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DEVELOPMENT OF AUDIO VISUAL-BASED E-HANDOUT ON THE TOPIC OF HUMAN BLOOD CIRCULATORY SYSTEM

Loren, P.R.P[1,a)], Sarkity, D[1], Fernando, A[1]
[1]Department of Biology Education, Universitas Maritim Raja Ali Haji, Tanjungpinang, Indonesia
[a)]E-mail: paulinareski07@gmail.com

ABSTRACT

This study aims to develop an audio-visual–based e-handout on the human circulatory system for Grade VIII students and to determine its validity, practicality, and effectiveness. The development process employed the ADDIE model, consisting of the stages of Analysis, Design, Development, Implementation, and Evaluation. The e-handout was created using digital media and integrated images, audio narration, videos, and interactive quizzes. Material and media validation was conducted by expert validators, while practicality and effectiveness were assessed through teacher and student responses and post-test results. The material validity reached an average of 86.11%, and the media validity reached 89.46%, both categorized as very valid. Teacher practicality was 76.79%, and student practicality was 86.92%, categorized as very practical. The effectiveness test yielded an N-gain score of 0.7112, indicating high effectiveness. Thus, the audio-visual–based e-handout is valid, practical, and effective for supporting learning on the human circulatory system.

Keywords: Audio Visual, E-Handout, Human Circulatory System

INTRODUCTION

Education in the 21st century is characterized by rapid advances in science, technology, and digital innovation, all of which influence the ways in which teaching and learning are conducted. The integration of technology in education is now a fundamental requirement to enhance the quality of instruction, support student engagement, and prepare learners to face global challenges (Putri et al., 2021). As education aims to facilitate the development of students' intellectual, social, and emotional growth, the learning process must provide meaningful experiences that allow students to

construct knowledge actively (Faizah, 2017). In this context, teaching activities need to be supported by relevant learning resources that align with curriculum goals and the developmental characteristics of learners (Handayani & Hasibuan, 2022).

Curriculum serves as the foundation for structuring educational activities. In Indonesia, the introduction of the Independent Curriculum (Kurikulum Merdeka) reflects a national effort to address learning losses resulting from the COVID-19 pandemic and to provide more flexible learning pathways tailored to students' needs (Zakso, 2022). Based on interviews conducted with teachers at SMPN 4 Tanjungpinang, Grades VII and VIII have implemented the Independent Curriculum for approximately two years, while Grade IX continues to use the 2013 Curriculum. However, teachers reported challenges in adjusting teaching materials to meet curriculum demands, particularly for science topics requiring high levels of conceptual understanding.

Learning resources play a crucial role in supporting students' conceptual comprehension. According to (Wahyudi, 2022), teaching materials must be systematic, engaging, and accessible; otherwise, students may struggle to connect theoretical concepts with real-world contexts. Observations and interviews with science teachers at SMPN 4 Tanjungpinang revealed that teaching materials used in class mainly consist of printed textbooks, student worksheets, and PowerPoint presentations. While these materials provide structure, they tend to be static and teacher-centered, limiting opportunities for meaningful student interaction. In addition, teachers acknowledged limited skills and time to develop digital teaching materials that incorporate multimedia elements.

Students' responses from the preliminary questionnaire administered to Grade VIII students at SMPN 4 Tanjungpinang further confirm these issues. The questionnaire results showed that many students expressed boredom and difficulty maintaining attention because the teaching materials used in class were not visually appealing or interactive. According to (Sirait, 2016), students' interest plays a crucial role in determining engagement and learning achievement. When teaching materials fail to stimulate interest, student motivation decreases, which in turn leads to reduced comprehension and suboptimal learning outcomes.

Furthermore, the questionnaire findings provide important insights into the learning challenges students experience during science lessons, particularly in understanding the human circulatory system. Several students reported that the materials presented in class tended to be text-heavy, lacked sufficient visual explanations, and were not accompanied by dynamic media such as animations or narrated videos. These limitations made it difficult for students to visualize abstract biological processes involving organs and physiological mechanisms that cannot be directly observed. This aligns with cognitive theory, which states that abstract concepts require concrete external representations to support mental visualization and prevent cognitive overload. When instructional materials do not provide such support, students may form fragmented or inaccurate concepts, leading to misconceptions that hinder further learning.

A deeper analysis of the problem at SMPN 4 Tanjungpinang, based on the results of the student questionnaire and documentation of learning outcomes, revealed that 56.4% of Grade VIII students still struggled to understand the human circulatory system. In addition, 86% of students had not yet met the school's minimum mastery criteria (KKM). These findings strongly indicate that conceptual understanding of the circulatory system remains low. This condition is consistent with the findings of (A. Safitri et al., 2021), who noted that circulatory system content

is inherently complex because it involves numerous scientific terms, multi-step physiological processes, and microscopic biological structures that cannot be directly observed. Without adequate multimedia support to visualize these elements, students may find it difficult to develop accurate mental models of circulatory mechanisms, thereby limiting their conceptual comprehension.

In addition, learning style analysis indicated that the majority of Grade VIII students at SMPN 4 Tanjungpinang possess dominant visual and auditory learning preferences. Research by (Editya et al., 2018) similarly demonstrates that adolescents aged 13–15 tend to benefit more from multimedia-supported learning resources that combine images, narration, video, and interactive elements. Mayer's cognitive theory of multimedia learning reinforces this, explaining that understanding improves when information is delivered through dual channels (visual and auditory) in a coordinated manner.

These gaps between learning needs and available teaching resources highlight the necessity for developing innovative instructional materials that integrate audio-visual components. Audio-visual–based materials have been shown to significantly enhance attention, interest, and learning outcomes, especially in content demanding visualization and conceptual integration (Pattaufi & Arnidah, 2019). An e-handout, as a flexible and interactive digital resource, offers advantages over traditional print media because it can incorporate animations, explanatory audio, videos, and illustrated diagrams that make abstract concepts easier to understand.

Therefore, the development of an audio-visual–based e-handout is proposed as an alternative teaching material to address the challenges identified among Grade VIII students at SMPN 4 Tanjungpinang. This innovation is expected to support student engagement, accommodate diverse learning styles, and improve conceptual understanding of the human circulatory system. Moreover, it aligns with the principles of the Independent Curriculum, which promotes differentiated instruction, learner autonomy, and the meaningful integration of digital tools in the learning process.

Based on the problems identified through interviews, questionnaires, and analysis of student learning outcomes at SMPN 4 Tanjungpinang, this study aims to develop an audio-visual–based e-handout on the topic of the human circulatory system for Grade VIII students using the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation); determine the validity of the developed e-handout, including material validity and media validity assessed by expert validators; determine the practicality of the e-handout based on teacher and student responses regarding its ease of use, clarity, accessibility, and usefulness in supporting independent learning; determine the effectiveness of the e-handout in improving students' conceptual understanding of the human circulatory system, as measured by learning outcomes and N-gain analysis.

METHOD

This study employed Research and Development (R&D) using the ADDIE development model, consisting of five stages: Analysis, Design, Development, Implementation, and Evaluation. According to M. Safitri & Aziz, (2022), the ADDIE model is highly suitable for instructional product development because it is adaptive, systematic, and incorporates assessment and evaluation at every stage. The research stages based on the ADDIE model are presented in Figure 1.

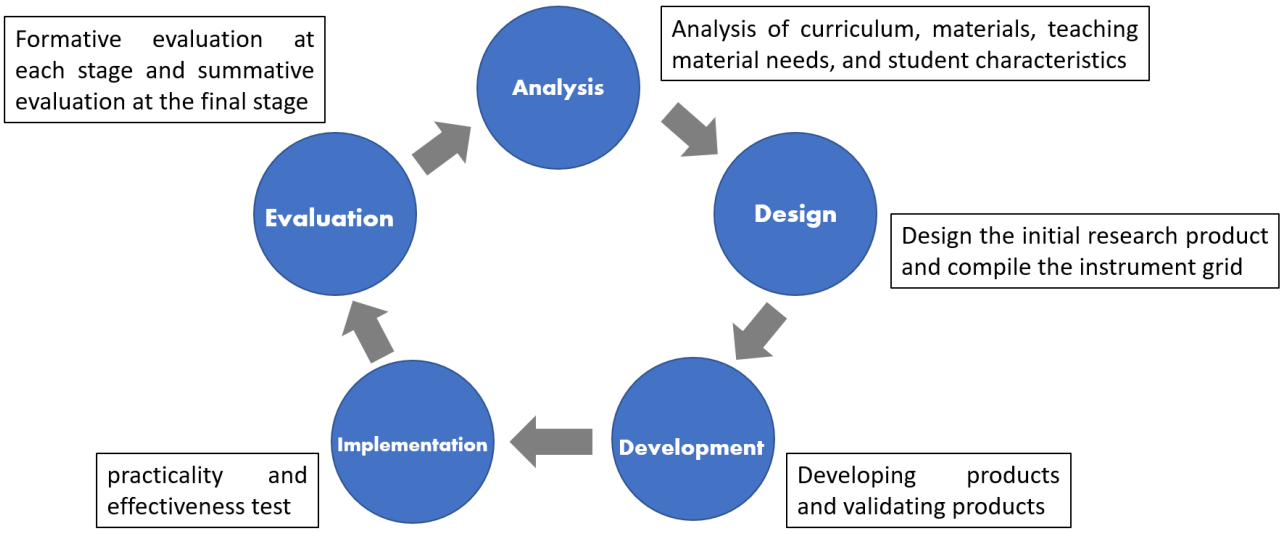

Figure 1. Research Stages with The Addie Model

1. Analysis Stage

This stage involved analyzing curriculum requirements, existing teaching materials, student characteristics, and learning needs. Data were collected from teacher interviews, student questionnaires, and documentation of learning outcomes to identify difficulties encountered by students in understanding the human circulatory system.

2. Design Stage

The design stage included: creating the initial blueprint of the audio-visual–based e-handout; structuring material content and multimedia elements; designing navigation and layout; preparing the instrument grids for validation, practicality, and effectiveness testing. The instrument grids used in this study are presented in Table 1, Table 2, and Table 3 respectively.

Table 1. Grid of Material Validity Test Instruments

Assessment Aspects	Indicators	Question number
Contain	Suitability of material with learning outcomes (CP)	1
	Suitability of material with learning objectives (TP)	2
	Systematic delivery of material	3
Display	Suitability of images to material	4
	Suitability of video to material	5
	Suitability of audio to material	6
	Relevance of reference sources	7
	Suitability of evaluation questions to learning objectives	8
Language and communication	Ease of use of language	9
	Compliance of language with PUEBI rules	10
	Communicative use of language	11

Table 2. Media Validity Test Instrument Grid

Assessment Aspects	Indicators	Question Number
Graphics	Cover display design	1
	E-handout content display design	2
	Suitability of font use	3
	Image clarity	4
	Navigation bar clarity	5
Characteristics	*Self-Instruction*	6
	Self-contained	7
	Self alone	8
	Adaptive	9
	User friendly	10
Layout	Image layout conformity	11
	Video layout conformity	12
	Audio layout conformity	13
Audio	Audio presentation quality	14
	Audio intonation	15
	Language usage	16
	Audio ease of operation	17
Video	Video presentation quality	18
	Ease of video operation	19

Table 3. Practicality Test Grid

Assessment Aspects	Indicators	Question number
Ease of use	Ease of accessing e-handouts	1
	Ease of understanding instructions for use	2
	Ease of operating audio	3
	Ease of operating video	4
	Ease of accessing evaluation questions	5
	Usage according to school conditions	6
	Ease of e-handout features	7
Benefits	Helping to learn independently	8
	Learning style adjustment	9
	Helps to understand concepts	10

3. Development Stage

During this stage, the initial design was developed into a functional e-handout using Canva Pro. The product included: material content presented concisely; images, audio narration, and embedded videos; interactive components and quizzes.

4. Implementation Stage

This stage consisted of two components:

a. Practicality Test

Practicality was assessed by: **Teachers**, to evaluate usability, clarity, and appropriateness of features; **Students**, to assess ease of access, multimedia operability, and usefulness for independent learning. Responses were analyzed using a Likert scale.

b. Effectiveness Test
Effectiveness was measured using a post-test after students used the e-handout. The normalized N-gain was used to measure improvement in student understanding.

5. Evaluation Stage

Evaluation included both:formative evaluation, conducted at every stage of the ADDIE process through validator comments and trial feedback; summative evaluation, conducted at the final stage to determine the overall validity, practicality, and effectiveness of the product. The final e-handout revisions were completed based on all evaluation results.

To calculate the feasibility of the e-handout, the following formula from Riduwan (2018) was used.

$$K = \frac{F}{N \times I \times R} \times 100\% \quad (1)$$

where:
K = Feasibility percentage
F = Total score from respondents
N = Highest possible score
I = Number of items
R = Number of respondents

The percentage obtained from the validity and practicality tests was interpreted using the criteria shown in Table 4.

Table 4. Validity and Practicality Criteria

Criteria		Score	Percentages (%)
Validity Test	**Practicality Test**		
Very Valid (SV)	Very Practical (SP)	4	76-100
Valid (V)	Practical (P)	3	51-75
Invalid (I)	Impractical (I)	2	26-50
Very Invalid (VI)	Very Impractical (VI)	1	0-25

Source: (Sugiyono, 2019)

The effectiveness of the audio-visual–based e-handout was analyzed using the N-gain formula, modified from Sundayana (2014):

$$\text{N-Gain} = \frac{X_{\text{posttest}} - X_{\text{pretest}}}{X_{\max} - X_{\text{pretest}}} \quad (2)$$

The normalized N-gain results were categorized according to Table 5.

Table 5. N-gains criteria

Criteria	N-gain score
High	N-gain > 0,7
Medium	0,3 ≤ N-gain ≤ 0,7
Low	N-gain < 0,3

RESULTS AND DISCUSSIONS

1. Analysis Stage

The analysis stage aimed to identify learning needs and challenges experienced by Grade VIII students at SMPN 4 Tanjungpinang. The school has implemented the Independent Curriculum for Grades VII and VIII, while Grade IX continues to use the 2013 Curriculum. Based on teacher interviews and student questionnaires, it was found that students experienced considerable difficulty in understanding the human circulatory system. This difficulty arises because the content involves complex terminology, abstract physiological processes, and structures that cannot be directly observed.

These findings align with Wardani & Syofyan (2018), who noted that biological processes that are microscopic or internal to the human body require the support of visual media for effective understanding. The absence of appropriate instructional media makes such content difficult for students to grasp. The needs analysis further showed that students require teaching materials that are

concise, visually informative, and aligned with predominant learning styles. Students aged 13–15 typically exhibit strong visual and auditory learning preferences (Editya et al., 2018), indicating that multimedia-based materials are more suitable for supporting their conceptual understanding. Conducting a needs analysis is important to identify barriers that arise during learning and to determine appropriate solutions (Hidayah et al., 2023).

2. Design Stage

At this stage, the researcher developed the initial prototype of the audio-visual–based e-handout. The design included the structure of the material, navigation flow, and multimedia components such as images, videos, and audio narration. The e-handout was prepared using Canva Pro with an A4 layout, and the "Balsamiq Sans" font (12–14 pt) was selected for clarity and readability.

The instrument grids were also prepared at this stage, consisting of: 11 items for the material validation instrument; 19 items for the media validation instrument; 10 items for the practicality test; and 15 multiple-choice questions for the effectiveness test.

This design ensured that both the learning content and the assessment instruments were aligned with the learning objectives and the characteristics of the target users.

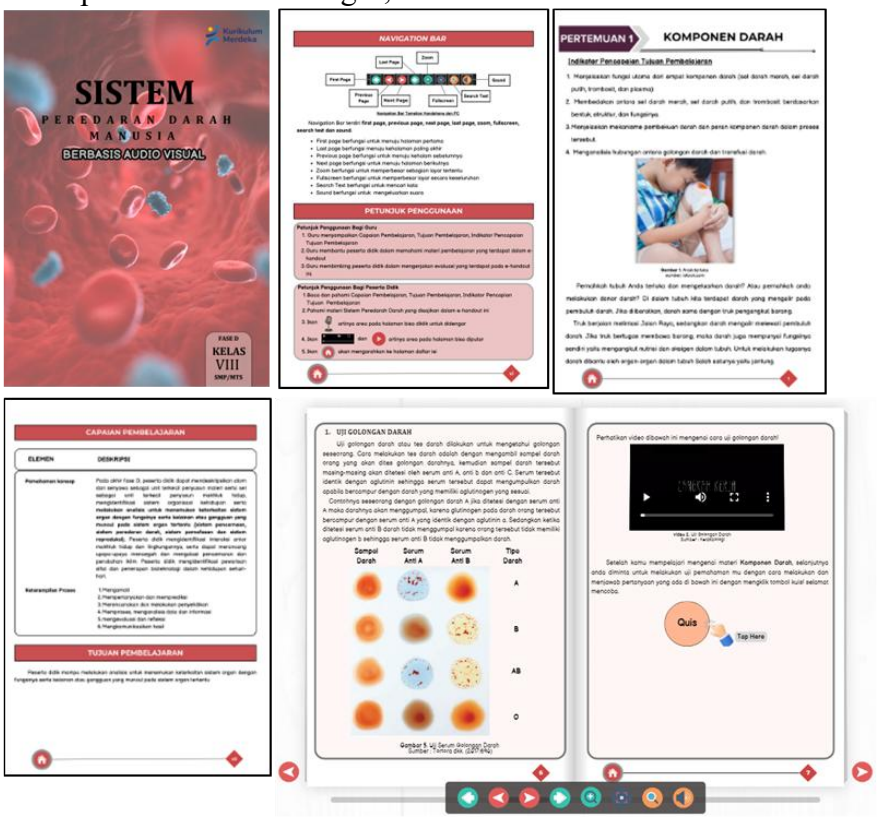

Figure 2. Audio Visual Based E-Handout on the topic of Human Circulatory System

3. Development Stage

The development stage involved transforming the design prototype into a complete e-handout. Components created included the cover layout, navigation bar, instructions for use, learning outcomes,

learning objectives, content explanations, illustrations, embedded videos, audio narration, and quizzes. The appearance of the developed product can be seen in *Figure 2*. According to Fitriana et al. (2022), good the achievement of learning objectives and be appropriate to the cognitive level of students.

During this stage, validation was conducted on both the research instruments instructional materials should clearly support and the objective questions used in the effectiveness test. The validation ensured that the tools used for data collection were feasible and accurate.

a. Material Validity Results

Material validity consisted of three aspects: content feasibility, presentation, and language & communication. As shown in Table 6, The overall average score was 86.11%, indicating that the material was in the very valid category.

The high score in the language aspect reflects that the e-handout used clear, age-appropriate language consistent with Indonesian grammar standards. This aligns with Hardiansyah (2019), who states that language in instructional materials must be correct, clear, and suitable for the intended audience.

Table 6. Material Validation Results

Assessment Aspects	Validators		Percentages	Criteria
	I	II		
Content/Material	83.33%	75%	79.17%	SV
Presentation	95%	80%	87.50%	SV
Language and Communication	100%	83.33%	91.67%	SV
Average	**92.78%**	**79.44%**	**86.11%**	**SV**

b. Media Validity Results

Media validators assessed five aspects: graphics, characteristics, layout, audio, and video. As summarized in Table 7, the average media validity score was 89.46%, categorized as very valid.

These results align with the findings of Tati et al. (2021) and Fadhila & Lufri (2023), who emphasize that visual structure, layout, and graphical features significantly influence the attractiveness and usability of digital learning media. Additionally, Siahaan et al. (2021) noted that clarity of instructions and user-friendly navigation enhances accessibility and student engagement. Multimedia elements such as images and videos play an important role in reinforcing understanding (Puspitoningrum, 2015).

Table 7. Media Validation Results

Assessment Aspects	Validators		Percentages	Criteria
	I	II		
Graphics	100%	90%	95%	SV
Characteristics	100%	80%	82.50%	SV
Layout	100%	83.33%	91.67%	SV
Audio	100%	81.25%	90.63%	SV
Video	100%	75%	87.50%	SV
Average	**97%**	**81.92%**	**8946%**	**SV**

4. Implementation Stage

The implementation stage involved practicality testing by teachers and students.

a. Teacher Practicality Test

Teachers assessed two dimensions: ease of use and learning benefits, as shown in Table 8. The overall practicality score was 76.79%, categorized as very practical.

b. Student Practicality Test

Students also assessed ease of use and benefits. The overall practicality score was 86.92%, categorized as very practical. These results demonstrate that the e-handout is easy to navigate and beneficial for independent learning. Oktaviana et al. (2020) similarly stated that a product is considered practical when both teachers and students can use it confidently and efficiently.

Table 8. Average Results of Practicality

Aspects	Percentages	Criteria
Practicality test by Teacher	76.79%	SP
Practicality test by Students	86.92%	SP
Averages	**81.85%**	**SP**

c. Effectiveness Test

After the product was confirmed valid and practical, an effectiveness test was conducted using a post-test. The normalized N-gain was calculated, yielding a score of 0.7112 (71.12%), categorized as high based on the criteria in Table 9.

This indicates that the e-handout significantly improved students' conceptual understanding. According to Evawani et al. (2013), instructional materials are considered effective when they can enhance mastery of concepts after learning.

Table 9. Results of Effectiveness Test

Learning ourcomes		N-Gain	%	Category	Interpretation
Pre-test	Post-Test				
44,67	84	0,7112	71,12	High	Effective

5. Evaluation Stage

The evaluation stage integrated feedback from validators, teachers, and students. Suggestions included improving audio clarity and refining some navigation icons. These suggestions were applied in the final revision. Overall, the evaluation results confirmed that the developed audio-visual–based e-handout is valid, practical, and effective for supporting learning on the human circulatory system.

CONCLUSION

Based on the results of the research and development process using the ADDIE model, the following conclusions can be drawn is the audio-visual–based e-handout developed in this study is valid, practical, and effective, and therefore feasible for use as an alternative digital learning resource to support science instruction, particularly for abstract biological topics. The e-handout has the potential to improve learning outcomes and increase student engagement in accordance with the goals of the Independent Curriculum.

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