



Development of a Google Sites-Based Escape Room Media in Science Learning for Grade VIII Junior High School

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Abstract: This study was motivated by challenges in science learning, particularly the Human Circulatory System material, which is often perceived as abstract and complex, leading to low student motivation and engagement. The research aimed to develop a valid and practical digital learning medium using a game-based Escape Room concept for junior high school students. This Research and Development (R&D) study applied the ADDIE model, involving material experts, media experts, 15 science teachers, and 23 eighth-grade students. Data were collected through questionnaires, observations, and interviews. The results showed that the developed media was highly valid, with material expert scores increasing from 76% to 85% and media expert scores from 73.3% to 86.7% after revisions. The media was also considered highly practical by teachers (86.3%), although internet stability was noted as a challenge. Students responded very positively, with a score of 91.9%. Qualitative findings revealed that the “Detective Mission” narrative enhanced classroom engagement, encouraged collaboration, and stimulated critical thinking. In conclusion, the Google Sites-based Escape Room is a feasible and effective innovative medium for visualizing abstract science concepts and supporting the development of students’ critical thinking and collaboration skills.

Keywords: ADDIE; Circulatory system; Escape room; Google sites; Science learning

Introduction

The rapid development of technology in the Society 5.0 era has fundamentally transformed the educational landscape, demanding a shift from passive learning to active, collaborative, and student-centered approaches (Fauzi et al., 2025). Current global demands are no longer limited to mastering subject content but also emphasize the development of essential 21st-century skills (Mulyadi et al., 2023). One relevant framework is the 7C, which includes Critical Thinking and Problem Solving, Creativity and Innovation, Communication, Collaboration, Cross-cultural Understanding, Career and Learning Self-reliance, and Computational Thinking (Wijaya, 2022). However, this study specifically focuses on two core competencies, namely critical thinking and collaboration, as these are the most relevant and measurable skills within the learning design and research instruments used (D. N. Sari et al., 2025).

In practice, the implementation of ideal science learning still faces various challenges, particularly at the junior high school level. One of the topics often perceived as difficult by eighth-grade students is the human circulatory system. This material is abstract and complex, as it involves interconnected concepts of anatomy, physiology, and biochemistry (Khairaty et al., 2018). On the other hand, it is rich in real-life contexts, such as health disorders that require analytical and problem-solving skills. However, conventional teacher-centered learning methods tend to make students passive, less motivated, and lacking opportunities to develop higher-order thinking skills (Rhamdan, 2023). Critical thinking is difficult to develop when students only receive one-way information, while collaboration skills require active interaction among students (Mulyadi et al., 2026; Qian et al., 2016).

From a cognitive development perspective, eighth-grade students are in the early formal operational stage, where abstract thinking begins to develop but still

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requires support through visualization and concrete contexts to understand complex concepts (Aini et al., 2017). Furthermore, as digital natives, they are more interested in interactive, visual, and challenging learning compared to traditional lecture methods (Urba et al., 2024). This is supported by observations conducted at SMPS IT Darul Istiqamah, which showed that 100% of students sometimes find science learning difficult, and 60% consider the circulatory system material difficult due to its abstract nature. Additionally, the continued use of conventional teaching methods makes learning less engaging. These findings are consistent with Rahmawati et al. (2022), who stated that traditional methods are less effective in fostering higher-order thinking skills, particularly critical thinking, and are also inadequate in developing collaboration skills.

Despite the growing number of studies on game-based learning and digital media in science education, most research has focused either on improving conceptual understanding or enhancing student motivation, without specifically linking the characteristics of the learning content with the design of the learning media. Moreover, previous studies on escape room learning generally emphasize engagement aspects but rarely align the narrative structure of the game with the scientific concepts being learned. This indicates a gap in integrating content structure, learning media design, and targeted skills (critical thinking and collaboration) into a coherent instructional strategy.

The human circulatory system has a dynamic and sequential flow, such as the process of blood circulation carrying oxygen from the lungs throughout the body and returning carbon dioxide for excretion. This characteristic is highly compatible with the narrative structure of an escape room, which typically involves mission-based progression, problem-solving sequences, and interconnected challenges. Therefore, designing an escape room with a storyline that simulates the journey of blood circulation can provide meaningful contextualization, helping students understand abstract processes through experiential learning while simultaneously engaging in problem-solving and teamwork. This alignment between content structure and game mechanics becomes a key novelty of this research.

Therefore, an innovative learning medium is needed to transform complex material into a more meaningful learning experience. One promising alternative is a Google Sites-based escape room learning media. This medium adopts a game-based learning approach, which has been proven to enhance students' motivation, engagement, and conceptual understanding (López-Pernas et al., 2021). Through engaging storylines and challenging puzzles, the escape room helps students understand abstract concepts more concretely while

promoting critical thinking and collaboration as students work together to solve problems (Makri et al., 2021). This is further supported by the view that immersive learning environments in escape rooms provide real-world contexts through situated learning (Veldkamp et al., 2020) and help reduce cognitive load through the integration of narrative and puzzles (Lopez-Pernas et al., 2019; Nicholson, 2015).

The selection of Google Sites as the platform is primarily based on student-oriented considerations. Google Sites is accessible across devices (smartphones and laptops), lightweight in terms of data usage, and easily integrated with familiar tools such as Google Forms, Google Slides, and YouTube, allowing students to navigate learning materials seamlessly. These features make it particularly suitable for supporting flexible and inclusive digital learning environments (Gulo et al., 2022).

This research is important because it not only addresses the problem of students' difficulties in understanding abstract science concepts but also responds to the need for developing essential 21st-century skills, particularly critical thinking and collaboration, through meaningful and contextually relevant learning experiences. In addition, this study contributes to bridging the gap between instructional design, learning media innovation, and subject matter characteristics, which are often treated separately in previous research.

Therefore, this study aims to develop and evaluate a Google Sites-based escape room learning media using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) as a systematic development framework (Branch et al., 2023), to improve students' understanding of the human circulatory system as well as to enhance their critical thinking and collaboration skills in a measurable and integrated manner.

Method

This study employed a Research and Development (R&D) design with a mixed methods approach, integrating both quantitative and qualitative data to comprehensively address the research objectives. The R&D design was used to systematically develop, validate, and evaluate an educational product in the form of a Google Sites-based Escape Room learning media. Quantitative data were used to measure validity (expert judgment scores), practicality (teacher and student responses), and effectiveness (students' pre-test and post-test scores), while qualitative data were used to explore in-depth feedback from experts, teachers, and students through interviews and open-ended questionnaire responses.

The development procedure followed the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), which is a flexible and systematic framework for instructional product development (Branch, 2009; A. P. P. Sari et al., 2017). In the analysis phase, a needs assessment was conducted through classroom observations, interviews with science teachers, and analysis of students' learning outcomes at SMPS IT Darul Istiqamah. The findings revealed that the human circulatory system material was perceived as abstract and difficult, and students showed low motivation and engagement. Curriculum analysis was also conducted to ensure alignment with basic competencies and learning indicators, along with an analysis of student characteristics, learning styles, and available technological infrastructure.

In the design phase, specific learning objectives were formulated, and a learning strategy combining Problem-Based Learning (PBL) with Escape Room elements was developed. The structure of the media included narrative-based problem scenarios, interactive puzzles, navigation through Google Sites, and collaborative activities. Evaluation instruments such as multiple-choice and essay tests, questionnaires, observation sheets, and expert validation sheets were also designed and aligned with competency indicators.

During the development phase, the Escape Room media prototype was created using Google Sites by integrating multimedia elements such as images, videos, and interactive quizzes (e.g., Google Forms). The learning content was presented in an engaging and accessible format, and all research instruments were developed based on predefined indicators. Importantly, expert validation was conducted at this stage, involving material and media experts who evaluated content accuracy, design quality, and pedagogical aspects. Revisions were made based on expert feedback to ensure the product met validity standards before being tested on students. A user guide was also prepared to facilitate implementation.

The implementation phase involved testing the validated product in a real classroom setting. A limited trial was first conducted with a small group of students and teachers to assess practicality and identify initial issues. After revision, a broader field trial was conducted involving a larger group of eighth-grade students at SMPS IT Darul Istiqamah. During this phase, data on student learning outcomes (pre-test and post-test), as well as student and teacher responses, were collected to evaluate the practicality and effectiveness of the developed media.

The evaluation phase included both formative and summative evaluation. Formative evaluation was conducted throughout each stage of development, while summative evaluation focused on the final product's

effectiveness. Quantitative data from pre-test and post-test scores were analyzed to measure learning improvement using the normalized gain (N-Gain). Qualitative data from interviews and observations were analyzed thematically to understand user experiences and provide deeper insights into the implementation process.

The data sources in this study consisted of primary and secondary data. Primary data included students' learning outcomes, student and teacher responses, expert validation results, and classroom observations. Secondary data included curriculum documents, previous studies, and school documentation. The research subjects were eighth-grade students and science teachers at SMPS IT Darul Istiqamah, selected based on their relevance to the study objectives.

Data collection techniques included tests, questionnaires, observations, interviews, and expert validation. To improve content validity and measurement accuracy, the test instrument was expanded to consist of 25 multiple-choice questions and 5 essay questions, covering all key indicators of the human circulatory system material, including structure, function, processes, and related disorders. These questions were administered as pre-test and post-test. Questionnaires used a Likert scale and open-ended questions (Khoirunnisa, 2023; Syarifuddin et al., 2022). Observations were conducted non-participatively to record student engagement, while semi-structured interviews were used to obtain in-depth qualitative data.

To ensure data trustworthiness, qualitative data were validated through credibility, transferability, dependability, and confirmability techniques. Quantitative instrument validity was assessed primarily through content validity using expert judgment, ensuring alignment between test items and learning indicators. Construct validity through statistical analysis was not emphasized due to the limited sample size in the trial phase, thus avoiding potential bias or weak statistical conclusions.

Data analysis used descriptive statistics to describe and interpret the collected data (Sutisna, 2020). Questionnaire data were converted into percentages using a Likert scale, and feasibility was determined based on a criterion of 75%–100% (Khoirunnisa, 2023). Learning outcomes were analyzed by comparing pre-test and post-test scores and calculating the normalized gain (N-Gain) to measure effectiveness. The N-Gain formula developed by Hake (1998) was used to determine the level of improvement, with interpretation categories of high ($g > 0.70$), medium ($0.30 \leq g \leq 0.70$), and low ($g < 0.30$) (Duhe et al., 2026). This analysis provides a more accurate measure of learning improvement by considering students' initial abilities and minimizing ceiling effects (Santoso et al., 2021).

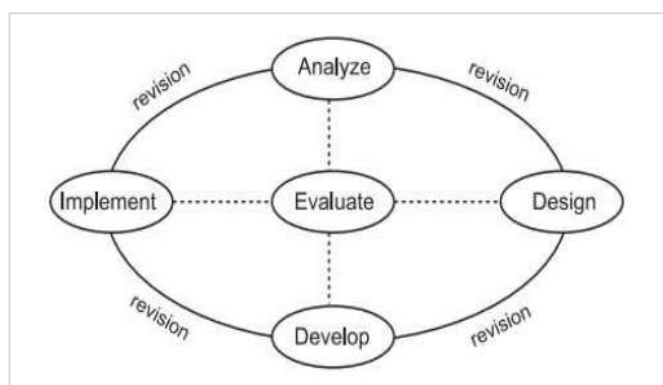


Figure 1. ADDIE development model flow

Result and Discussion

The development of the Google Sites-based Escape Room learning media in this study began with the analysis phase, which refers to the ADDIE model.

Analysis Stage

The development of the Google Sites-based Escape Room learning media began with a comprehensive analysis stage, which served as the foundation for identifying instructional problems and aligning the product with actual classroom needs. This stage included students' needs analysis, teachers' needs analysis, and curriculum analysis. Based on the student questionnaire results involving 23 eighth-grade students, it was found that although students demonstrated a high interest in science learning (82.60%), this interest was not supported by varied instructional strategies. The use of learning media was still limited (39.10%), and conventional lecture methods remained dominant (86.90%), leading to boredom and disengagement, as indicated by 73.90% of students. In contrast, 82.60% of students preferred group-based learning, highlighting the need for collaborative learning environments. In terms of conceptual difficulty, 78.20% of students reported that the human circulatory system material was difficult, while 82.60% struggled to visualize abstract processes such as blood circulation. Furthermore, 100% of students expressed the need for visual media support. From a technological perspective, all students had access to Chromebooks and were familiar with web-based platforms, with 91.32% expressing interest in Escape Room-based learning and 95.60% indicating increased motivation when learning could be accessed flexibly. From the teachers' perspective, the main challenge lay in explaining abstract concepts such as systemic and pulmonary circulation, as students often developed misconceptions. The teacher also emphasized that conventional methods were insufficient to support deep conceptual understanding, while infrastructure and digital literacy

were already adequate for implementing web-based learning. Curriculum analysis confirmed that the development aligns with the Merdeka Curriculum (Phase D), particularly in enabling students to analyze organ systems and related disorders. Learning objectives were further translated into measurable indicators and structured into sequential stages, forming a strong foundation for the design of the Escape Room learning media.

Design Stage

The design stage transformed the findings from the analysis into a structured instructional blueprint. The Escape Room media was designed as a "learning ecosystem" that integrates content structure, learning strategy, and user experience. A linear-progressive navigation flow was developed, requiring students to complete each stage sequentially before progressing to the next. This design was intentionally aligned with scaffolding principles, enabling students to build understanding gradually from basic to complex concepts, particularly important for abstract topics such as the circulatory system.

In addition to the flow design, a narrative-based learning scenario was developed to enhance engagement and meaningful learning. The storyline, titled "*Heart Detective Mission: Solving Aini's Mystery*," positioned students as active problem-solvers rather than passive learners. Using a Problem-Based Learning (PBL) approach, students were assigned the role of a medical detective team tasked with diagnosing a fictional patient. Each stage of the Escape Room represented a learning checkpoint, where students completed tasks such as analyzing heart rate data, distinguishing blood vessels, interpreting laboratory results, and mapping circulation pathways.

This narrative structure naturally integrated 21st-century skills. Students collaborated in teams, communicated hypotheses, analyzed data critically, and synthesized information creatively to arrive at a final diagnosis. The inclusion of a reflection stage further supported metacognitive development, allowing students to evaluate their learning experiences and conceptual understanding. This narrative not only increases engagement but also contextualizes abstract concepts into real-world situations. Furthermore, the design integrates Problem-Based Learning (PBL), encouraging students to collaborate, communicate, and think critically throughout the learning process. The inclusion of a reflection stage at the end allows students to evaluate their understanding, thereby supporting metacognitive development.

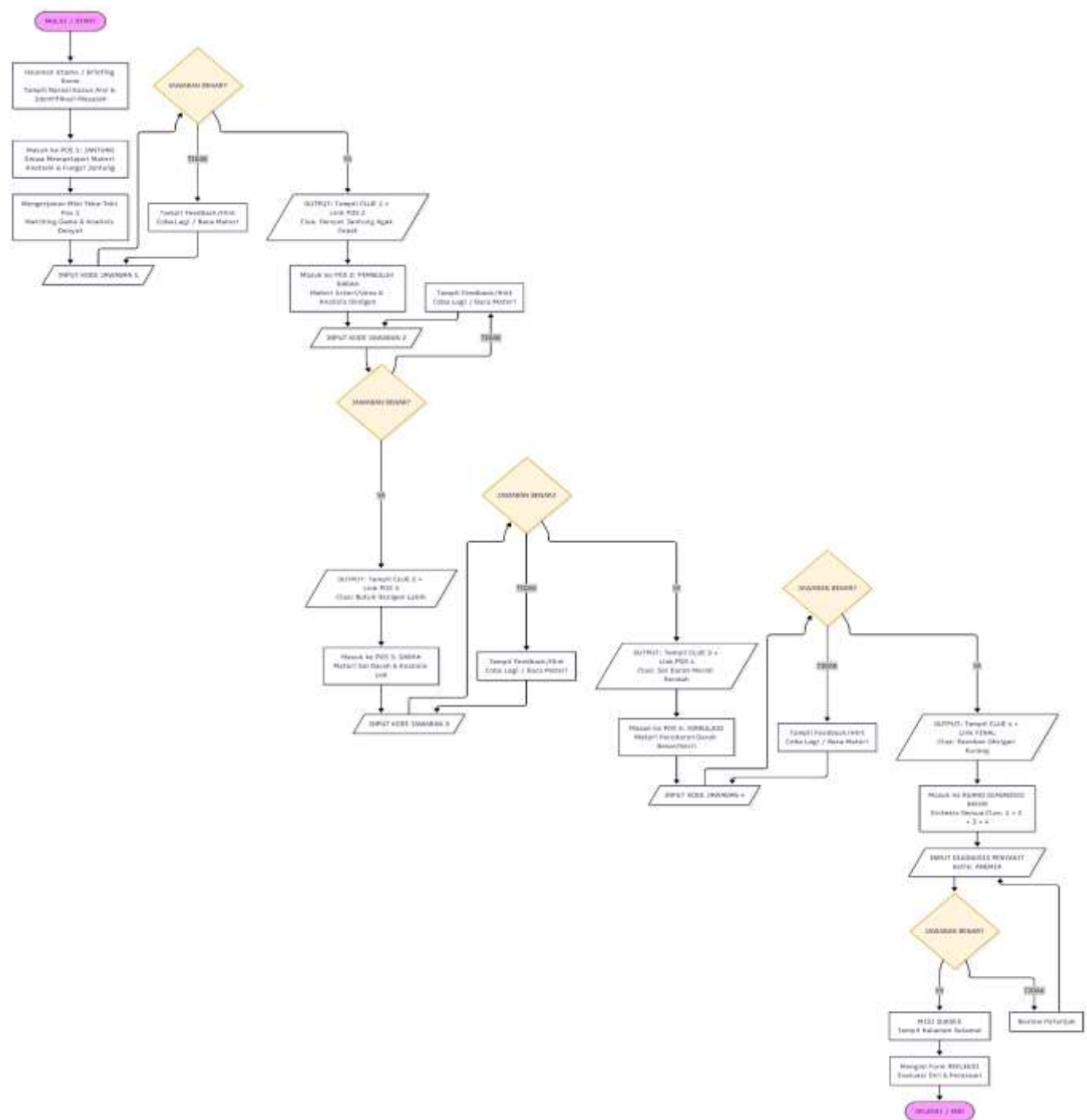


Figure 2. Flowchart of escape room learning media design.

Development Stage

The development stage in this study is a crucial process that focuses on transforming the design into a tangible product in the form of an interactive escape room-based learning media using Google Sites. This stage not only involves the creation of the media but also includes a refinement process through validation by material experts and media experts to ensure that the product meets feasibility standards in terms of both content and visual presentation.

At the initial stage of development, the media interface was designed using the Google Sites platform combined with visual elements from Canva and image sources obtained through Google search. The visual design emphasizes readability, consistency, and attractiveness to enhance students' engagement. The layout is designed to be responsive so that it can be accessed through various devices such as Chromebooks, laptops, and smartphones. Navigation is made simple and intuitive through the use of main buttons such as

Home, Learning Objectives, and Briefing Room, thereby supporting aspects of Information and Communication Technology (ICT) literacy.

In terms of color selection, the media uses a dominant combination of maroon red, white, and light blue. This color scheme was chosen to represent the medical theme and the circulatory system while maintaining visual comfort (eye-friendly). Meanwhile, the material visualization is designed by minimizing long textual explanations and replacing them with interactive infographics, short animated videos, and clickable visual elements. This approach aims to help students understand abstract concepts in a more concrete and engaging way.

From an implementation perspective, the media "Heart Detective Mission" is developed using a game-based learning approach integrated with the Problem-Based Learning (PBL) model. Students are invited to solve a series of puzzles at each learning "station," starting from the heart, blood vessels, blood, and blood circulation stations, culminating in the final diagnosis stage. Each page display is designed thematically with a medical-detective atmosphere to create an immersive, challenging, and non-monotonous learning experience. There is URL acces: <https://sites.google.com/darulistiqaamah.org/misi-detektif-jantung>

The media also includes a thematic logo (Figure 3), which combines elements of a heart and detective identity to reflect the integration of scientific content and problem-solving missions, although its primary function is as visual branding.



Figure 3. Logo media escape room

After the initial product was developed, a validation stage was conducted by material experts and media experts as part of formative evaluation. This validation aimed to assess the feasibility of the product and to provide constructive feedback for improvement. In the first stage of validation, the material expert noted that the content had not fully met curriculum requirements, particularly regarding disorders of the circulatory system and the clarity of learning objectives.

Material experts evaluated the accuracy and completeness of the content, while media experts assessed design quality, navigation, and interactivity. The validation results showed significant improvement after revisions, with material validity increasing from 76.00% to 85.00% and media validity improving from 73.30% to 86.70%. Revisions included adding content on circulatory disorders, clarifying learning objectives, simplifying navigation, and improving user instructions. This iterative process ensured that the developed media met feasibility standards in terms of both content and usability before being implemented in the classroom. Overall, this development stage produced a learning media product that is not only visually appealing but also strong in terms of content and functionality. The revision process based on expert feedback demonstrates that the development was conducted iteratively and systematically, ensuring that the final product meets the criteria of an effective interactive learning media. Therefore, the "Heart Detective Mission" media is considered ready to be implemented in the next stage of the ADDIE model, namely the implementation stage.

Implementation Stage

The implementation stage in this study represents a crucial phase in the ADDIE development model, where the validated product an interactive escape room learning media entitled "*Misi Detektif Jantung*" is tested directly in real classroom settings. This stage aims to examine the practicality and effectiveness of the media when used by actual users, namely teachers as facilitators and students as end-users. The implementation process not only evaluates how well the media functions technically, but also how it influences learning dynamics, student engagement, and learning outcomes.

From the teachers' perspective, practicality testing involved 15 science teachers consisting of 5 internal teachers from SMPs IT Darul Istiqamah and 10 external teachers from the MGMP IPA community. Data were collected through closed-ended questionnaires, open-ended responses, and interviews to obtain both quantitative and qualitative insights. The quantitative results indicated that the overall practicality level reached 86.3%, which falls into the "very practical" category. Teachers highly appreciated the ease of use, clarity of instructions, and intuitive navigation of the media. However, findings also revealed variability in responses, particularly related to technical constraints such as internet connectivity. One teacher consistently gave lower ratings due to limited internet access in their school, highlighting that the practicality of web-based media is influenced not only by design quality but also by infrastructural readiness.

Qualitative analysis further enriched these findings by revealing three major themes. First, in terms of pedagogical strength, teachers acknowledged that the media successfully transformed abstract concepts into meaningful problem-solving activities aligned with Problem-Based Learning (PBL). Second, the media significantly altered classroom atmosphere, increasing student enthusiasm, participation, and engagement. Teachers observed that even typically passive students became more active and collaborative during the activity. Third, challenges related to internet dependency emerged as a key concern, with several teachers recommending the development of an offline version to ensure broader applicability across schools with limited digital infrastructure.

From the students' perspective, the implementation involved 23 participants, and data were collected through questionnaires, observations, and interviews. The quantitative results showed a very positive response, with an average score of 91.9% categorized as "very positive." Students expressed high interest in the game-based storyline, interactive challenges, and visual presentation of the material. The highest scores were found in aspects related to narrative engagement and visual support, confirming the effectiveness of gamification in enhancing motivation and comprehension. However, a small anomaly was identified, where one student expressed dissatisfaction with group work, indicating that not all learners are equally comfortable with collaborative learning environments.

Qualitative findings revealed that the media created a strong sense of immersion, where students perceived the activity as a game rather than traditional learning. This intrinsic motivation encouraged them to actively solve problems and engage with the material. Additionally, students demonstrated collaborative strategies such as task division and peer support, reflecting the development of teamwork and metacognitive skills. Nevertheless, some students preferred individual work, highlighting the importance of considering learner diversity in instructional design.

Observation data provided further evidence of behavioral changes during the learning process. Most students demonstrated high levels of collaboration and critical thinking, with 69.6% categorized as "very good" in teamwork and 43.5% in critical reasoning. However, approximately 13% of students required additional guidance, indicating that teacher support remains essential. These findings emphasize that while the media serves as an effective learning tool, it does not replace the role of the teacher, particularly in providing scaffolding for students with lower academic abilities.

To evaluate learning effectiveness, the study employed a pre-test and post-test design analyzed using

the normalized gain (N-Gain) formula. The results showed a significant improvement in student achievement, with the average score increasing from 59 (pre-test) to 95 (post-test). The calculated N-Gain value was 0.88, which falls into the "high" category according to Hake's criteria. This indicates that students achieved 88% of the maximum possible improvement, demonstrating that the media is highly effective in enhancing conceptual understanding.

Moreover, one of the most significant findings is the reduction of learning gaps among students. The lowest pre-test score of 20 increased dramatically to 92 in the post-test, indicating that the media successfully supported lower-performing students. This suggests that the escape room approach is inclusive and capable of equalizing learning outcomes across diverse student abilities, aligning with the principle of "no student left behind."

Overall, the implementation stage demonstrates that the "Misi Detektif Jantung" media is not only highly practical but also highly effective in improving learning outcomes and classroom engagement. The integration of teacher and student data confirms that the media creates a dynamic, collaborative, and meaningful learning environment. However, the findings also highlight the importance of addressing technical limitations, particularly internet accessibility, and maintaining the teacher's role as a facilitator.

Evaluation Stage

Based on the entire series of evaluation processes conducted, several important findings were obtained that demonstrate the quality of the developed learning media. The Google Sites-based Escape Room media, "Misi Detektif Jantung," has been proven to have a very high level of validity, practicality, and effectiveness in supporting science learning, particularly on the topic of the Human Circulatory System. The implementation of gamification in this media has also been shown to significantly enhance students' motivation and engagement, as reflected in their enthusiasm, active participation, and collaborative interactions throughout the learning process. Nevertheless, the evaluation results also emphasize that the role of the teacher remains irreplaceable as a learning facilitator, especially in providing scaffolding for students who still experience difficulties in understanding the concepts. On the other hand, there are limitations that need to be considered, particularly the media's dependence on internet connectivity, which poses challenges for implementation in schools with limited digital infrastructure.

Based on these findings, several recommendations for further development are proposed to improve the quality and sustainability of the media's use. The

development of an offline or hybrid version is considered a strategic solution to overcome internet-related constraints, allowing the media to be accessed more widely and equitably. In addition, it is necessary to provide more flexible learning approaches, both individual and group-based, to accommodate diverse student learning styles. The incorporation of adaptive features that can adjust to students' varying levels of ability and learning needs is also an important step toward supporting more personalized and inclusive learning. Therefore, the developed media is not only effective in specific contexts but also has strong potential for broader implementation while maintaining its quality.

Conclusion

This study concludes that the development of a Google Sites-based Escape Room learning media using the ADDIE model has successfully produced an instructional product that is valid, practical, and effective for learning the human circulatory system. The media was developed through a systematic process starting from needs analysis, design, development with expert validation, classroom implementation, and summative evaluation. The validation results indicate that the media meets high feasibility standards in terms of content accuracy and technical design, while practicality data show that both teachers and students respond very positively to its use in classroom settings. From the implementation perspective, the media creates an engaging and interactive learning environment, transforming passive learning into active and collaborative experiences. Students demonstrate increased participation, motivation, and interaction, particularly through problem-solving activities embedded in the Escape Room narrative. The integration of Problem-Based Learning (PBL) further supports the development of critical thinking and collaboration skills, which are the main focus of this study. Based on the evaluation results, the media is proven to be highly effective in improving students' learning outcomes, as indicated by the increase in the average score from 59.00 (pre-test) to 95.00 (post-test) and an N-Gain value of 0.88 in the high category. This significant improvement suggests that the integration of narrative structure, visual representation, and collaborative problem-solving successfully facilitates students' understanding of abstract concepts. In addition, the media contributes to reducing learning gaps among students, particularly by supporting lower-achieving learners through peer collaboration and repeated exposure to key concepts during gameplay. The novelty of this research lies in the integration of content structure (circulatory system flow), instructional

design (PBL), and game-based learning (Escape Room) into a coherent and meaningful learning experience. This study not only addresses students' difficulties in understanding abstract science concepts but also responds to the need for developing essential 21st-century skills in a measurable and contextual manner. However, this study also identifies several limitations, particularly the dependence on internet connectivity and the absence of a control group, which may influence the generalization of the findings. Therefore, future research is recommended to develop offline or hybrid versions of the media and to employ experimental designs to further validate its effectiveness. Overall, the developed Escape Room learning media has strong potential to be implemented more broadly as an innovative digital learning solution that enhances conceptual understanding while fostering critical thinking and collaboration skills in science education.

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