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Development of Learning Media "Holoscience Application" Problem-Based Circulatory System Material Assisted by Hologram Pyramid to Improve Student Collaboration Skills

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ABSTRACT

The development of this media aims to design, validate, test practicality, and evaluate the effectiveness of the Holosains Application in enhancing collaborative skills in the Circulatory System topic. The research method used is R&D, with the development design following the Lee & Owens model. This model includes five stages: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation. The research site was SMPN 16 Malang in class 8B, with a total of 34 students. The media validation results showed a score of 93.8%, categorized as "Very Valid," while content validation reached a percentage of 100%, also deemed "Very Valid." Field validation obtained a 100% score, rated as "Very Valid." The practicality test scored 83%, which falls under the "Very Practical" category. The effectiveness test, derived from the N-gain calculation of pretest and posttest scores, achieved a score of 0.61, classified as "Moderate." Based on the testing results and collaborative skill assessments, the development of the Holosains Application is deemed valid, practical, and effective.

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1. INTRODUCTION

Twenty-first-century learning has developed an educational framework that requires students to possess skills, knowledge, and abilities in technology, media, and information. The 21st-century learning framework includes critical thinking, communication, collaboration skills, and creative thinking (The Partnership for 21st Century Learning [P21], 2015). Students are expected to master information technology and communication skills to meet the demands of 21st-century learning. These skills foster the development of high-quality human resources, especially in cultivating and utilizing creative thinking and collaborative skills.

The development of skills in working in groups to understand and consider others' thoughts and opinions is an essential ability for facing the demands of the 21st century, often referred to as collaboration skills (Palennari et al., 2021). Collaboration skills enhance students' learning processes, including negotiation between individuals, consideration of various perspectives, decision-making for shared goals, and fostering positive interdependence among individuals (Renner et al., 1988). Consequently, students who possess strong collaboration skills are better equipped for effective learning. This concept is supported by Mustofa and Hidayah (2020), who assert the importance of collaboration skills for students to actively and effectively engage in learning activities.

The problem-based learning (PBL) model is characterized by its student-centered approach, use of contextual problems, activation of student engagement in the learning experience, and development of students as flexible thinkers in problem-solving (Djidu & Jailani, 2018). This learning model involves a process of deep investigation, collaboration, solution development, and reflection, all aimed at enhancing students' critical, creative, and collaborative thinking skills. PBL, which emphasizes collaboration, engages students by focusing on everyday or contextual problem-solving. Assigning students tasks related to the material reinforces their collaborative skills effectively.

Teaching materials and media used in learning play a crucial role in the instructional process. The use of media in education can enhance learning effectiveness, particularly in science education (Arsyad, 2013). Many

students still struggle to construct an understanding of the learning material. Positive impacts from technology-based learning media have led to the development of mobile-based learning media, allowing students to easily bring it to various locations, such as on smartphones and tablets (Squire, 2009). Smartphone applications can serve as flexible media that facilitate learning anytime and anywhere. This increased access can result in higher study frequency, thereby improving student retention (Lubis & Ikhsan, 2015). Through this application, students can continue learning without interrupting their hobbies.

The smartphone application will be designed with the aid of a hologram pyramid. A hologram pyramid is a system used to create three-dimensional visual models of objects. This system consists of hardware and software structured to generate holographic images. Three-dimensional objects can also serve as teaching aids, thus falling into the category of three-dimensional visual media as perceived by the senses. Visual media can be categorized as projected visual media if the format consists of still images projected onto a transparent surface. Research conducted by Soepriyanto et al. (2018) on the development of 3D digital object teaching materials using hologram pyramids received positive feedback, showing that the use of hologram pyramids in classroom learning activities is engaging, innovative, motivating for students, and facilitates teachers in delivering material.

2. RESEARCH METHOD

The type of research used in this study is Research and Development (R&D). One of the development models applicable in this type of research is the Lee & Owens model. The stages of the Lee & Owens development model are shown in Figure 1.

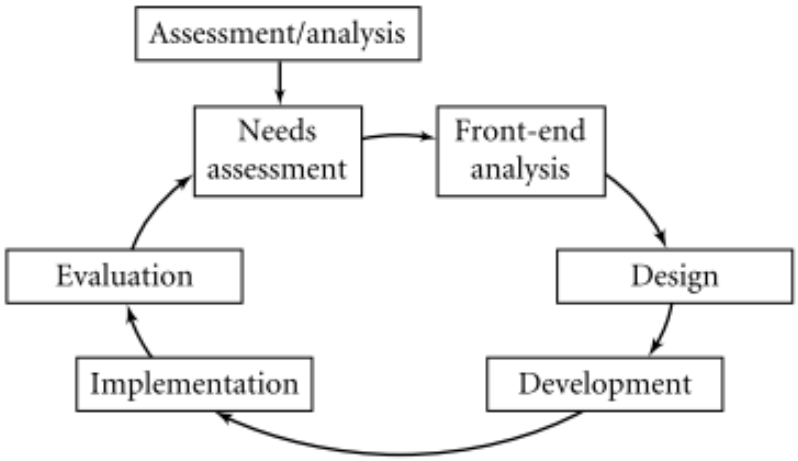

Figure 1 Stages of the Lee & Owens Model
Source: Lee & Owens, (2004:3)

The data collection techniques consist of questionnaires, tests, and documentation. The data analysis focuses on validity, practicality, and effectiveness. This research design employs a One Group Pretest-Posttest approach. The implementation design for the research using the One Group Pretest-Posttest can be found in Table 1.

Table 1. One Group Pretest-posttest Research Design

Subject	Pre-test	Treatment	Post-test
Siswa	O1	X	O2

Source: Leedy & Omrod, 2019

a. Validity of Holoscience Application Media

The validation uses the Likert Scale with the author's modification, here is the formula used to calculate the validation results.

$V = \frac{TSe}{TSh} \times 100\%$

Source: Akbar, (2017)

The results were obtained with the criteria presented in Table 2.

Table 2. Guidelines for the Validity of Data Analysis in Percentages

Score (%)	Qualification	Description
81-100	Very Valid	The Product can be used without revision
61-80	Valid	The Product can be used with minor revisions

Score (%)	Qualification	Description
41-60	Less Valid	The Product is not recommended because it needs major revisions
20-40	Not Valid	The product cannot be used
0-20	Highly Invalid	The product cannot be used

Source: Akbar, (2017)

b. Practicality of Holoscience Application Media

Indicators of the practicality of holoscience applications can be seen from student responses that can be operated easily (Akbar, 2017). The following formula is used in calculating practicality.

$V = \frac{TSe}{TSh} \times 100\%$

Source :Akbar, (2017)

Decription :

V : User validation
Tse : Total Validator Empirical Score
TSh : Maximum score

The results were obtained with the criteria presented in Table 3.

Table 3. Guidelines for the Validity of Data Analysis in Percentages

Score (%)	Qualification	Description
81-100	Very Practical	The Product can be used without revision
61-80	Practical	The Product can be used with minor revisions
41-60	Less Practical	The Product is not recommended because it needs major revisions
20-40	Not Practical	The product cannot be used
0-20	Highly Inpractical	The product cannot be used

Source: Akbar, (2017)

c. Media Effectiveness of Holoscience Application

The N-gain score test is an assessment that provides an overview of the improvement between pretest and posttest results. The Normality Gain test is an evaluation that offers a general overview of the score improvement in learning outcomes before and after the implementation of a treatment. The effectiveness of the e-module can be calculated using the N-gain formula as follows.

$$\textit{Normalized Gain (g)} = \frac{posttest\ score - pretst\ score}{maximum\ score - pretest\ score}$$

The following is a description of the effectiveness assessment in Table 4.

Table 4. N-Gain Level Categories

Range	Effectiveness Level
$g > 0,7$	High effectiveness
$0,3 \leq g \leq 0,7$	Medium effectiveness
$g \leq 0,3$	Low effectiveness

Source: Hake, R, (1999)

3. RESULT AND DISCUSSION

A. RESULT

1) Analysis

A needs analysis was conducted by distributing questionnaires to students of SMPN 16 Malang, class 8B, and providing a questionnaire to the science teacher who teaches in class 8B. This needs analysis was performed on January 10, 2024. Based on the results of the needs analysis, students in class 8B experienced a decline in interest in learning science, particularly in the topic of the Circulatory System, due to the abstract nature of the material and the continued use of lecture methods in the classroom, resulting in infrequent use of digital media by teachers. Additionally, students had limited access to teaching materials or media that could support their learning.

2) Design

In this stage, the media product focuses on the results of the needs analysis, which serve as the foundation for developing the application. The development process is scheduled to commence on January 10, 2024, and continue until April 2024. The results of the design of the developed Holosains application are presented in the image below.

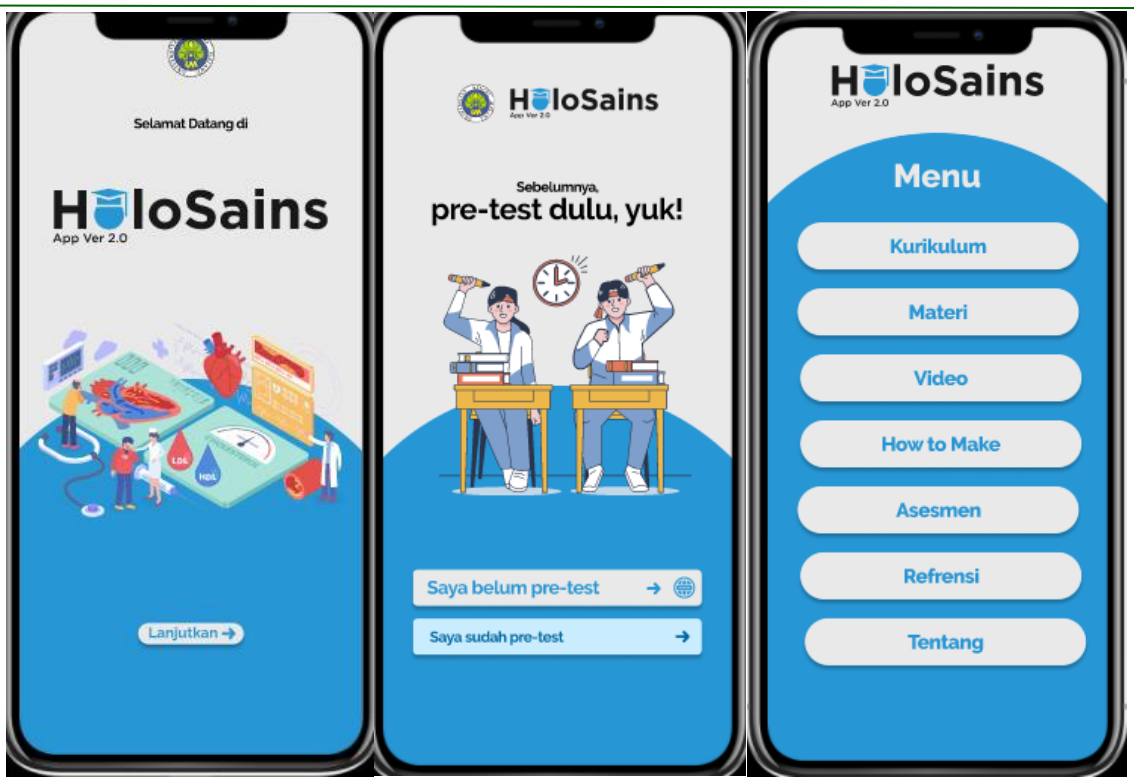

Figure 2. Holoscience Application View

3) Development

The media developed in this study is the Holosains Application, which operates on laptops and mobile phones. The content of the Holosains application refers to the Merdeka Curriculum, specifically regarding the final competency standards of Phase D for 8th-grade science on the topic of the circulatory system. The Holosains Application was provided to validators to assess the validity of the developed media. The validation process involved giving the validators a validation assessment questionnaire. Revisions to the media were made based on the feedback and suggestions provided by the validators. Once the media was deemed valid and suitable for trial, it was prepared for implementation.

4) Implementation

The Holosains Application media, which has been deemed valid and suitable for trial, will be tested with students in class 8B at SMPN 16 Malang. The field trial activities will be conducted from May to June 2024..

5) Evaluation

This stage involves the collection of data from the validation and field trials. Validation includes the assessment of content, media, and biology education practitioners. The data collected will be evaluated to inform the determination of validity and suitability for testing with 34 students in class 8B.

Data Presentation

The presentation of data presented the results of validation and field trials. The following is a presentation of the data as follows:

1) Validation

The following are the results of the validation data analysis of the Holoscience Application, namely the validation of material experts, the validation of media experts and field practitioners.

a) Material Expert Validation

Material validation was carried out to the material validator, Mrs. Dr. Elsje Theodora Maasawet, M.Pd. on May 2, 2024. This validation was carried out to provide an assessment of the circulatory system material in the Holoscience Application

Table 5. Material Validation Results

No	Indicator	Assessment Aspects	Average	Percentase (%)	Category
1.	Material Organization	Topic titles according to CP	5	100	Highly Valid

No	Indicator	Assessment Aspects	Average	Percentase (%)	Category
		and indicators The title describes the content of the material			
2.	Examples or illustrations	Examples or illustrations relevant to the content of the material. Examples or illustrations that facilitate students' understanding of the material. Sources of examples or illustrations from credible references (journals/textbooks).	5	100	Highly Valid
3.	Images/Photos/ Videos	Images/photos/videos are presented clearly (size) Pictures/photos/videos on the e-module make it easier for students to understand the material Images/photos/videos according to the topic of the material discussed	5	100	Highly Valid
4.	Language	Clear and easily understandable language. Scientific writing that adheres to the systematic format for scientific nomenclature. Consistency in the use of words or terms.	5	100	Highly Valid
5.	Depth of matter	The material of the human circulatory system explains the concepts that must be mastered by students The material of the human circulatory system makes it easier to master the concept	5	100	Highly Valid
6.	The Truth of the Concept of Material	The presented material contains accurate concepts. The sources used in the presentation of the material are credible (journals/textbooks). The material does not include misconceptions.	5	100	Highly Valid
7.	Updating Materials	The material is aligned with the latest developments in science and technology (up-to-date). The material corresponds to the learning outcomes outlined in the Indonesian National Qualification Framework (KKNI). The material is relevant to the	5	100	Highly Valid

No	Indicator	Assessment Aspects	Average	Percentase (%)	Category
		learning objectives.			
8.	Contextual Material	The presented material establishes a connection with the students' environment. The material includes contextual examples related to everyday activities. The presented material is relevant to the context of daily life.	5	100	Highly Valid
	Average		**5**	**100**	Highly Valid

The validation results meet the criteria of "Highly valid" and can be subjected to testing. The comments and suggestions provided by the validators emphasize that improvements in linguistic aspects are crucial for enhancing the quality of the material and should be a primary consideration in the revision process.

b) Media Expert Validation

The product results of the Holosains Application on the topic of the Circulatory System were validated by a media expert, Mr. Prof. Dr. Dedi Kuswandi, M.Pd, a lecturer in the Department of Educational Technology at Universitas Negeri Malang. This validation was conducted on July 30, 2024.

Table 7. Results of Media Expert Validation Assessment

No	Indicator	Assessment Aspects	Score	Categori
1	Cover Design	Cover engraving qualifications	93.3	Highly Valid
2	Content Design	Feasibility of content design graphics	94.3	Highly Valid
		Average	**93,8**	**Highly Valid**

The validation results indicate that the Holosains Application media, which is problem-based and utilizes a hologram pyramid for the topic of the circulatory system, is highly valid for use, with a percentage of 93.8%.

c) Validasi Praktisi Lapangan

The validation of field practitioners was carried out by a validator of biology education practitioners, namely a science teacher at SMPN 16 Malang, Mrs. Novia Tita Liliani, S.Si., Gr on May 8, 2024.

Table 8. Field Practitioner Validation Results

No	Indicator	Rerata	Persentase (%)	Kategori
1	Completeness of Contents	5	100	Highly Practical
2	Linguistics	5	100	Highly Practical
3	Serving	5	100	Highly Practical
4	Material	5	100	Highly Practical
5	Graphics	5	100	Highly Practical
6	PBL Learning Syntax (in LKPD)	5	100	Highly Practical
	Average		**100**	**Highly Practical**

The practicality results from field practitioners indicate a score of 100%, meeting the criteria of "highly practical" or suitable for testing.

Practicality

Field trials were conducted to assess the practicality of the Holosains Application learning media before implementation. The field trials were carried out in the class designated for implementation, specifically class 8B at SMPN 16 Malang, which comprises 34 students.

Table 10. Practicality Data on Field Tests

No	Respondents	Sum	Score Max	Value %	Categori
1	Students 1	67	80	83,7	Very Practical
2	Students 2	65	80	81	Very Practical

No	Respondents	Sum	Score Max	Value %	Categori
3	Students 3	69	80	86	Very Practical
4	Students 4	72	80	87,5	Very Practical
5	Students 5	65	80	81	Very Practical
6	Students 6	68	80	85	Very Practical
7	Students 7	60	80	75	Practical
8	Students 8	61	80	76,2	Practical
9	Students 9	63	80	78	Practical
10	Students 10	69	80	86	Very Practical
11	Students 11	70	80	87,5	Very Practical
12	Students 12	64	80	80	Practical
13	Students 13	70	80	87,5	Very Practical
14	Students 14	67	80	83,7	Very Practical
15	Students 15	61	80	76,2	Practical
16	Students 16	62	80	77,5	Practical
17	Students 17	75	80	93,7	Very Practical
18	Students 18	62	80	77,5	Practical
19	Students 19	63	80	78	Practical
20	Students 20	74	80	92,5	Very Practical
21	Students 21	61	80	76,2	Practical
22	Students 22	72	80	87,5	Very Practical
23	Students 23	69	80	86	Very Practical
24	Students 24	64	80	80	Practical
25	Students 25	67	80	83,7	Very Practical
26	Students 26	65	80	81	Very Practical
27	Students 27	63	80	78	Practical
28	Students 28	63	80	78	Practical
29	Students 29	75	80	93,7	Very Practical
30	Students 30	66	80	82,5	Very Practical
31	Students 31	69	80	86	Very Practical
32	Students 32	66	80	82,5	Very Practical
33	Students 33	64	80	80	Practical
34	Students 34	69	80	86	Very Practical
Average				**83**	**Very Practical**

The results of the practicality test obtained an average score of 83%. The results show that the developed Holoscience Application is in the category of "Very Practical" and can be used by students.

2) Effectiveness

The effectiveness of the Holosains Application learning media can be assessed by measuring students' collaboration skills through peer assessment. Peer assessment is evaluated using pretest and posttest data analysis.

Table 11. Effectiveness Results

Pretest	Posttest	N-Gain	Categori
61.50	86.00	0.62	Medium Effectiveness

The effectiveness test of the Holosains Application media yielded an average pretest score of 61.50 and an average posttest score of 86 out of a maximum score of 100, resulting in an N-gain score of 0.62, which falls into the "moderate" effectiveness category. Therefore, the Holosains Application media is deemed "effective" for use in learning.

B. DISCUSSION

The analysis stage consists of two phases: needs assessment and front-end analysis. The needs assessment involves situational analysis in the field and among the students, as well as the collection of reference materials that will serve as the core topics for media development (Lee & Owens, 2004). Based on the results of the needs assessment, students in class 8B experienced a decline in interest in learning the science subject on the topic of the Circulatory System due to the abstract nature of the material and the reliance on lecture methods in classroom activities. Consequently, teachers rarely use digital media, and students have limited access to teaching materials or media that can support their learning. The lack of learning media negatively impacts students' skills, particularly their creative thinking and collaboration skills.

The design phase involves material collecting (gathering the necessary materials for media development), creating a storyboard, developing a schedule for media development, determining the development team, specifying media requirements, outlining the content of the media, and preparing the instruments for validity and practicality testing. This media is implemented using the PBL model, where in the learning process, students act as facilitators or mediators, allowing them to build their own knowledge and enhance their collaboration skills (Febrolianti, 2022).

The development stage involves creating and developing the Holosains application by integrating all the prepared components into a cohesive unit, following the designed storyboard using software such as Microsoft Word and the Figma website. A limitation of the Holosains application media is that it cannot be used offline. Students can operate the media individually using their own computers or laptops online. Validation is conducted to obtain assessments and feedback regarding the development, accompanied by a validation assessment questionnaire for the Holosains application media.

In this implementation stage, the Holosains application media has been fully developed and its validity tested. The Holosains application media can be implemented with students at SMPN 16 Malang in class 8B, consisting of 34 students. The implementation activities involve assessing the pretest results conducted before using the media and the posttest results obtained after using the media to determine the effectiveness of the Holosains application. After using the media, students are asked to complete a student response questionnaire to evaluate the practicality of the Holosains application media that has been utilized. In this learning process, students have applied collaboration skills to solve tasks or problems related to the content available in the Holosains application. The level of collaboration skills varies among individual students.

The evaluation stage involves the assessment of development, validity, practicality, and effectiveness. The development evaluation is conducted by expert lecturers to determine whether the Holosains application media is suitable for use in instructional media. This evaluation provides data that describes the quality of the media, indicating whether it is valid or not valid for educational purposes. The results of the Holosains application media development align with previous research that can be utilized for future media development. Similar to the study by Ruswan et al. (2024), the utilization of instructional media plays a crucial role for teachers in fostering creativity and innovation in delivering learning materials, whether in the form of visual, audio, or digital content. This also aids in creating a more meaningful and interactive learning experience, thereby enhancing the effectiveness and efficiency of the learning process (Hadayani et al., 2023). Furthermore, instructional media can serve as a mediating tool in learning, facilitating communicative interactions between teachers and students while stimulating students' thinking, emotions, attention, and collaboration skills (Idawati et al., 2022)..

The Holosains application learning media can assess students' collaboration skills based on observation results and peer assessment. Collaboration skills observations were conducted during each meeting of the implementation phase, with teachers filling out observation sheets accompanied by a skills rubric from Greenstein (2012). Peer assessments were measured using pretest and posttest data analysis through the average N-Gain to evaluate the effectiveness of the Holosains application. The effectiveness test of the Holosains application revealed an average pretest score of 61.50 and an average posttest score of 86.0 out of a maximum score of 100. The resulting N-Gain was 0.62, which falls into the moderate effectiveness category. This provides a comparison of the acquisition of each collaboration skills indicator.

Based on the results of the peer assessment questionnaire, the collaboration skills of students were evaluated through pretest and posttest scores (Appendix 27). For the indicator of productive work, the pretest score was 65.15, and the posttest score was 85.29, resulting in an improvement of 35.05%. For the indicator of showing respect, the pretest score was 64.39, and the posttest score was 81.82, reflecting an increase of 27.06%. For the indicator of compromising, the pretest score was 58.33, while the posttest score was 87.88, indicating an improvement of 38.96%. Lastly, for the indicator of responsibility, the pretest score was 65.25, and the posttest score was 87.88, showing an increase of 34.88%.

Table 12. Comparison of the Achievement for Each Indicator of Collaboration Skills

No.	Indicator	*Pretest*	*Posttest*	Increased (%)
1.	Working Productively	65,15	85,29	35,05
2.	Demonstrating Respect	64,39	81,82	27,06
3.	Compromising	58,33	81,06	38,96
4.	Responsibility	65,15	87,88	34,88

Based on the comparison table of the scores for each collaboration skill indicator above, it can be seen that the compromising indicator achieved the highest percentage at 38.96%. This indicates that the majority of students are able to demonstrate a willingness to compromise in achieving common goals, both with group members and others during collaborative learning activities (Narsan, 2022). Students are able to provide

opportunities and entrust tasks to each group member, without taking over the work of others; if they need to critique another member's work, they do so with gentle language that does not offend (Junita et al., 2021).

4. CONCLUSION

Based on the data from the research results developed and analyzed, it can be concluded as follows: The developed Holosains Application is declared valid and suitable for use in the material on the human circulatory system. The development results align with the stages of the Lee & Owens model. The Holosains Application is confirmed to be valid for use in the material on the human circulatory system. The validity results include a media validation score of 93.8%, categorized as "Very Valid." The content validation achieved a score of 100%, categorized as "Very Valid," and the validation from field practitioners also received a score of 100%, categorized as "Very Valid." The summary of these three validations indicates a declaration of "Very Valid." The usage of the Holosains Application is deemed practical. The practicality score obtained is 83%, categorized as "Very Practical." This score was derived from the questionnaires completed by students after using the Holosains Application. After the Holosains Application was utilized in the classroom, pretest and posttest results were obtained from each student. The effectiveness score achieved was 0.62, which falls within the "Moderate" effectiveness category. Therefore, the e-module is considered effective for use in teaching.

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