

Development of Poster-Based Learning Media Using Adobe Animate for the Human Circulatory System in Madrasah Ibtidaiyah

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Abstract: This study aimed to assess the need for poster-based learning media created with Adobe Animate on the human circulatory system, evaluate its feasibility, and measure its effectiveness in improving fifth-grade students' learning outcomes at MI Ma'had Islam Plalar Kopeng. The study used a Research and Development (R&D) approach based on Saputro's three-stage model: preliminary study, media development, and effectiveness testing. The preliminary study with 60 respondents established a strong need for the media ($M = 3.74$). The development phase produced Adobe Animate-based poster media in DVD format, validated by experts, yielding high feasibility scores (subject-matter experts: $M = 4.85$; media expert: $M = 3.92$). Trials with individual ($n = 6$), small-group ($n = 12$), and limited field tests ($n = 30$) rated the media as very feasible (mean scores: 4.50, 4.32, 4.49). The effectiveness test, using a one-group pretest-posttest design with 23 students, indicated significant improvement in learning outcomes (Wilcoxon signed-rank test: $Z = -4.26$, $p < .001$; paired-samples t-test: $t(22) = 15.42$, $p < .001$), with a mean normalized gain of 0.57 (medium). The media proved feasible and effective for teaching the human circulatory system at the Madrasah Ibtidaiyah level, offering an engaging alternative for enhancing science education.

Keywords: Adobe animate, human circulatory system, instructional media, interactive poster, learning outcomes, Madrasah Ibtidaiyah



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A. Introduction

Learning media are widely regarded as an important component of science instruction because they help students connect abstract concepts with concrete representations (Ani et al., 2023). Evidence from primary science classrooms supports this view. A meta-analysis of 20 research articles concluded that using learning media significantly improved students' science learning outcomes (Nengsih et al., 2021). An experimental study in a primary school likewise found that multimedia produced better science learning outcomes than instruction without it (Nur Jannah, 2020), and interactive PowerPoint-based media improved fourth-grade students' science learning outcomes compared with conventional instruction (Sefina et al., 2024).

These benefits matter even more in twenty-first-century learning, where digital media are no longer merely an option but a strategic resource for increasing student engagement and developing skills such as critical thinking, collaboration, creativity, and digital literacy (Chafshah et al., 2024; Destriani and Warsah, 2022). Digital media are particularly valuable for science topics that cannot be observed directly, because animation and simulation can visualize complex scientific concepts and thereby make learning more contextual and meaningful (Angelika et al., 2025; Chafshah et al., 2024).

The human circulatory system is a typical example. Students must understand the structure of the heart and blood vessels, the direction of blood flow, and the difference between small (pulmonary) and large (systemic) circulation, none of which can be observed directly in the classroom. Interactive multimedia has been used to make this abstract content more concrete for primary and madrasah students (Audhiha et al., 2021; Maielfi and Ardiana, 2023), and digital learning materials on human blood circulation have also been developed using a STEAM approach (Utaminingsih et al., 2023).

A preliminary study at Madrasah Ibtidaiyah (MI) Ma'had Islam Plalar Kopeng, Semarang Regency, revealed four conditions. First, posters were available as learning media but did not effectively support learning activities. Second, teachers had not yet used interactive digital media of the kind developed in this study. Third, students showed little enthusiasm for learning because the available media were not varied or developed further. Fourth, teachers had not utilized the media available in the students' surroundings to facilitate learning. Taken together, these findings point to one central problem: the media used in the school are static. They are not designed to engage students with an abstract topic, so learning about the circulatory system depends largely on verbal explanation and still images. Solving this problem requires media that keep the concise, visual format of a poster while adding animation and interactivity. Adobe Animate, the successor to Adobe Flash, is one software option that meets this requirement because it integrates animation, graphics, and interactive elements in a compact format that can be distributed across devices (Yuliawati, 2017).

Previous studies have examined animation and multimedia for related topics, although their focus differs from that of the present study. Maielfi and Ardiana (2023) developed interactive multimedia on the human circulatory system for fifth-grade primary school students. They reported that computer-based multimedia was effective, but they did not use a poster as the main medium (Maielfi and Ardiana, 2023). Audhiha et al. (2021) developed Macromedia Flash-based interactive multimedia on the same topic for madrasah ibtidaiyah students. However, their study emphasized validity and user responses rather than changes in learning outcomes (Audhiha et al., 2021). Utaminingsih et al. (2023) developed a STEAM-based e-module on human blood circulation, which is a different format from a poster-based animation (Utaminingsih et al., 2023). Studies using Adobe Animate have addressed other content: Cholis and Aziz (2024) developed interactive media on human-body analogies (Cholis and Aziz, 2024), Sasongko (2025) developed media for solid geometry (Sasongko, 2025), Rosemarry and Isdaryanti (2024) reported improved learning outcomes in fifth-grade science (Rosemarry and Isdaryanti,

2024), and Jayawi et al. (2026) reported improved understanding of human organs among fifth-grade students (Jayawi and Kurniawati, 2026). However, none of these studies developed poster-style media on the human circulatory system using Adobe Animate.

Three gaps therefore remain. First, to our knowledge, poster-style media on the human circulatory system built with Adobe Animate have not been developed for the madrasah ibtidaiyah level. Second, the poster format, concise, easy to read, and based on educational iconography and short text, has rarely been combined with micro-animation and interactive game and evaluation features. Third, some development studies on this topic stopped at validity and user response without testing changes in students' learning outcomes (Ani et al., 2023; Audhiha et al., 2021).

This study's novelty lies in developing interactive, poster-based learning media using Adobe Animate that combine micro-animation, educational iconography, and concise text to present the human circulatory system visually, and that add a companion character, an educational game, and a formal evaluation module. The media were developed through a complete sequence of needs analysis, expert validation, three-stage user trials, and an effectiveness test on learning outcomes. Accordingly, the objectives of this study were, first, to identify the need for poster-based learning media developed with Adobe Animate on the human circulatory system; second, to determine the feasibility of the media according to experts and users; and third, to measure the effectiveness of the media in improving the learning outcomes of fifth-grade students at MI Ma'had Islam Plalar Kopeng.

B. Method

Research Design and Procedure

This study used a Research and Development (R&D) design to produce interactive learning media on the human circulatory system using Adobe Animate and to test its effectiveness in improving student learning outcomes. Development followed Saputro's three-stage model: a preliminary study, media development, and effectiveness testing (Saputro et al., 2019).

The preliminary study included a needs analysis using structured questionnaires, interviews, and documentation with at least 30 respondents to identify learning needs and respondents' expectations for the draft product. In the development stage, the draft product was discussed in a Focus Group Discussion (FGD) involving subject-matter experts, a media expert, and selected respondents. After the FGD, the product was tested in an individual trial with at least six students, a small-group trial with 12 students (twice the number in the individual trial), and a limited field trial with 30 students. Respondents in one trial did not participate in any other trial, and the authors revised each trial as needed based on user feedback. In the effectiveness-testing stage, the product from the limited field trial was tested for its effect on learning outcomes to produce the final product.

Setting and Participants

The study was conducted at MI Ma'had Islam Plalar Kopeng, Semarang Regency. The needs analysis included 60 respondents: 30 teachers and 30 students. Three validators conducted expert validation: two subject-matter experts (pseudonyms ERK and SNC) and one media expert, MS. The individual, small-group, and limited field trials involved 6, 12, and 30 fifth-grade students, respectively, and the effectiveness test involved 23 fifth-grade students.

Instruments and Data Collection

Data were collected with three types of instruments: structured questionnaires and interviews for the needs analysis and user trials, validation sheets for the experts, and a written learning outcome test on the human circulatory system administered as a pretest and a posttest. Experts scored each aspect of the media according to the indicators and descriptors in the validation sheets. The user trials used Likert-scale questionnaires. Learning outcome data were obtained by giving the pretest before and the posttest after the students learned with the media.

Data Analysis

The effectiveness test used a one-group pretest–posttest design ($O_1 \rightarrow X \rightarrow O_2$) (Sugiyono, 2019; Sukarelawan et al., 2024), in which one group of students is measured twice. O_1 is the pretest score, which measures students' initial knowledge before the treatment; X is the treatment, namely learning with the Adobe Animate–based media on the human circulatory system; and O_2 is the posttest score, which measures students' knowledge after the treatment.

Expert validation and trial data were analyzed descriptively by calculating the mean score of the assessments, $M = \sum x_i / n$, and were classified into five categories on a five-point scale: very feasible (4.21–5.00), feasible (3.41–4.20), fairly feasible (2.61–3.40), less feasible (1.81–2.60), and not feasible (1.00–1.80) (Sugiyono, 2019). The media were considered feasible for use if the mean score reached at least the feasible category (≥ 3.41).

Learning outcome data were described using the mean, median, standard deviation, minimum, and maximum of the pretest and posttest scores. The magnitude of improvement was calculated with the normalized gain (g) (Hake, 1998; Sukarelawan et al., 2024):

$$g = (\text{posttest} - \text{pretest}) / (\text{maximum score} - \text{pretest})$$

The researchers interpreted the gain as high ($g \geq 0.7$), medium ($0.3 \leq g < 0.7$), or low ($g < 0.3$). Before hypothesis testing, the Shapiro–Wilk test (Shapiro & Wilk, 1965), was used to assess the normality of pretest and posttest scores, as it is suitable for small samples. If the data were normally distributed ($p > .05$), the researchers used the paired-samples t-test, $t = Md / (sd / \sqrt{n})$, to compare pretest and posttest scores; otherwise, the researchers used the Wilcoxon signed-rank test as a nonparametric alternative (Field, 2018). Effect sizes were reported as $r = |Z| / \sqrt{N}$ for the Wilcoxon test and Cohen's d for

the paired-samples *t*-test. The significance level was set at .05, and the media were considered effective in improving learning outcomes if $p < .05$ (Saputro et al., 2019). All analyses were performed with SPSS version 22.

C. Results and Discussion

This section presents the results of media development in the order of the stages of the model used, namely the preliminary study, product development, and effectiveness testing, and then discusses the feasibility and effectiveness of the media in light of theory and previous studies.

Results

Needs Analysis

At the initial stage, the researchers conducted interviews and distributed questionnaires to 60 respondents, consisting of 30 teachers and 30 students, to analyze the need for practical and innovative Adobe Animate-based science learning media on the human circulatory system. Table 1 shows that all six indicators fell in the very needed category, with an overall mean score of 3.74. Innovative learning media on the human circulatory system were therefore strongly needed by teachers and students.

Table 1. Results of the Needs Analysis for Innovative Learning Media

No.	Indicator	Mean ($n = 30$)	Description
1	Type of media	3.65	Very needed
2	Content of the material	3.94	Very needed
3	Practicality	3.83	Very needed
4	Benefits	3.66	Very needed
5	Implementation	3.76	Very needed
6	Evaluation	3.63	Very needed
Total		22.49	
Mean		3.74	Very needed

Product Development and Expert Validation

In this stage, the draft of the poster-based media was presented in a Focus Group Discussion (FGD). Three validators took part in the validation: one media expert (Muhammad Safari) and two subject-matter experts (Erna Risfaula Kusumawati and Siti Nok Chalimah). The validators recommended improving spelling and punctuation and using brighter colors to make the poster more attractive to students. After the revisions, the researchers consulted the experts again, and the product was declared validated once all improvements had been made in line with the feedback. The experts' final assessments are presented in Tables 2 and 3.

Table 2 shows that the subject-matter experts rated all four aspects as very feasible, with an overall mean of 4.85 on a five-point scale. The media expert rated the six aspects between 3.66 and 4.33, with an overall mean of 3.92, which falls in the feasible category (Table 3). The lowest-rated aspects were the presentation's attractiveness and the

authenticity of the facts. Overall, the expert assessments indicate that the media are feasible for learning the human circulatory system.

Table 2. Assessment by the Subject-Matter Experts

No.	Assessment aspect	Mean	Description
1	Core and basic competencies (KI-KD)	4.75	Very feasible
2	Indicators of learning objectives	5.00	Very feasible
3	Material presentation	4.66	Very feasible
4	Language presentation	5.00	Very feasible
Total		19.41	
Mean		4.85	Very feasible

Table 3. Assessment by the Media Expert

No.	Assessment aspect	Mean	Description
1	Media design	4.33	Very feasible
2	Media content	3.80	Feasible
3	Presentation technique	4.00	Feasible
4	Attractiveness of the presentation	3.66	Feasible
5	Instructional presentation	4.00	Feasible
6	Authentic facts	3.75	Feasible
Total		23.55	
Mean		3.92	Feasible

Product Description

After revision and validation, the final product was an interactive, poster-based learning medium on the human circulatory system that integrates pedagogical and technological aspects to create a more dynamic, student-centered learning environment. The medium is titled BATIK, which stands for *Belajar Asyik dengan TIK* and translates to "Fun Learning with ICT", Human Circulatory System Series.

The interface was designed to be user-friendly, using the metaphor of a futuristic medical laboratory, and the navigation is arranged hierarchically so that users can move between menus without obstacles. The main navigation gives direct access to the core material, the discussion of circulatory disorders, and the evaluation module. Supporting features include icons for settings, application information, and help, which are designed to be responsive so that students can operate the medium easily. The menu structure also allows students to explore the material independently at their own pace (self-paced learning).

The material is organized into two main domains. The first domain, the circulatory system, has four subtopics: the mechanism of the circulatory system, the organs involved, and the pathways of small (pulmonary) and large (systemic) circulation. The second domain, circulatory disorders, focuses on health education and presents four case studies, namely leukemia, anemia, hypertension, and hemophilia, which connect biological theory with the clinical reality of health disorders in humans.

A key strength of the medium is its integration of gamification to increase students' cognitive engagement. In addition to textual material, the medium contains two

interactive elements. The first is a companion character, a virtual agent that serves as an interactive guide, encourages students, and creates a less monotonous learning atmosphere. The second is an evaluation module with two approaches: an educational game designed to reinforce conceptual understanding in a low-pressure way, and a formal evaluation instrument that quantitatively measures students' learning outcomes after they interact with the medium. Overall, the medium is expected to help overcome learning barriers related to abstract content by providing concrete visualizations and participatory learning experiences. The final product can be accessed at <https://bit.ly/Produkfinalmediapembelajaran>.

Media Display

Figures 1 to 6 show the medium's main screens and explain the function of the tools on each screen.

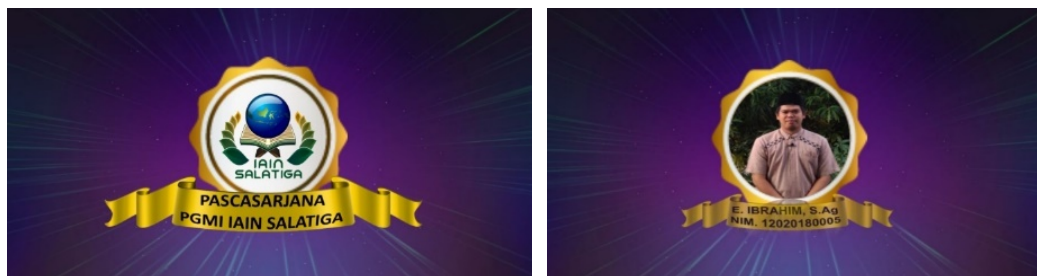


Figure 1. Opening screens of the medium: (a) institutional identity screen; (b) developer identity screen

Figure 1 shows the two opening screens that appear when the program is launched. The first screen displays the logo of the developer's institution and postgraduate study program, and the second displays the developer's name and student number. Both screens serve as the identification and credit page before the user proceeds to the main menu.



Figure 2. Start page and main menu: (a) start page; (b) main menu

Figure 2a shows the start page, which displays the medium's title and a green play button that starts the program. The gear icon at the upper left opens the application settings, and the close button at the upper right exits the program. Figure 2b shows the main menu, which organizes the content into three panels: the circulatory system (four subtopics), circulatory disorders (leukemia, anemia, hypertension, and hemophilia), and game and evaluation. The information and help buttons provide access to application details and guidance on how to use it, and the animated companion character in the lower right guides students through the menu.

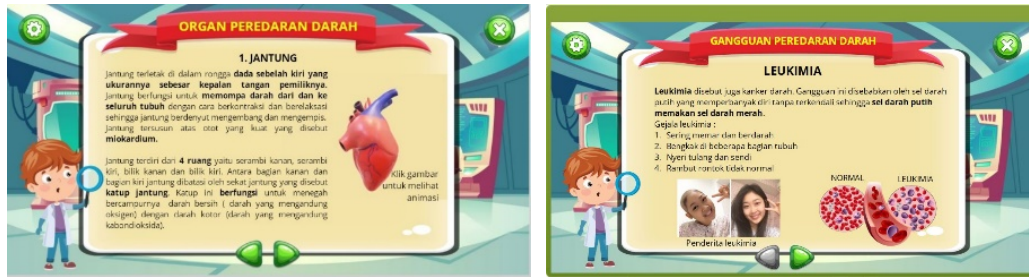


Figure 3. Material pages: (a) circulatory organ page (heart); (b) circulatory disorder page (leukemia)

Figure 3 shows two material pages. Each page includes a concise text panel explaining the concept, an illustration that supports the text, and a pair of arrow buttons to move to the previous or next page. On the organ page (Figure 3a), the heart illustration is clickable and, according to the on-screen instruction, plays an animation when selected, allowing students to observe how the heart works. On the disorder page (Figure 3b), the text explains the definition and symptoms of leukemia, and the illustration compares normal blood cells with leukemic blood cells to help students connect the clinical description with the biological concept.



Figure 4. Game pages: (a) question page; (b) feedback for a correct answer; (c) feedback for an incorrect answer; (d) game score page

Figure 4 shows the game pages. On the question page (Figure 4a), students read a question, type their answer in the text box, and press the answer button, while a counter at the top of the screen records the running score. After each answer, the medium provides visual feedback: three gold stars and an encouraging message for a correct answer (Figure 4b), and empty stars with a message encouraging students to keep studying for an incorrect answer (Figure 4c). At the end of the game, a score page displays the total game score, and the arrow button proceeds to the next screen (Figure 4d). These tools give students immediate feedback in a low-pressure setting and allow them to practice the material before the formal evaluation.

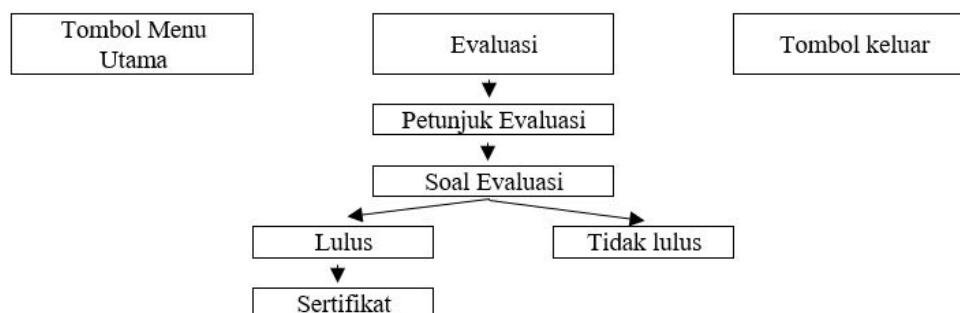


Figure 5. Flowchart of the evaluation module

Figure 5 summarizes the evaluation module flow. From the evaluation menu, students first read the evaluation instructions and then work on the evaluation questions. Students who reach the passing score receive a certificate; those who do not receive one. The main menu button and the exit button remain available at every step, so students can return to the menu or leave the program at any time.

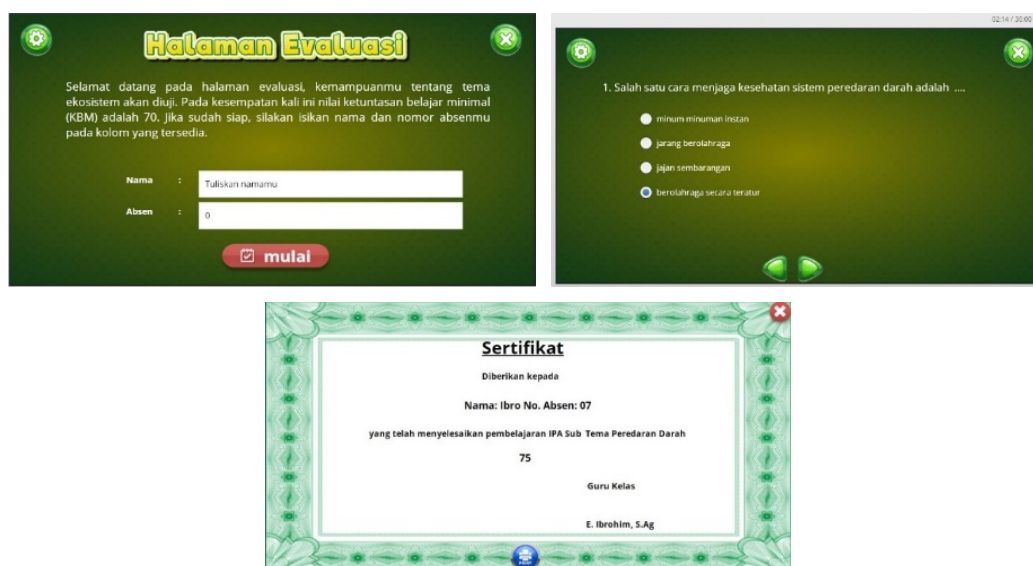


Figure 6. Evaluation pages: (a) instruction and identity page; (b) question page; (c) certificate page

Figure 6 shows the evaluation pages. On the instruction page (Figure 6a), students enter their name and attendance number and press the start button; the page also states the minimum mastery criterion of 70. On the question page (Figure 6b), each item appears as a multiple-choice question with option buttons; a timer in the upper right shows the remaining time, and arrow buttons move to the previous or next item. On the certificate page (Figure 6c), the medium displays the student's name, attendance number, and score, and the print button at the bottom allows printing the certificate as a record of completion.

Trials

The trials were carried out at MI Ma'had Islam Plalar Kopeng on October 2, 2021, and consisted of an individual trial, a small-group trial, and a limited field trial. The results are presented in Tables 4 to 6.

Table 4. Results of the Individual Trial

No.	Assessment aspect	Mean ($n = 6$)	Description
1	Media novelty	4.66	Very feasible
2	Media attractiveness	4.16	Feasible
3	Media presentation	4.33	Very feasible
4	Communicative and interactive media	4.50	Very feasible
5	Presentation of learning activities	4.33	Very feasible
6	Language appropriateness	4.83	Very feasible
7	Compatibility with authentic learning	4.66	Very feasible
	Overall mean	4.50	Very feasible

Table 5. Results of the Small-Group Trial

No.	Assessment aspect	Mean ($n = 12$)	Description
1	Media novelty	4.25	Very feasible
2	Media attractiveness	4.16	Feasible
3	Media presentation	4.33	Very feasible
4	Communicative and interactive media	4.50	Very feasible
5	Presentation of learning activities	4.25	Very feasible
6	Language appropriateness	4.50	Very feasible
7	Compatibility with authentic learning	4.25	Very feasible
	Overall mean	4.32	Very feasible

Table 6. Results of the Limited Field Trial

No.	Assessment aspect	Mean ($n = 30$)	Description
1	Media novelty	4.56	Very feasible
2	Media attractiveness	4.69	Very feasible
3	Media presentation	4.39	Very feasible
4	Communicative and interactive media	4.47	Very feasible
5	Presentation of learning activities	4.65	Very feasible
6	Language appropriateness	4.39	Very feasible
7	Compatibility with authentic learning	4.30	Very feasible
	Overall mean	4.49	Very feasible

The overall mean scores were 4.50 in the individual trial ($n = 6$), 4.32 in the small-group trial ($n = 12$), and 4.49 in the limited field trial ($n = 30$), all of which fall in the very feasible category. From the individual to the small-group trial, the largest decreases occurred in media novelty, language appropriateness, and compatibility with authentic learning.

Effectiveness Test

In the final stage, the researchers tested the medium's effectiveness by comparing students' science learning outcomes on the human circulatory system before and after they learned with the medium, using a pretest and a posttest. This test corresponds to the third objective of the study, namely measuring the effect of the medium on students' learning outcomes. The scores are presented in Table 7 and summarized in Table 8.

Table 7. Pretest and Posttest Scores of the Students (n = 23)

No.	Student code	Pretest	Posttest	Difference	N-gain
1	S1	55	70	15	0.33
2	S2	60	75	15	0.38
3	S3	60	70	10	0.25
4	S4	65	80	15	0.43
5	S5	65	75	10	0.29
6	S6	65	90	25	0.71
7	S7	65	80	15	0.43
8	S8	70	85	15	0.50
9	S9	60	90	30	0.75
10	S10	60	80	20	0.50
11	S11	75	90	15	0.60
12	S12	75	95	20	0.80
13	S13	80	100	20	1.00
14	S14	75	90	15	0.60
15	S15	65	80	15	0.43
16	S16	65	85	20	0.57
17	S17	60	90	30	0.75
18	S18	60	80	20	0.50
19	S19	75	90	15	0.60
20	S20	80	100	20	1.00
21	S21	85	100	15	1.00
22	S22	65	75	10	0.29
23	S23	65	80	15	0.43
Mean		67.39	84.78	17.39	0.57

Table 8. Descriptive Statistics of the Pretest and Posttest Scores

Test	N	M	Median	SD	Minimum	Maximum
Pretest	23	67.39	65.00	7.96	55	85
Posttest	23	84.78	85.00	9.11	70	100

Table 7 shows that all 23 students (100%) obtained higher scores on the posttest than on the pretest. The class mean increased from 67.39 to 84.78, an average gain of 17.39 points. The lowest pretest score was 55, and the highest was 85. On the posttest, the lowest score rose to 70, and three students (S13, S20, and S21) reached the maximum score of 100. All students scored 70 or above on the posttest, compared with eight students on the pretest. S9 and S17 had the largest individual gain, 30 points. The mean normalized gain was 0.57 ($SD = 0.23$), which falls in the medium category; seven students achieved a high gain, 13 a medium gain, and three a low gain.

Table 9 presents the normality test results. The pretest scores deviated from a normal distribution ($W = .898$, $p = .023$), whereas the posttest scores did not ($W = .934$, $p = .132$). The difference scores also deviated from normality ($W = .845$, $p = .002$).

Because the normality assumption was not met, we used the Wilcoxon signed-rank test as the primary test, in accordance with the decision rule described in the Method section.

Table 9. Results of the Shapiro–Wilk Normality Test

Scores	<i>W</i>	<i>df</i>	<i>p</i>	Interpretation
Pretest	.898	23	.023	Not normal
Posttest	.934	23	.132	Normal
Difference (posttest – pretest)	.845	23	.002	Not normal

Note. Normality was assumed when $p > .05$.

The Wilcoxon signed-rank test showed a significant difference between pretest and posttest scores ($Z = -4.26$, $p < .001$), with a large effect size ($r = .89$): all 23 students had higher posttest scores, with no negative ranks or ties (Table 10). The paired-samples *t*-test, reported for completeness and for comparison with earlier studies, yielded the same conclusion: $t(22) = 15.42$, $p < .001$, with a mean difference of 17.39 points (95% CI [15.05, 19.73]). Because p was below .05, the null hypothesis of no difference between pretest and posttest scores was rejected, and the alternative hypothesis was accepted; that is, the Adobe Animate-based poster media effectively improved the learning outcomes of fifth-grade students at MI Ma'had Islam Plalar Kopeng.

Table 10. Results of the Wilcoxon Signed-Rank Test and the Paired-Samples *t*-Test

Test	Statistic	<i>df</i>	<i>p</i> (two-tailed)	Effect size
Wilcoxon signed-rank	$Z = -4.26$	–	$< .001$	$r = .89$
Paired-samples <i>t</i> -test	$t = 15.42$	22	$< .001$	$d = 3.22$

Note. Wilcoxon test: 23 positive ranks, 0 negative ranks, and 0 ties. Paired-samples *t*-test: mean difference = 17.39 ($SD = 5.41$; $SE = 1.13$), 95% CI [15.05, 19.73]; d is Cohen's d_z .

Discussion

Feasibility of the Media

Expert validation and three-stage user trials indicate that poster-based media are feasible for teaching the human circulatory system in madrasah ibtidaiyah. Subject-matter experts judged the media to be highly consistent with the core and basic competencies, the indicators of the learning objectives, and the quality of the material and language (Zainuri and Saepuloh, 2023). This finding is important because the circulatory system is a topic in which conceptual errors are easily introduced, for example, when the pathways of pulmonary and systemic circulation are confused (Nur et al., 2026). Expert-validated content therefore provides the necessary foundation for using a medium in the classroom (Nur et al., 2026).

The media expert also judged the product feasible, although the appraisal was more moderate than that of the subject-matter experts (Fahrezi et al., 2026). The aspects that received comparatively lower appraisals were the presentation's attractiveness and the authenticity of the facts, and the experts' recommendations concerned spelling, punctuation, and brighter colors. This pattern suggests that, when visual media are

developed, the main revisions tend to focus on the display's surface features rather than the core concept. That valid content does not, by itself, guarantee an attractive presentation. This aligns with the multimedia design principles synthesized by Mayer (Mayer, 2024), which ask designers to pay attention to how words and images are combined so that learners are not distracted by poorly presented or unnecessary elements.

The user trials showed that students and teachers accepted the media well, and ratings were relatively stable across the three stages (Richter et al., 2018). The slight decline from the individual to the small-group trial, especially in novelty, language appropriateness, and compatibility with authentic learning, may reflect the more heterogeneous conditions of a group, in which students differ in reading ability and prior knowledge, compared with the individual trial, in which respondents interact with the medium under closer supervision (Rachmadtullah et al., 2018). The higher ratings in the limited field trial may reflect revisions made after the earlier trials, although this study cannot confirm this explanation (Sudarma et al., 2021). These results are in line with earlier development studies on the same topic, in which interactive multimedia validated by experts was judged suitable for madrasah and primary school students (Audhiha et al., 2021; Maielfi and Ardiana, 2023).

Effectiveness of the Media

The results show that students' learning outcomes improved after learning with the poster-based media, that every student benefited, and that the improvement was large and statistically reliable, with a medium normalized gain (Fitrianti et al., 2026). Both nonparametric and parametric analyses led to the same conclusion, strengthening confidence in the finding despite the departure from normality in the pretest scores. This finding agrees with previous studies showing that interactive and animation-based media improve elementary students' science learning, including Adobe Animate-based media for human organs (Jayawi and Kurniawati, 2026) and for fifth-grade science more broadly (Rosemarry & Isdaryanti, 2024), animated videos (Angelika et al., 2025), and multimedia in general (Nengsih et al., 2021; Nur Jannah, 2020). It also extends earlier work on the circulatory system, which relied on Flash-based or general multimedia and emphasized validity and user responses (Angelika et al., 2025; Maielfi and Ardiana, 2023), by showing that poster-style media built with Adobe Animate can improve learning outcomes in a madrasah setting.

The Cognitive Theory of Multimedia Learning (CTML) explains why the media are effective. This theory proposes that people learn through separate channels for verbal and visual information, that each channel has a limited capacity, and that meaningful learning requires active processing, namely selecting, organizing, and integrating information (Hake, 1998; Mayer, 2024). The media design aligns with these assumptions. The poster-like screens pair short explanatory text with illustrations, presenting information through both channels at the same time, consistent with dual coding theory, which holds that verbal and imagery representations reinforce each other in memory (Clark and Paivio, 1991). Animations of the heart and the direction of blood flow make a dynamic process visible, particularly the difference between small and large circulation,

in a way that static posters cannot, and this is likely to help students build a coherent mental model of the circulatory pathway (Hauk and Gröschner, 2022). The concise text and division into short subtopics limit the information presented at one time, which can help manage cognitive load (Mutlu-Bayraktar et al., 2019), while learner-controlled navigation allows students to proceed at their own pace and to revisit difficult parts. Because the preliminary study found that the posters previously used at the school were ineffective, the improvement observed here suggests that adding animation and interactivity to the poster format addresses that limitation.

The game and evaluation features may also have contributed. They prompt students to retrieve and apply what they have studied and provide immediate visual feedback after each answer, which likely sustains attention and motivation. Meta-analytic evidence indicates that gamification generally has a positive effect on learning outcomes, although the effect size depends on how the game elements are designed and used (Li et al., 2023). The companion character may likewise make the learning atmosphere less monotonous, as intended by the design (Beege and Ploetzner, 2025; Kleftodimos, 2024). However, this study did not measure these mechanisms separately. They are interpretations that are consistent with theory and previous findings and should be tested in studies that isolate each feature.

Finally, because this study used a single group without a control group, the improvement cannot be attributed to the media alone; other factors, such as the teacher's instruction and students' familiarity with the test items, may also have contributed. Nevertheless, the consistent gains across all students and the convergence with earlier controlled studies make the media a plausible contributor to the improvement.

D. Conclusion

Theoretically, the findings support the Cognitive Theory of Multimedia Learning and dual coding theory in a madrasah ibtidaiyah setting. They show that combining concise text, educational iconography, and micro-animation in a poster format can be a workable way to apply the principles of dual channels and limited capacity in real classroom media. The study also shows that the three-stage R&D model, from needs analysis through staged trials to effectiveness testing, can yield media that are both expert-validated and associated with measurable learning gains. In addition, the findings suggest that interactive features such as games and self-paced navigation may complement multimedia design principles, an idea that requires further testing.

Practically, teachers can use the media as a supplementary teaching resource to help students visualize abstract processes such as blood flow and to practice through the built-in game and evaluation, especially in classrooms with computers or projectors. The self-paced structure allows students to review the material independently, and the evaluation module gives immediate feedback on their performance. The development procedure can also serve as a model for madrasah teachers who wish to develop interactive media for other topics.

This study has several limitations. It used a one-group pretest-posttest design without a control group, so the gains cannot be attributed exclusively to the media. The effectiveness test involved only 23 students from one madrasah and measured learning outcomes immediately after use, so generalizability and long-term retention remain unknown. The study did not examine the contribution of individual features, such as the animation, the game, and the evaluation module; the expert panel was small; and the media are currently distributed on DVD and via an online link, which may limit access on some devices.

Future studies should use quasi-experimental or randomized designs with control groups, larger samples from several madrasahs, and delayed posttests to assess retention. Researchers could also examine which features contribute most to learning and add adaptive features that adjust the difficulty of the material based on students' real-time performance, taking students' digital literacy into account. The media could further be adapted for mobile and web platforms and extended to related topics, such as the circulatory system in animals.

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