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Analysis of the Development Needs of Digital Interactive Learning Media of the Circulatory System to Facilitate Critical Thinking of Elementary School Students

Ginanjar Husnul Azizah[1], Ristiana Dyah Purwandari[2]
[1.2]University of Muhammadiyah Purwokerto, Indonesia

[2]ristianadyah@yahoo.com
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Abstract

This study aims to analyze the needs for the development of digital interactive learning media for the human circulatory system and identify its suitability in facilitating the critical thinking skills of elementary school students. The research uses *mixed methods* with *a multiphase* design which is carried out in two phases. Phase 1 involves 30 grade VI teachers and 39 grade VI students through a needs survey, initial tests of critical thinking skills, and open questions to teachers. Quantitative data is analyzed descriptively, while qualitative data is analyzed thematically and integrated through *joint* displays. Phase 2 was carried out by demonstrating the Circulatory System to 30 teachers in Karangkobar District, then continued with a response survey and open-ended questions. The results of Phase 1 showed that students had difficulty in visualizing blood flow (87.1%) as well as difficulties analyzing information, determining solutions, and making conclusions (89.8%). The initial test of critical thinking ability obtained an average of 51.01, with the lowest achievement in the *evaluation* indicator of 44.2%. All teachers and students also showed the need for more visual, interactive learning media, equipped with simulations, exercises, and feedback. In Phase 2, teachers' responses to the Circulatory System were very positive with an overall percentage of 96.2%; The aspects of visualization and concept understanding obtained 98.9%, interactivity 97.8%, and critical thinking facilitation 95.0%. The findings show that the Circulatory System is perceived in accordance with learning needs, especially in concept visualization, interactivity, and critical thinking facilitation. However, these results have not proven the effectiveness of the Circulatory System in improving students' critical thinking skills, so direct implementation and further testing are still needed.

Keywords: needs analysis, digital interactive learning media, circulatory system, critical thinking, elementary school.

Introduction

The Natural and Social Sciences (IPAS) subject is one of the updates contained in the Independent Curriculum which is a merger of two disciplines, namely science and social studies. Based on BSKAP Number 046/H/KR/2025, science subjects have a very important role in developing scientific understanding and skills, as well as the characters needed to face increasingly complex future challenges. One of the goals of IPAS learning is to develop knowledge and understanding of concepts in IPAS, as well as apply them in daily life. IPAS

learning not only emphasizes the mastery of knowledge, but also the ability of students to observe, analyze information, solve problems, and draw conclusions. This process not only enriches academic knowledge, but also forms the critical and analytical mindset needed to face daily challenges (Ristiani, et al., 2025).

Critical thinking skills are closely related to the ability to think in science which contains concepts or theories that must be understood in depth. Through the science learning process, students can be trained to be able to think critically because critical thinking skills are not innate from birth, but must be taught in the learning process (Purwandari, 2026). One of the learning outcomes of IPAS based on BSKAP Number 046/H/KR/2025 is to reflect the human organ system which is associated with how to maintain the health of the body. Based on these achievements, one of the learning objectives is to reflect on the human circulatory system which is associated with how to maintain the health of the body.

The material of the human circulatory system is an abstract and complex concept that is difficult for students to understand (Ningrum et al., 2022). Abstract concepts are often difficult for learners to imagine, let alone relate them to everyday life (Fitriyah & Sandjaya, 2023). The processes that occur in the circulatory system are very difficult to observe verbally because they are too fast/slow; therefore, a multimedia application that represents the circulatory system interactively is needed (Puriadi & Surnjono, 2024). This is in line with the opinion (Kumalasari & Zunaidah, 2021) which states that The concept of the circulatory system will be easier for students to understand if it is presented with interactive learning media that provides dynamic and interesting visualization. Furthermore, (Rahmasari & Raharjo, 2023) It also said that learning the circulatory system requires special visualization so that abstract and misconception-prone material can be understood.

Based on the results of the study Widiastika et al., (2021) shows that Students lack knowledge and understanding of the organs in the circulatory system, as well as how the processes occur in the circulatory system. This is because teachers use less varied media and seem monotonous. Teachers also do not innovate in the learning process. Teachers only use textbooks that have been provided by the school to be used as a medium and full source in the learning process. As a result, students feel bored and find it difficult to understand the concepts that have been conveyed. Ambaryuni et al., (2026) also states that The learning process in elementary schools still tends to be conventional. Learning is often still teacher-centered (teacher-centered) with a high dependence on textbooks as the only source of learning.

Based on the description, There is a need for media that supports the learning process and helps students understand abstract concepts such as the human circulatory system. The use of multimedia can stimulate various human senses, such as sight, hearing, and motion perception through the presentation of images, text, videos, and interactive animations. The more senses involved in the learning process, the easier it will be for students to absorb all the material (Purba et al., 2017). The results of the study show that interactive multimedia on circulatory system materials has also proven to be very feasible and able to improve the learning outcomes of high school students with high category N-gain (Puriadi & Surnjono, 2024). Rofiyadi & Handayani, (2021) Developing an interactive e-module based on Android MHuman Circulatory System for grade V elementary school students who have proven to be feasible and have received a very good response from students. Interactive multimedia development developed by Munawaroh et al., (2022) also stated valid, feasible, and effective in improving learning outcomes students on the material of the human circulatory system.

Learning media can also be chosen to support the improvement of students' critical thinking and problem-solving skills. The designed learning media should be integrated with the

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application of certain models and methods that are believed to be able to improve students' critical thinking and problem-solving skills (Widarta et al., 2024). Various research results show that the use of interactive learning media has the potential to improve students' critical thinking skills. The use of interactive virtual laboratories on circulatory system materials has a significant influence on the critical thinking skills of high school students (Rahmasari & Raharjo, 2023). At the elementary school level, web-based interactive media has a positive and significant influence on critical thinking skills compared to classical learning (Saputra et al., 2025). The findings are consistent with research on Android-based multimedia development, Augmented Reality, and GEMBI interactive media which shows an increase in critical thinking skills with moderate to significant categories (Hamdani et al., 2022; Syawaludin et al., 2019; Idris & Suhendi, 2023). Overall, the results show that interactive media that integrate visualization, navigation, simulation, problem-solving, and feedback have strong potential to facilitate the activities of analysis, evaluation, inference, and decision-making that are an important part of critical thinking skills.

Based on a study of previous research, it is shown that the development of learning media on human circulatory system materials has been carried out. However, most of the development research is still oriented towards aspects of media feasibility, practicality, student response, concept understanding, learning outcomes, motivation, or learning interest, and has not specifically made the critical thinking skills of elementary school students the main abilities that are developed and measured. Based on this description, there is a need for an analysis of the needs of teachers and students as the basis for the development of digital interactive learning media for human circulatory system materials that not only emphasizes aspects of visualization, attractiveness, feasibility, and concept understanding, but deliberately designs learning activities that are oriented to indicators of critical thinking skills of elementary school students. Thus, needs analysis is needed as a basis for identifying the gap between the learning conditions that take place and the expected learning needs. This study aims to analyze the conditions of media use, the obstacles experienced by teachers and students, and the need for the development of digital interactive learning media on the concept of human circulation. The results of the needs analysis are expected to be an empirical foundation in determining the characteristics, content, and features of relevant media to support the understanding of concepts and facilitate the critical thinking skills of grade VI elementary school students.

Method

This study uses mixed *methods* with a multiphase design which is carried out in two phases. Phase 1 aims to identify the need for the development of digital interactive learning media for the Circulatory System. The research subjects consisted of 30 grade VI teachers in the Korwilcamdikpora environment, Karangkobar District and 39 grade VI students from SD Negeri 1 Ambal, SD Negeri 2 Ambal, and SD Negeri 3 Ambal. Quantitative data were obtained through a survey analyzing the needs of teachers and students as well as initial tests of students' critical thinking skills. The survey of teachers was carried out by asking 29 questions related to aspects of the suitability of learning materials and resources, students' learning difficulties, the implementation of learning and the use of media, student learning outcomes, students' critical thinking skills, the ability of media to practice critical thinking, and the need for the development of interactive learning media. Meanwhile, the survey of students was carried out by asking 18 questions related to aspects of difficulty understanding the material, learning conditions, critical thinking skills, and the need for interactive learning media. The critical thinking test measured six Facione indicators, namely *interpretation, analysis,*

inference, evaluation, explanation, and *self-regulation*. Qualitative data in Phase 1 was obtained through two open-ended questions to teachers regarding the constraints on the use of learning media and expectations for the development of digital interactive media. Quantitative data was analyzed descriptively using the frequency, percentage, average, standard deviation, and achievement of each critical thinking indicator. Meanwhile, qualitative data was analyzed thematically through grouping based on similarity in meaning. Furthermore, the two types of data were integrated through *joint displays* to formulate the needs and characteristics of the Circulatory System media. In Phase 2, the Circulatory System media developed based on the results of Phase 1 was demonstrated to 30 teachers of grade VI. After the demonstration, teachers filled out a response survey that included aspects of suitability with learning needs, visualization and understanding of concepts, interactivity, facilitation of critical thinking, deep and contextual learning, and ease of use and implementation. The survey also included three open-ended questions regarding the most helpful features, areas that need improvement, and implementation constraints. Phase 2 data were analyzed descriptively and thematically. In the final stages, the results of Phase 1 and Phase 2 were integrated to see the fit between the initial needs and the teacher's response after the Circulatory System demonstration, as well as identify media aspects that still need to be improved.

Results

Phase 1

An overview of the learning conditions of the human circulatory system and the need for the development of digital interactive learning media was obtained by conducting a needs analysis through the dissemination of a google form survey to 30 grade VI teachers in the Korwilcamdikpora environment, Karangkobar District. The survey covers several aspects, namely the suitability of learning materials and resources, students' learning difficulties, the implementation of learning and the use of media, student learning outcomes, students' critical thinking skills, the ability of media used in practicing critical thinking, and the need for the development of digital interactive learning media. The results of the teacher's survey analysis are then presented in Table 1.

Table 1. Teacher Needs Analysis Survey

No.	Aspects	Key Findings	Implications
1	Learning materials and resources	90% of teachers consider that student books are not enough as the only source of learning, and 100% need additional learning resources. The use of interactive digital media is still very limited.	Additional learning resources that are more visual, interactive, and digital are needed.
2	Student learning difficulties	100% of teachers stated that students had difficulty understanding the material, especially large and small blood circulation. Difficulties were influenced by the abstract nature of the	The media needs to provide visualization and simulation to contract the circulatory process.

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		material, many scientific terms, and a lack of visual media.	
3	Learning and use of media	Learning is still dominated by lectures, questions and answers, and assignments. The media used tends to be static; 100% of teachers consider that the media has not been able to visualize the process and attract students' attention optimally.	The media needs to be more interactive, dynamic, and encourage active student engagement.
4	Student learning outcomes	Learning outcomes tend to be in the category of sufficient to insufficient and no teacher has estimated ≥75% of students achieve learning goals.	Media is needed that helps understand concepts and supports the achievement of learning objectives.
5	Critical thinking skills	70–80% of teachers rate their ability to identify problems, analyze, give reasons, solve problems, and draw conclusions as low.	The media needs to contain activities that systematically train critical thinking.
6	The ability of media to train critical thinking	100% of teachers consider that the media used so far is not able to train students' critical thinking skills.	Media needs to integrate case analysis, argumentation, problem-solving, and conclusion.
7	The need for digital interactive media	100% of teachers stated that digital interactive media is needed. The main features expected include animation, simulation, educational games, quizzes, and feedback.	The circulatory system needs to integrate multimedia, interactivity, critical thinking activities, evaluation, and feedback.

Based on Table 1, the results of the needs analysis show that there is a gap between the characteristics of the circulatory system material and the available learning media. Although the IPAS material in the student's book is generally considered to be in accordance with the learning objectives, most teachers consider the student book to be insufficient to be used as the only source of learning. Students' difficulties are mainly found in the concept of large and small blood circulation which is abstract and requires the ability to visualize the processes that take place in the body. This condition is strengthened by the limited use of digital media, animation, and simulation in learning.

In addition to conceptual difficulties, there is also a need to strengthen students' critical thinking skills. The ability to identify problems, ask questions, analyze information, give reasons, solve problems, and make conclusions is still dominated by the low to medium category. The available media are also considered not to be able to train these skills optimally. Therefore, all teachers stated the need for digital interactive learning media that integrates

visualization of the circulatory process with problem identification, case analysis, problem-solving, conclusion, interactive quizzes, and providing feedback. The teacher's hope also emphasizes media that is interesting, easily accessible, able to increase activeness, and helps students understand concepts in their entirety.

From the perspective of students, a needs analysis was also carried out through the dissemination of a google form survey to 39 grade VI students of SD Negeri 1 Ambal, SD Negeri 2 Ambal, and SD Negeri 3 Ambal. The survey included aspects of understanding the material and learning outcomes, attention and interest in learning, activities related to critical thinking skills, and the need for digital interactive learning media. The results of the student survey analysis are then presented in Table 2.

Table 2. Student Needs Analysis Survey

No.	Aspects/Indicators	Agree	Strongly agree	S + SS	Interpretasi
1	Difficulty understanding circulatory material	19 (48,7%)	9 (23,1%)	71,8%	Most students still have difficulty understanding the material
2	The results of the assignment/retest have not met expectations	24 (61,5%)	7 (17,9%)	79,5%	The learning outcomes felt by students are not optimal
3	Difficulty imagining the process of blood flow	21 (53,8%)	13 (33,3%)	87,1%	Process visualization is a very powerful necessity
4	Difficulty understanding the work of the heart and blood vessels if only through books	24 (61,5%)	8 (20,5%)	82,0%	Books alone are not enough to help understand the process
5	Difficulty maintaining attention when the teacher explains	21 (53,8%)	7 (17,9%)	71,8%	Learning needs to be more involved in students
6	Lack of enthusiasm for circulatory tasks	22 (56,4%)	7 (17,9%)	74,3%	Need more interesting learning activities
7	Quickly get bored if you only listen to the teacher's explanation	24 (61,5%)	6 (15,4%)	76,9%	One-way learning is not in line with the needs of students
8	Less interested if the source is only books/LKPD	24 (61,5%)	9 (23,1%)	84,6%	Learning resources need to be more varied and interactive
9	Hesitating to convey a question	20 (51,3%)	9 (23,1%)	74,4%	Participation and courage to put

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	or opinion				forward thoughts need to be improved
10	Still relying on memorization in answering questions	24 (61,5%)	5 (12,8%)	74,3%	Learning still needs to be directed from memorization to understanding and reasoning
11	Difficulty finding the main problem in a case	22 (56,4%)	8 (20,5%)	76,9%	Problem identification capabilities still need to be strengthened
12	Difficulty giving reasons for answers	24 (61,5%)	6 (15,4%)	76,9%	The ability to give arguments needs to be trained
13	Difficulty analyzing information, determining solutions, and drawing conclusions	26 (66,7%)	9 (23,1%)	89,8%	Analysis, problem-solving, and inference skills are the main needs
14	Requires media that displays blood circulation through images/animations	24 (61,5%)	15 (38,5%)	100%	All students need dynamic visualization
15	Easier to understand material with self-controlled media	24 (61,5%)	15 (38,5%)	100%	Interactivity and user control become important characteristics of media
16	Need interactive learning media	17 (43,6%)	22 (56,4%)	100%	All students support the development of interactive media
17	Requires simulation, practice questions, and feedback	24 (61,5%)	15 (38,5%)	100%	The media needs to provide activities, evaluations, and feedback
18	Interested in learning through PID/smartphone with animation and simulation	15 (38,5%)	24 (61,5%)	100%	Digital media has a very high acceptance among students

Based on Table 2, the results of the analysis of student needs show that the development of digital interactive learning media on the concept of the circulatory system has a high level of need. Students' difficulties are mainly related to understanding abstract and dynamic processes, such as imagining blood flow and understanding how the heart and blood vessels work. This condition is strengthened by the use of learning resources dominated by books and worksheets, which are considered less able to maintain the attention and interest of most students.

The survey results also showed that students had difficulties in activities related to critical thinking skills, especially in finding the main problem, giving reasons for answers, analyzing information, determining solutions, and making conclusions. Meanwhile, all students stated that they needed media that were able to display the circulatory process through images or animations, could be controlled independently, provided simulations, practice questions and feedback, and could be used through digital devices. The findings show the need for the development of digital interactive learning media that not only visualizes the concept of blood circulation, but also integrates problem-based activities and interactive exercises to facilitate the development of students' critical thinking skills.

Furthermore, to obtain an initial overview of students' critical thinking abilities on the material of the human circulatory system, a preliminary study test was conducted on 39 grade VI students from three elementary schools, namely SD Negeri 1 Ambal, SD Negeri 2 Ambal, and SD Negeri 3 Ambal. This test aims to identify the initial condition of students' critical thinking skills and achievements in each indicator based on the Facione framework. The test results are analyzed descriptively to complement the findings of the questionnaire of teacher and student needs, so that it can be an empirical basis in formulating the needs of the development of digital interactive learning media. The results of the initial test analysis are presented in Table 3 and Table 4.

Table 3. Results of the Initial Test of Students' Critical Thinking Ability

School	Number of students	Average score	Default deviation	Lowest value	Highest score
SD Negeri 1 Ambal	19	53,94	5,77	45,8	64,6
SD Negeri 2 Ambal	8	47,93	7,30	39,6	60,4
SD Negeri 3 Ambal	12	48,43	3,45	43,8	56,2
Overall	39	51,01	6,12	39,6	64,6

Table 4. Preliminary Test Results Based on Critical Thinking Indicators

No.	Critical Thinking Indicators	Question Number	Average Achievement
1	Interpretation	1–2	60,6%
2	Analysis	3–4	52,2%
3	Inference	5–6	50,3%
4	Evaluation	9–10	44,2%
5	Explanation (Eksplanasi)	7–8	49,7%
6	Self-Regulation	11–12	49,0%

The results of the initial test of critical thinking ability for 39 grade VI students from three elementary schools showed that the average overall score reached 51.01. Based on school, the average score of SD Negeri 1 Ambal students was 53.94, SD Negeri 2 Ambal was 47.93, and SD Negeri 3 Ambal was 48.43. Analysis based on indicators showed that the highest achievement was found in the interpretation indicator of 60.6%, while the lowest achievement was found in the evaluation indicator of 44.2%. The findings provide a preliminary overview of the aspects of critical thinking skills that require attention, especially the ability to evaluate information and reason. The results of this test can complement the findings of the

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questionnaire of teachers and students as the basis for the formulation of the need for the development of digital interactive learning media for the circulatory system.

To complete the results of the quantitative analysis, this study also used qualitative data obtained through two open-ended questions to 30 teachers of grade VI. The question aims to explore teachers' obstacles in using learning media as well as suggestions and expectations for the development of digital interactive learning media on the material of the human circulatory system. The respondents' answers were analyzed thematically through grouping based on similarity of meaning to identify the main themes. The results of this qualitative analysis were used to deepen the understanding of teachers' needs and complement quantitative findings as the basis for media development. The results of the analysis are presented in Table 5 and Table 6.

Table 5. Results of Thematic Analysis of Teachers' Obstacles in Using Learning Media

Theme	Number of teachers	Key findings
Limited availability, adequacy, and variety of media	17	The available media is still limited, inadequate, or less varied.
Limitations of Facilities and Infrastructure	7	School facilities have not fully supported the use of learning media.
Media incompatibility with student needs	9	The media is not in accordance with the characteristics of students, is not attractive, or has not been able to encourage active learning.
Constraints on the use and mastery of technology	9	Teachers experience obstacles in the ease of using media, skills in operating digital applications, or the use of PID.
Time limitations	4	Teachers face limited time to create interesting media or carry out learning.

Table 6. Results of Thematic Analysis of Teachers' Expectations for Digital Interactive Learning Media

Theme	Number of teachers	Key findings
Media attracts and increases interest in learning	13	The media is expected to be interesting in terms of presentation and able to arouse students' interest in learning.
Support concept understanding	9	The media is expected to facilitate the delivery and understanding of circulatory system material.

Visualization and animation	4	Teachers specifically expect circulatory flow animations, including large and small circulation.
Facilitating critical thinking skills	13	The media is expected to train or help improve students' critical thinking skills.
Encourage activity and task completion activities	7	Media is expected to actively engage students, including through missions or learning assignments.
Integration of deep learning approaches	9	Media is expected to be in accordance with the deep learning approach.
Ease of use and access	7	Media is expected to be easy to use or access by students.

The results of the thematic analysis of the open answers from 30 teachers showed that the obstacles to the use of learning media were mainly related to the limited availability and variety of media, the incompatibility of the media with the needs of students, the limitation of facilities and infrastructure, the constraints of the use of technology, and the limitation of time. The most common theme found was the limitation of learning media, which was mentioned by 17 teachers. The findings indicate that the available media is not fully able to support the learning needs of the human circulatory system.

Meanwhile, the results of the analysis of teachers' expectations showed that media development needs to pay attention to aspects of attractiveness, concept understanding, visualization, student activity, and ease of use. A total of 13 teachers explicitly expect media that can facilitate critical thinking skills, while 9 teachers expect the integration of deep learning approaches. Thus, the results of the qualitative analysis directed the development of digital interactive learning media that is not only visually appealing, but also easy to use, according to school conditions, and contains activities that support students' understanding of concepts and critical thinking processes.

Quantitative and qualitative findings are then integrated through *joint displays* to obtain a more complete picture of the needs for the development of digital interactive learning media for the Circulatory System. The integration includes the results of teacher and student surveys, initial tests of critical thinking ability, and qualitative findings of teachers, which are then used to formulate the implications of media development. The results of the integration are presented in Table 7.

Table 7. Integration of Needs Analysis Results

Focus	Quantitative Findings	Qualitative Findings of Teachers	Integration and Implications
Concept understanding and visualization	Teachers and students showed difficulty understanding and visualizing circulatory processes; 87.1% of students had	Teachers expect media that facilitates understanding through visualization and animation.	The Circulatory System needs to contain animations and blood flow simulations to concretize abstract concepts.

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	difficulty imagining blood flow.		
Critical thinking skills	70–80% of teachers assessed that students' critical thinking skills were still low; 89.8% of students had difficulty analyzing information, determining solutions, and concluding. The average initial test was 51.01 with the lowest achievement in evaluation (44.2%).	Teachers expect media that facilitates critical thinking and problem-solving activities.	The Circulatory System needs to contain cases, information analysis, evaluation, reasoning, problem solving, and reflection.
Interactivity and interest in learning	The media used is considered less interesting and less interactive. All students need interactive media, simulations, exercises, and feedback.	Teachers expect interesting media and encourage student activity.	The Circulatory System needs to provide exploration, simulations, games/missions, quizzes, and interactive feedback.
Ease and suitability of use	100% of teachers need digital interactive media and 90% assess that the available media does not meet learning needs.	Obstacles include limitations in media, facilities, mastery of technology, and time; teachers expect media to be easy to use and access.	The Circulatory System needs to have simple navigation, clear instructions, easy accessibility, and appropriate to the conditions of the school.

Phase 2

After analyzing the needs and development of the Circulatory System media, the research continued with a media demonstration to 30 grade VI teachers. Furthermore, teachers were asked to provide responses to suitability, interactivity, support for critical thinking, and ease of use of media. This stage aims to confirm the extent to which the Circulatory System has been in accordance with the learning needs identified in the previous phase. The results of the teacher's response survey after the demonstration are presented in Table 8.

Table 8. Results of the Teacher Response Survey

Aspects	Item Number	Average	Positive Responsibility (S+SS)	Interpretasi
Fit for learning needs	1–3	4,53	96,7%	Very positive
Visualization and conceptual understanding	4–6	4,64	98,9%	Very positive
Interactivity and student engagement	7–9	4,61	97,8%	Very positive
Facilitation of critical thinking	10–15	4,46	95,0%	Very positive
Deep and contextual learning	16–17	4,48	95,0%	Very positive
Ease of use and implementation	18–20	4,51	94,4%	Very positive
Overall	1–20	4,53	96,2%	Very positive

Based on the results of a survey of 30 teachers after the media demonstration of the Circulatory System, a very positive response was obtained to all aspects assessed. The average overall score was 4.53 on a scale of 5, with a positive response percentage of 96.2%. The visualization and concept understanding aspects obtained the highest average of 4.64, which shows that teachers assessed that animation and simulation in the Circulatory System were able to help clarify the abstract concept of the circulatory system. Positive responses were also found in the aspects of student interactivity and involvement with an average of 4.61, as well as the facilitation of critical thinking skills of 4.46.

In the survey stage after the Circulatory System media demonstration, the survey not only contains a closed-ended statement, but is also equipped with three open-ended questions. These questions are used to obtain more in-depth information about the teacher's response to the media that has been demonstrated. The three open-ended questions include the features of the Circulatory System that are considered the most helpful for learning, the parts of the media that still need to be improved or developed, and obstacles that may arise in the implementation of the Circulatory System in the classroom. The teacher's answers are then analyzed thematically to complement the results of the quantitative survey and become the basis for improving the media.

Based on the open answers of 30 teachers after the demonstration of the Circulatory System, the most helpful features were animation and visualization of blood flow, followed by simulation/interactivity as well as case questions and critical thinking activities. Teachers also appreciated the quizzes, feedback, games, and characters of the Circulatory System. Several parts still need to be improved, especially the variety of critical thinking questions, instructions and navigation, text/audio clarity, and material duration. The most mentioned implementation obstacles are the availability of the internet and devices, users' digital capabilities, and limited learning time. In general, these findings show that the main strength of the Circulatory System lies in visualization, interactivity, and support for critical thinking, with several technical aspects that still need to be improved before being applied more widely.

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After the results in Phase 1 and Phase 2 are obtained, the next two phases are integrated to see the compatibility between the learning needs identified in the initial stage and the teacher's response after the Circulatory System media demonstration. Integration is carried out by comparing findings on aspects of concept visualization, critical thinking skills, interactivity, and ease of use of media. The results of this integration are used to assess the extent to which the Circulatory System has been in accordance with learning needs while identifying parts that still need to be improved. The results of the integration of Phase 1 and Phase 2 are presented in Table 9.

Table 9. Integration of Phase 1 and Phase 2 Results

Focus	Phase 1: Needs Analysis	Phase 2: After the Demonstration of the Circulatory System	Integration Results
Concept visualization	Teachers and students need media that is able to visualize the circulatory process.	Visualization and concept understanding received a positive response of 98.9%.	The Circulatory System is considered appropriate to help clarify abstract concepts.
Critical thinking	Students' critical thinking skills still need to be strengthened; evaluation achievement is the lowest.	Critical thinking facilitation received a positive response of 95.0%.	The circulatory system is considered to support critical thinking activities, although the variety of questions still needs to be increased.
Interactivity	Teachers and students need engaging, interactive media, accompanied by simulations, quizzes, and feedback.	Student interactivity and engagement obtained a positive response of 97.8%.	The interactive features of the Circulatory System are assessed according to learning needs.
Ease of use	Teachers expect media that is easy to use and in accordance with school conditions.	The ease of use and implementation received a positive response of 94.4%.	The Circulatory System is considered easy to use, but aspects of navigation, devices, and access still need to be considered.

The findings of Phase 1 show that the main learning needs include conceptual visualization, critical thinking reinforcement, interactivity, and ease of use of media. After the Circulatory System was demonstrated in Phase 2, all aspects received a very positive response, with a positive response percentage between 94.4%–98.9%. Overall, the results of

the integration showed that the Circulatory System was perceived to be in accordance with the needs found in Phase 1, especially in helping visualize concepts, increasing interactivity, and facilitating critical thinking. However, some aspects still need to be improved, especially the variety of questions, navigation, and the readiness of devices and access when used in schools.

Discussion

The results of Phase 1 show that there is a gap between the characteristics of the abstract and dynamic concept of the human circulatory system and the learning media that has been used. Learning is still dominated by books, LKPD, pictures, lectures, questions and answers, and assignments, while media that are able to display the circulatory process dynamically have not been widely used. All teachers indicated that there are difficulties in students in understanding the material, especially large and small blood circulation, while 87.1% of students expressed difficulty imagining the process of blood flow. These findings show that learning difficulties are not solely related to the amount of material, but also to the limitations of visual representations that are able to show the relationship between the heart, blood vessels, lungs, and blood flow continuously.

These needs are the basis for the development of the Circulatory System by integrating animations, simulations, drawings, interactive activities, quizzes, games, and feedback. The results of Phase 2 provide initial confirmation of the development decision. The aspects of visualization and concept understanding received the highest positive response of 98.9%, while interactivity and student involvement received a positive response of 97.8%. The teacher's open answer also showed that animation and visualization of blood flow, simulation, and interactivity were the most perceived parts that helped learning. Thus, there was a consistency between the needs found in Phase 1 and the characteristics of the Circulatory System that were appreciated in Phase 2.

The findings are in line with international research on the use of interactive multimedia in science learning. Adeyele, (2024) Found that Interactive Multimedia effectively increased achievement *Basic Science* in students, especially in regular schools. The media developed in the study integrates animation, video, audio, interactive simulations, self-paced navigation, and quick feedback. The study also emphasizes that science learning needs to move away from the *talk-and-chalk* towards a more active learning experience so that students can understand concepts more concretely. Similar things are put forward Cirkony et al., (2022), that a digital learning environment that provides a variety of representations can help students build a more active understanding of scientific concepts.

The next important aspect is the ability to think critically. In Phase 1, 70–80% of teachers assessed students' ability to identify problems, analyze information, give reasons, solve problems, and make conclusions was still in the low category. This perception is in line with the results of student surveys, where 89.8% of students admitted that they had difficulty analyzing information, determining solutions, and making conclusions. The perception findings were strengthened by the results of the initial test of 39 students who obtained an average of 51.01. Based on six Facione indicators, evaluation was the lowest achievement at 44.2%, followed by self-regulation at 49.0%, explanatory at 49.7%, inference at 50.3%, analysis at 52.2%, and interpretation at 60.6%.

The findings show that media development does not stop enough at the presentation of attractive animations. The Circulatory System needs to place students on cognitive activities that require information interpretation, cause-and-effect analysis, inference extraction,

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evaluation of information or decisions, reason-based explanations, and reflection on their own thoughts. In Phase 2, the critical thinking facilitation aspect received a positive response of 95.0%, which shows that teachers perceive the features and activities of the Circulatory System to have led to this need. However, teachers' input on the need to add variations of critical thinking questions shows that this aspect still needs to be refined before wider implementation.

These findings are in line with Puger et al., (2024), which found that metacognitive-based learning produced significant differences in students' critical thinking skills in elementary school science learning. These results are especially relevant for the development of indicators *self-regulation* in the Circulatory System because critical thinking skills not only involve problem solving, but also the ability of students to examine and reflect on their thought processes. Saputra et al., (2025) It also reported that the use of web-based interactive learning media had a positive and significant influence on the critical thinking skills of elementary school students compared to classical learning.

Based on the overall findings, the digital interactive learning media of the Circulatory System needs to be designed not only as a material presenter, but as a learning environment that encourages students to actively think. Visualization and simulation need to focus on large and small blood circulation, the heart–lung–whole body relationship, and the structure and function of the heart. The next learning activities are directed at problem identification, information exploration, analysis, inference, evaluation of information or decisions, reasoning, problem-solving, drawing conclusions, and reflection. Feedback should also not stop at true or false information, but give students the opportunity to find out the reason, re-examine the answers, and make improvements. Thus, the interactivity of the Circulatory System is not only technical, but also has a cognitive function. Nevertheless, the media still functions as a support for learning, while teachers play an important role in providing direction, scaffolding, discussion, and strengthening of students' thinking processes.

The researcher limited the research area and the number of respondents, namely 30 grade VI teachers in the Korwilcamdikpora environment, Karangkobar District and 39 grade VI students from SD Negeri 1 Ambal, SD Negeri 2 Ambal, and SD Negeri 3 Ambal. Therefore, the results of the study could not be generalized widely. The assessment of critical thinking skills in teacher and student surveys is also still in the form of perception, although it has been equipped with an initial test to provide a more objective picture. The test is descriptive so that it cannot show a cause-and-effect relationship between the use of Circulatory System media and critical thinking skills. In addition, Phase 2 is only in the form of media demonstrations and teacher response surveys, so that the high acceptance of teachers cannot be used to conclude that media is effective in improving students' critical thinking skills.

Further research is suggested to continue the development of the Circulatory System through expert validation, gradual trials, and direct implementation to students. The effectiveness of the media needs to be tested using a posttest design by involving a comparison group and analyzed based on each of Facione's critical thinking indicators. The next development is also suggested to increase contextual cases, information evaluation exercises, questions asking for reasons, reflection activities, and adaptive feedback, especially to strengthen self-evaluation and regulation. Research in schools with different device conditions, internet access, and digital capabilities is also needed to determine the consistency of the practicality of the Circulatory System in various contexts. Thus, further research can not only answer whether the Circulatory System is attractive and suitable, but also how effective the medium is in empirically improving students' critical thinking skills.

Conclusion

Based on the integration of the findings of Phase 1 and Phase 2, this study shows that there is a strong need for the development of digital interactive learning media for the Circulatory System on human circulatory system materials. This need is mainly related to the difficulty of visualizing the circulatory process, the limited use of interactive media, and the need to strengthen students' critical thinking skills. The results of the initial test support these findings, with an average critical thinking ability of 51.01 and the lowest achievement on the evaluation indicator of 44.2%.

The Circulatory System media was then developed by emphasizing visualization, simulation, interactivity, problem-based activities, quizzes, and feedback. After being demonstrated to 30 teachers, the media received a very positive response, with an overall response percentage of 96.2%. The visualization and concept understanding aspects received the highest response, followed by interactivity and facilitation of critical thinking. These findings show that the Circulatory System is perceived to be in accordance with the learning needs identified in the initial phase.

However, the findings need to be interpreted carefully. The positive response of teachers after the demonstration showed suitability, acceptance, and potential use of media, but it has not been proven that the Circulatory System is effective in improving students' critical thinking skills. In addition, the research was conducted on a limited number and area of respondents, so the results cannot be generalized widely. Thus, this study mainly provides an empirical foundation for the development and refinement of the Circulatory System, while its effectiveness in improving critical thinking skills needs to be proven through direct implementation to students with a stronger research design.

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