimensional visualizations of the human digestive system. This integration provides a more engaging learning experience than using educational board games or AR applications separately and offers an empirical foundation for developing innovative learning media in elementary education.

Contact : Corresponding author  e-mail: dianjarduwi@gmail.com

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Introduction

Education is a deliberate and systematically organized process designed to maximize students' potential in terms of knowledge, skills, and character development (Fatoni, 2020; Citra, 2022; Supangat, 2022; Soge, 2023). Its role extends beyond the transmission of knowledge to fostering the competencies and personal qualities required to meet the demands of the twenty-first century (Anugrahsari & Ismail, 2023; Anggreani et al., 2024; Indawati et al., 2025). Along with rapid technological advancement, the education sector has undergone significant transformation, creating new opportunities to enhance teaching and learning practices (Putri, 2023; Kadiret al., 2025; Iswahyudi et al., 2025). According to UNESCO (2024), the effective integration of technology can promote more adaptive learning experiences that better address students' diverse learning needs. Therefore, teachers are expected to integrate technology appropriately into the learning process. One effective approach is the development of innovative and integrated learning media that support meaningful and engaging learning experiences (Palui et al., 2021; Syamsuriyanti et al., 2024; Hukubun et al., 2024; Artina, 2021).

Learning media are one of the key factors that can stimulate students' interest and engagement, thereby supporting the effectiveness of the learning process (Aulia et al., 2021; Muzammil et al., 2025; Wardoyo et al., 2025; Pagarra et al., 2024). They serve as instructional tools for delivering information in ways that facilitate students' understanding of learning materials (Fadilah et al., 2023; Sulfany et al., 2023; Assidik et al., 2024). When appropriately designed and implemented, learning media can enhance students' attention, motivation, and active participation throughout the learning process (Harini & Sulistiono, 2015; Khasanah et al., 2025; Eva & Irfan, 2024). Maryati et al. (2026) reported that integrating textual and visual elements improves conceptual understanding more effectively than relying solely on verbal instruction. With the rapid advancement of technology, digital learning media have become increasingly prevalent in educational settings. Consequently, the development and use of innovative learning media are expected to promote more meaningful and effective learning experiences.

The development of learning media is intended not only to enhance the attractiveness of the learning process but also to support students in developing a more systematic understanding of concepts (Ningrum et al., 2024; Nur et al., 2024). Learning media designed in accordance with the characteristics of the subject matter and students' learning needs can create more meaningful learning experiences by encouraging students to actively engage in the learning process rather than passively receive information (Darman et al., 2024; Anomeisa et al., 2024; Arfianto et al., 2024; Makapuan et al., 2024; Ode et al., 2024). Therefore, the selection of appropriate learning media is a crucial aspect that teachers should consider when designing effective instruction.

At the elementary school level, Science and Social Studies (IPAS) instruction continues to face various challenges (Oktaviani et al., 2025). Students' understanding of the human digestive system remains limited because the topic involves abstract concepts. Learning this topic requires students to understand the structure, functions, and physiological processes of the digestive organs, which cannot be directly observed. Difficulties in comprehending abstract concepts may lead to lower conceptual understanding and poorer learning outcomes (Karentius & Hardiyantari, 2025). Hairunnisa (2025) reported that limited visualization hinders students'

mastery of complex learning materials. These findings highlight the need for learning media that can represent abstract concepts in a more concrete and meaningful manner.

According to Mayer's (2021) Cognitive Theory of Multimedia Learning, learning becomes more effective when information is presented through a combination of words, images, animations, and other complementary visual elements. Multimedia presentation enables students to construct more accurate mental representations than verbal explanations alone. For abstract topics such as the human digestive system, Augmented Reality-based learning media can help students visualize the structure and functions of digestive organs more concretely, thereby reducing cognitive load and enhancing conceptual understanding.

Based on classroom observations conducted in a fifth-grade class at SD Negeri Sukorame 2, the implementation of Science and Social Studies (IPAS) instruction was generally well organized. However, the learning media used had not fully supported students' active engagement in the learning process. Interview findings revealed that the teacher primarily relied on YouTube instructional videos to teach the human digestive system. Although these videos facilitated content delivery, they provided limited opportunities for student interaction because the learning process remained predominantly one-way. In addition, the results of the student needs questionnaire indicated that most students still required further support to understand the human digestive system. These findings highlight the need for more interactive learning media that are aligned with students' learning characteristics and needs.

One promising alternative for enhancing students' engagement is the use of educational games (W. S. R. Ningtyas & El-Yunusi, 2024). Educational games create an engaging learning environment while facilitating students' understanding of the concepts being learned (S. Z. Ningtyas & Pradikto, 2025). Among the various types of educational games, educational Monopoly has been widely adopted as a learning medium. Lestari et al. (2021) reported that educational Monopoly effectively supports students in constructing conceptual understanding through game-based learning activities. In addition to promoting conceptual understanding, educational Monopoly has been shown to enhance students' learning motivation (Fikry et al., 2024). Therefore, the Monopoly game concept was selected as the foundation for developing the SEPA (Educational Demonstration System) learning media.

Advances in technology have created opportunities to develop more innovative learning media through the integration of Augmented Reality (AR) (Muti et al., 2024). By combining virtual elements with the real-world environment, AR provides immersive learning experiences that foster greater interactivity (Resti et al., 2024). Putra et al. (2026) argued that AR facilitates students' conceptual understanding by presenting learning content through concrete and interactive visualizations. Similarly, Sundari et al. (2026) reported that the use of AR enhances students' engagement and conceptual understanding. The visual and interactive characteristics of AR make it particularly suitable for elementary school students. Tarmidzi et al. (2018) also found that implementing AR in elementary education positively influences students' learning activities, curiosity, and overall learning experiences. Furthermore, Garzón and Acevedo (2019) demonstrated that AR has a positive effect on students' learning outcomes. Consistent with these findings, Sakr and Abdullah (2024) emphasized that AR should be designed and implemented according to learners' needs to maximize its effectiveness in supporting the learning process.

The development of learning media generally follows a systematic instructional design model, one of which is the ADDIE model, consisting of the Analysis, Design, Development,

Implementation, and Evaluation phases. Among these phases, the analysis stage serves as the foundation of the development process, as it aims to identify users' needs and instructional challenges to ensure that the resulting learning media align with the characteristics of teachers, students, and the learning content (Branch & Varank, 2009). Therefore, this study focuses on the needs analysis phase as the basis for developing Educational Demonstration System (SEPA) learning media integrated with Augmented Reality.

Previous studies on the use of AR in elementary education have demonstrated its effectiveness in improving the visualization of abstract concepts, enhancing students' learning motivation, and increasing learning outcomes. However, most studies have focused on developing AR-based learning media as standalone applications rather than integrating them with educational games that promote active student engagement. Consequently, the potential benefits of combining these two instructional approaches remain underexplored. To date, studies integrating educational Monopoly with QR code-supported Augmented Reality for teaching the human digestive system in elementary schools are still limited. Furthermore, few studies have conducted a comprehensive needs analysis as the foundation for developing such learning media. This study addresses these research gaps by analyzing the need for developing SEPA learning media that integrates educational Monopoly with Augmented Reality technology. The proposed media are expected to facilitate the visualization of abstract concepts while encouraging students' active participation in the learning process. Therefore, this study aims to analyze the need for developing SEPA learning media integrated with Augmented Reality for teaching the human digestive system to fifth-grade elementary school students.

Method

The research instruments consisted of an observation checklist, an interview guide, and a student needs questionnaire developed based on theoretical frameworks and the objectives of the study. These instruments were used to identify teachers' and students' needs regarding the development of learning media. The study was conducted at SD Negeri Sukorame 2 and involved one fifth-grade teacher and 29 fifth-grade students, who were selected using purposive sampling. Quantitative data obtained from the questionnaire were analyzed using descriptive percentage analysis based on the formula $P = \frac{f}{N} \times 100\%$ (Harmita et al., 2022). Meanwhile, qualitative data collected through observations and interviews were analyzed following the interactive model of Miles, Huberman, and Saldaña (2014), which includes data reduction, data display, and conclusion drawing. As this study employed a descriptive analysis, its findings were intended to describe users' needs as the foundation for developing learning media rather than to examine relationships among variables or generalize the findings to a broader population.

Results and Discussion

Results

To obtain an overview of the Science and Social Studies learning process in the fifth-grade classroom at SD Negeri Sukorame 2, classroom observations were conducted to examine the implementation of instructional activities. The observations focused on teachers' instructional practices, students' engagement, the use of learning media, and the overall implementation of the learning process. The observation findings served as the basis for identifying the need to develop learning media that align with classroom conditions. The results of the classroom observations are presented in Table 1.

Table 1. Results of the Classroom Observation Questionnaire

Criteria	Frequency	Percentage (%)
Yes	4	57,14%
No	3	42,85%

As presented in Table 1, the implementation of Science and Social Studies (IPAS) instruction was generally satisfactory; however, several indicators had not yet been achieved optimally. The findings indicate that the existing learning media have not fully supported students' active engagement in the learning process. In addition, the instructional models and teaching methods employed lacked sufficient variety, limiting opportunities for meaningful student interaction during classroom activities. These findings suggest that the current learning media do not adequately accommodate the learning characteristics of elementary school students, who tend to understand concepts more effectively through concrete and interactive learning experiences. Therefore, there is a need for more dynamic learning media that actively promote students' participation and engagement throughout the learning process.

Table 2. Teacher Interview Results

Questions	Responses
Is Science and Social Studies (IPAS) a difficult subject?	It is moderately difficult; however, overall it is more difficult than easy.
Is the human digestive system a difficult topic?	Yes. It is quite difficult, particularly the functions of the digestive organs.
Have you used learning media in Science and Social Studies (IPAS) instruction?	Yes, depending on the topic. For the human digestive system, I mainly use instructional videos from YouTube.
Do YouTube instructional videos make the learning process more engaging?	They are interesting; however, they are still limited because they provide one-way instruction, resulting in relatively low student participation.
Have you ever used 3D learning media?	I have not developed one myself, but I have used a 3D reading book, although not for the human digestive system topic.
In your opinion, can 3D learning media help students understand the human digestive system?	Although I have not used 3D media for this topic, I believe it would create a more positive and engaging learning experience for students
Do you agree with the use of 3D learning media in Science and Social Studies (IPAS) instruction?	Yes, provided that the media are easy to access and do not create additional difficulties for teachers.
Have you ever seen a 3D representation of the human digestive system?	Yes, in the 3D reading book that I mentioned earlier.
Do you agree if a 3D representation of the human digestive system is incorporated into learning media?	Yes, I strongly agree because it would make students more enthusiastic during the learning process.
Have you ever used QR codes? If so, do you agree with integrating QR codes into 3D learning media?	Yes, I have. I strongly agree because QR codes are easy to access, even when students are learning at home.

To complement the observation data, a semi-structured interview was conducted with the fifth-grade teacher at SD Negeri Sukorame 2. The interview focused on identifying

challenges encountered during the teaching and learning process, examining the use of learning media, and exploring the teacher's needs and expectations regarding the learning media to be developed and implemented. The interview findings are presented in Table 2.

The interview findings revealed that the human digestive system remains a challenging topic for students, particularly in understanding the functions of the digestive organs. Although the teacher had incorporated instructional videos into classroom instruction, these media were considered predominantly one-way and therefore provided limited opportunities to promote students' active participation. In addition, the teacher emphasized that integrating three-dimensional learning media and digital technologies has the potential to enhance students' interest in learning. These findings indicate the need for interactive learning media that are easy to use and capable of presenting abstract concepts through concrete visualizations. In addition to classroom observations and teacher interviews, the needs analysis was further supported by a questionnaire administered to 29 fifth-grade students. The questionnaire was designed to collect information on students' learning difficulties, their experiences with the use of learning media, and their needs and preferences regarding the learning media to be developed. The questionnaire results are presented in Table 3.

Table 3. Student Needs Questionnaire Results

Statement	Yes (n)	Percentage (%)
Is Science and Social Studies (IPAS) a difficult subject?	26	89,66%
Is the human digestive system a difficult topic?	28	96,55%
Is the Science and Social Studies (IPAS) instruction provided by the teacher easy to understand?	18	62,07%
Has your teacher ever used learning media during Science and Social Studies (IPAS) lessons?	20	68,97%
If yes, did the use of learning media make the lesson more interesting?	3	10,34%
Have you ever learned while playing educational games?	7	24,14%
Have you ever learned using instructional teaching aids?	24	82,76%
Do instructional teaching aids help you understand the learning material?	24	82,76%
Have you ever viewed instructional teaching aids on a smartphone?	1	3,45%
Would you agree if instructional teaching aids for the human digestive system were displayed on a smartphone using Augmented Reality (AR)?	27	93,10%
Have you ever used a QR code?	28	96,55%

The student needs questionnaire revealed that 96.55% of the respondents considered the human digestive system to be a difficult topic. This finding indicates that most students continue to experience challenges in understanding abstract concepts. Meanwhile, 82.76% of the students reported that the use of learning aids facilitated their understanding of the subject matter, and 93.10% expressed support for the use of Augmented Reality (AR)-based learning media. These findings suggest that students' difficulties in understanding the topic are accompanied by a strong demand for learning media capable of presenting abstract concepts through concrete visualizations. Furthermore, 96.55% of the students reported being familiar

with the use of QR codes, indicating their readiness to engage with technology-enhanced learning media. The key findings of the student needs questionnaire are summarized in Figure 1.

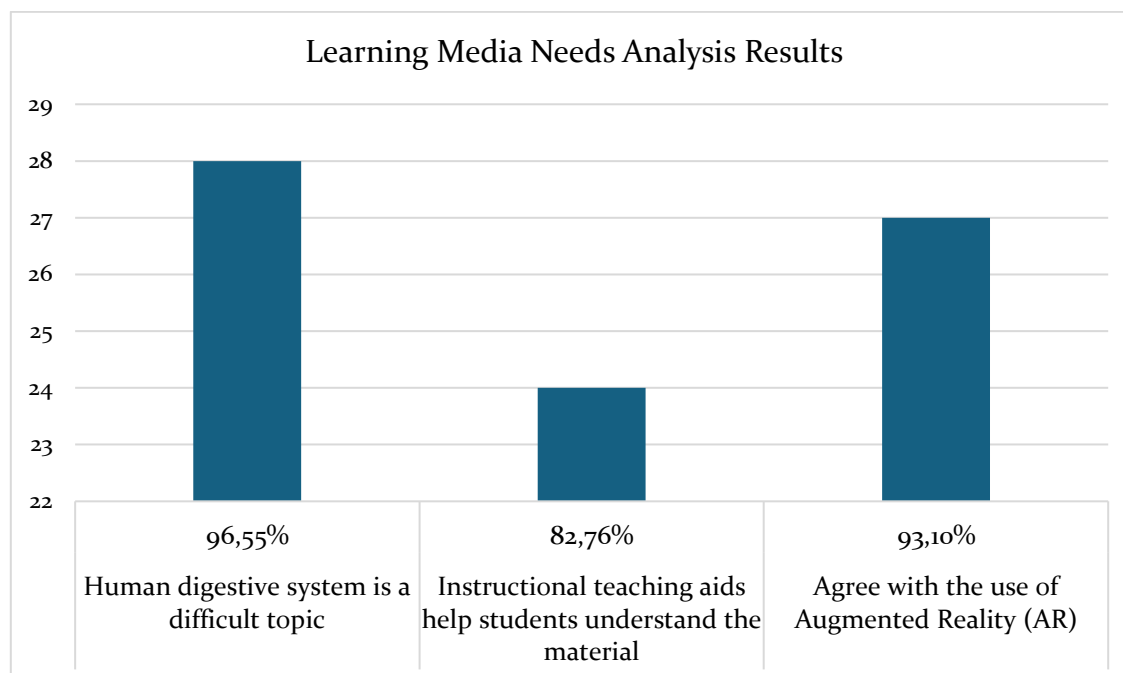


Figure 1. Results of the Learning Media Needs Analysis

The high percentage of students who reported difficulties in understanding the human digestive system (96.55%) was accompanied by a high percentage of students who indicated that learning aids facilitated their understanding of the subject matter (82.76%) and who expressed support for the use of AR-based learning media (93.10%). These findings suggest that students who experience difficulties in understanding abstract concepts have a strong need for learning media that provide concrete visualizations and incorporate digital technology.

Overall, the findings from the classroom observations, teacher interviews, and student questionnaires consistently supported one another. The classroom observations indicated that the learning media currently used by the teacher had not fully promoted students' active engagement, as instruction was still dominated by one-way media. This finding was reinforced by the interview results, in which the teacher explained that instructional videos from YouTube were the primary learning media used, resulting in limited opportunities for student interaction during classroom activities. These findings were consistent with the questionnaire results, which showed that 96.55% of students experienced difficulties in understanding the human digestive system, 82.76% reported that learning aids facilitated their understanding of the subject matter, and 93.10% expressed support for the use of AR-based learning media. The convergence of evidence from these three data collection methods demonstrates a clear need for more interactive learning media that can provide concrete visualizations of abstract concepts while accommodating the learning characteristics of elementary school students.

Discussion

The findings of this study indicate that fifth-grade students continue to experience difficulties in mastering concepts related to the human digestive system. These difficulties stem

from the abstract nature of the subject matter, which makes it challenging for students to directly observe the structure and physiological processes of the digestive organs. Consequently, the learning process requires instructional media capable of providing more concrete and meaningful visual representations of these concepts. This finding is consistent with Mayer's (2002) Cognitive Theory of Multimedia Learning, which proposes that learning is more effective when information is presented through a combination of text, images, animations, and other visual elements, allowing learners to process information through both verbal and visual channels simultaneously. Presenting learning content in multiple forms of representation enables students to construct a deeper conceptual understanding than relying solely on verbal explanations. Therefore, the development of learning media that transform abstract concepts into concrete visual representations is essential for improving Science and Social Studies (IPAS) instruction.

The interview findings further revealed that the teacher primarily relied on instructional videos from YouTube as the main learning medium. Although instructional videos can facilitate content delivery, they provide relatively limited opportunities for students' active engagement during the learning process. This finding is consistent with the constructivist perspective, which emphasizes that learners actively construct knowledge through interactions with their learning environment (Piaget, 1977). Lathifah et al. (2024) further argued that, from a constructivist perspective, students should not merely receive information passively but should actively participate in learning activities that enable them to explore and construct their own understanding. Therefore, interactive learning media have greater potential to create meaningful learning experiences than media that simply deliver information through one-way instruction.

The findings also revealed that students showed strong interest in learning media that integrate game-based elements with digital technology. This finding is supported by Ulpa and Jamal (2024), who reported that educational games can enhance students' learning motivation and active engagement. Similarly, a meta-analysis conducted by Garzón and Acevedo (2019) concluded that the use of Augmented Reality (AR) has positive effects on students' learning outcomes and motivation. In addition, Affandi et al. (2023) found that educational Monopoly creates a more enjoyable learning environment, thereby encouraging greater student participation during classroom activities. Unlike previous studies, which primarily employed educational Monopoly as a conventional learning medium, the present study identifies the need to develop learning media that integrate educational games with digital technology. Such integration is expected to provide a more engaging learning experience while promoting students' conceptual understanding.

The need for Augmented Reality (AR)-based learning media identified in this study highlights the important role of digital technology in helping students understand concepts that cannot be directly observed. Augmented Reality enables the visualization of three-dimensional objects that can be explored from multiple perspectives, thereby providing a more authentic and engaging learning experience. Sakr and Abdullah (2024) emphasized that the integration of Augmented Reality into educational settings should be designed according to users' needs to maximize its effectiveness in supporting the learning process. Similarly, Wibowo et al. (2022) reported that AR enhances interactivity by providing immediate feedback and visual information, allowing students to actively engage with learning content throughout the

instructional process. Furthermore, the meta-analysis by Garzón and Acevedo (2019) demonstrated that the use of AR contributes positively to students' learning outcomes, motivation, and knowledge retention. Compared with conventional learning media, Augmented Reality offers a distinct advantage in presenting abstract concepts through concrete and interactive visualizations.

Nevertheless, the findings of this study differ from those of previous research. Most earlier studies have developed Augmented Reality (AR) either as a standalone digital visualization tool or as an independent educational game. In contrast, the present needs analysis revealed that students require not only concrete visualizations of abstract concepts through AR but also more interactive learning experiences that incorporate game-based activities. Therefore, this study proposes integrating educational Monopoly with QR code-supported Augmented Reality as the foundation for developing the SEPA (Educational Demonstration System) learning media.

The contribution of this study extends beyond identifying the need for Augmented Reality (AR)-based learning media. It also lies in proposing the conceptual design of the SEPA (Educational Demonstration System) learning media, which integrates educational Monopoly with QR code-supported Augmented Reality. The needs analysis indicates that the development of such learning media is well aligned with the characteristics of elementary school students, who enjoy game-based activities while requiring concrete visualizations to facilitate conceptual understanding. Therefore, this study provides an empirical foundation for the future development of more interactive and contextually relevant learning media for teaching the human digestive system.

Conclusion

The needs analysis findings indicate that the development of SEPA learning media integrated with Augmented Reality is necessary to support Science and Social Studies instruction in elementary schools. The findings reveal that students continue to experience difficulties in understanding abstract concepts, while teachers face limitations in accessing learning media that effectively promote students' active engagement. Integrating educational Monopoly with QR code-supported Augmented Reality represents a promising approach that aligns with the learning characteristics of elementary school students by combining game-based activities with interactive visualizations of abstract concepts. Therefore, the results of this needs analysis provide an empirical foundation for the future development of SEPA as an innovative learning medium to enhance the quality of Science and Social Studies instruction in elementary schools.

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Authors' Note

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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