JPPIPA 10(12) (2024)

Jurnal Penelitian Pendidikan IPA

*Journal of Research in Science Education*

http://jppipa.unram.ac.id/index.php/jppipa/index

# Development of Flashcard Media Based on Augmented Reality on Dynamic Fluid Material to Train Critical Thinking Skills of High School Students

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Received: August 26, 2024
Revised: November 11, 2024
Accepted: December 25, 2024
Published: December 31, 2024

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DOI: 10.29303/jppipa.v10i12.9778

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**Abstract:** Based on challenges in physics education, complex and abstract fluid dynamics, improving critical thinking skills is crucial for 21st-century learning. Needs analysis of 59 XI SMA Negeri 2 Plus Banyuasin III students revealed 90% had never used AR-based flashcards and showed high interest. The study aimed to develop valid, practical, and effective augmented reality-based flashcards using Research and Development (R&D) methodology with the Rowntree model and Tessmer formative evaluation. The research process involved planning, development, and evaluation stages. Results demonstrated high validity across components: media (93.33%), material (93.32%), critical thinking skills (96.66%), language (97.77%), and design (100%). Practicality assessments showed 95.18% in one-to-one and 95.73% in small group evaluations. The media effectively enhanced critical thinking skills with an N-Gain of 0.71, indicating high potential for dynamic fluids learning in grade XI. Conclusively, the augmented reality-based flashcards proved valid, practical, and effective for physics education.

**Keywords:** Augmented Reality; Critical thinking; Dynamic fluid; Flashcard; Learning media.

## Introduction

The rapid progress in science and technology today has a broad impact on all areas of life, including education (Ambarwati et al., 2021). The advancement of research and technology has a big influence on how science, especially physics, is taught in schools. In this context, science and technology enables visualization of abstract concepts, simulation of complex experiments, and access to real-time data, so that students can better understand the existing scientific reality (Maritsa et al., 2021). Along with these technological developments, the demands on students' skills are also increasing.

According to Bacca et al. (2019), augmented reality (AR) is a modern visualization technique that expands sensory perception through digital objects. With AR, teachers may create cutting-edge learning environments that bring the invisible to life, offer immersive and interactive experiences, and immerse students in engaging and gamified learning situations (Buchner & Kerres, 2023). AR facilitates learning through animation, video, music, and writing (Ng et al., 2024). Students were probably inspired to reflect critically on the underlying problems and think of creative solutions by interacting with virtual characters who might have asked difficult questions, provided opposing viewpoints, or promoted the investigation of unusual solutions (Huyen, 2024). According to Astriani & Alfahnum (2023), AR makes the classroom more lively. Users can see things or items in three dimensions with Augmented Reality technology (Listiyani et al., 2021).

**How to Cite:**
Putri, M., Rizki, I. N., Marlina, L., Sudirman, & Murniati. (2024). Development of Flashcard Media Based on Augmented Reality on Dynamic Fluid Material to Train Critical Thinking Skills of High School Students. *Jurnal Penelitian Pendidikan IPA*, *10*(12), 10269–10277. https://doi.org/10.29303/jppipa.v10i12.9778

Khairunnisa (2022) emphasized the importance of higher-order thinking skills in 21st-century education. One of the key skills that are the focus of 21st century critical thinking is the process of learning. 21st-century education is intended to equip students with learning and development skills that include decisive reasoning and the ability to deal with problems, being imaginative and creative, and having the ability to communicate and cooperate. Students who possess critical thinking abilities are better able to comprehend ideas, become more sensitive to issues, and address difficulties in their environment (Marlina et al., 2018). In all area of one's life, critical thinking is a crucial ability (Marlina et al., 2021). The quality of education will increase as pupils' critical thinking abilities advance.

It appears that the lack of clarity surrounding the definition of critical thinking and its applicability to a variety of circumstances belies 21st century competencies, particularly critical thinking. Golja & Clerke (2020) give multiple definitions of critical thinking that all point to the same fundamental concept. It combines knowledge, abilities, and attitude (Halpern & Sternberg, 2019). "The ability to take charge of one's own thinking, assess and evaluate the effectiveness of thinking according to the purpose and develop a criterion for constant evaluation which is based on logic" is the definition of critical thinking (Fahim & Eslamdoost, 2024). One of the main objectives of higher education has been to encourage students' critical thinking (Tiruneh et al., 2014).

These problems were also found by research conducted by Harjilah et al. (2019) learning at SMAN 3 Bengkulu City did not focus enough on developing students' critical thinking skills. Furthermore, research conducted by Maulana et al. (2019) found that there was still a lack of critical thinking in the physics classes. Students have not been able to apply the physics material learned for problem solving. This shows that students' critical thinking skills are low. These results highlight how crucial it is to figure out ways to help students become more adept at critical thinking, particularly when it comes to studying physics.

From these various problems, an approach is needed in the teaching process that can facilitate the development of students' critical thinking skills in understanding physics concepts. One of the things that can be a solution is to improve the teaching and learning process that is centered on students and meet the needs of students in terms of facilities and infrastructure with the aim of increasing student activeness in critical thinking (Yunus & Fransisca, 2020). By adopting a more student-centered approach and utilizing technology effectively, it is expected to create a learning environment that supports the development of critical thinking skills, especially in physics learning.

According to Purwani et al. (2019), media is a means of disseminating information. The use of learning media can help deliver material more effectively and efficiently, allowing students to more quickly understand the material as a whole and increase their interest in learning (Meliana et al., 2022). The learning media used today are always related to technology, one of which is Augmented reality which is the result of combining objects contained in the virtual world (virtual) which is applied to the real world in two-dimensional or three- dimensional form so that it can be touched, seen, and heard (Mustaqim & Kurniawan, 2017).

One of the physics topics that require spial emphasis on the concept is dynamic fluid (Frihanderi Aprita et al., 2018). Dynamic fluid material is included in a fairly complex topic in physics learning. Concepts such as ideal fluid characteristics, discharge, continuity equation, Bernoulli principle and Torricelli theory require a deep understanding (Permana et al., 2021). Physics material, such as fluid dynamics, can be a challenge for students to understand (Setiawan et al., 2023). By utilizing augmented reality through flashcard media, students can visually and interactively understand these concepts better. By using AR-based flashcards, students can more easily visualize and review the material, thus helping them develop their critical thinking skills (Vari, 2022). Flashcards that combine interactive 3D graphics and text with augmented reality (AR) provide a more effective and engaging learning experience (Alfares & Murwonugroho, 2021).

Researchers conducted a needs analysis in the use of augmented reality aimed at 59 class XI students at SMA Negeri 2 Plus Banyuasin III in physics subjects. Based on a survey conducted, 90% of students have never used augmented reality-based flashcards in learning. In addition, 90% of students are interested in using augmented reality-based flashcards in learning. 90 percent of students expressed interest in using AR flashcards for learning, which is consistent with studies (Sari et al., 2020).

This research presents innovation in physics learning through the development of Augmented reality (AR)-based flashcard media. The main novelty lies in the integration of the latest AR technology with a learning approach that focuses on improving critical thinking skills. This media is specifically designed for dynamic fluid material, allowing the visualization of abstract concepts to be more concrete and interactive. Thus, this research not only addresses challenges in physics learning, but also paves the way for broader educational innovation. Therefore, this research

conducts development with the title Development o f Flashcard Media Based on Augmented Reality on Dynamic Fluid Material to Train Critical Thinking Skills of High School Students.

## Method

The aim of developing augmented reality-based flashcard media for dynamic fluid learning that is valid, practical and effective, this study uses a research and development (R&D) research methodology with the Rowntree model development model consisting of the planning stage, development stage, and evaluation stage. In this evaluation stage using Tessmer formative evaluation. The subjects of this study were students of class XI.3 SMA Negeri Plus Banyuasin III in the 2024/2025 school year. Data collection instruments are walkthrough, validation and practicality sheets, questionnaires and questionnaires. With data analysis techniques using a Guttman scale at the validation stage and a Likert scale on practicality. The development procedure can be seen Figure 1.

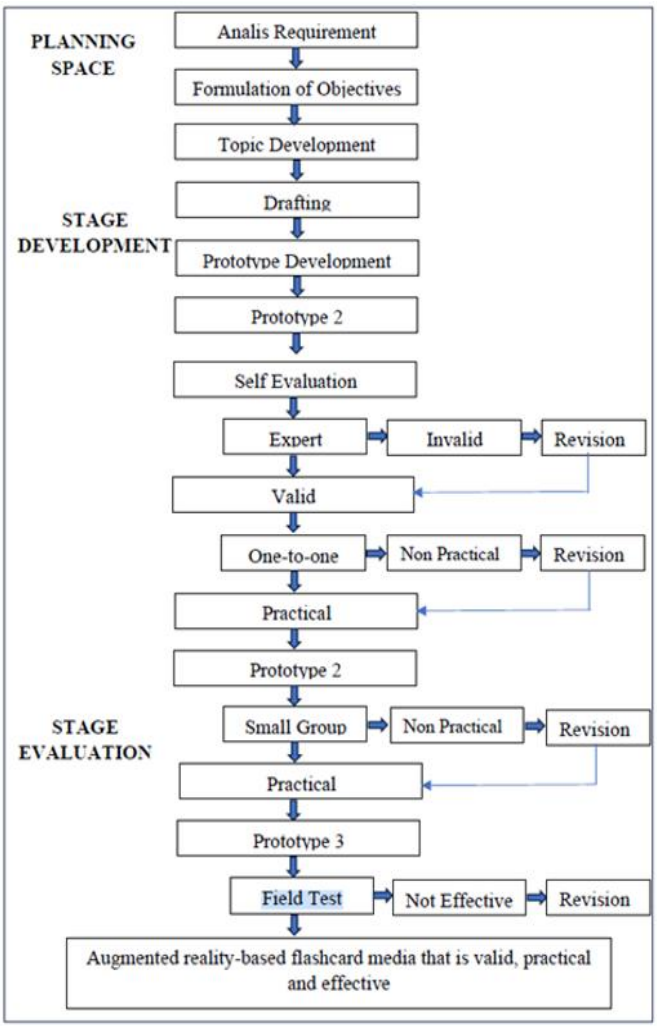


**Figure 1.** Research Procedure

*Data Analysis Techniques*

*Walkthrough Data Analysis*

The data obtained from the walkthrough is analyzed descriptively to evaluate the validity of prototype 1. The analysis of augmented reality-based flashcard validation data using the Guttman scale aims to obtain definitive answers regarding the developed augmented reality-based flashcards.

**Table 1.** Scoring Criteria

| Validation Results | Score |
|---|---|
| Yes | 1 |
| No | 0 |

*Validation Sheet*

Data analysis techniques to measure the validity level based on the Guttman scale obtained from the validation sheet, according to Akbar (2017), the formula used is as follows:

$$NP_{r_1} = \frac{TS_{-e}}{TS_{-max}} \times 100\% \quad (1)$$

$$NP_{r_2} = \frac{TS_{-e}}{TS_{-max}} \times 100\% \quad (2)$$

$$NP_{r_3} = \frac{TS_{-e}}{TS_{-max}} \times 100\% \quad (3)$$

$$V = \frac{NP_{r_1} + NP_{r_2} + NP_{r_3}}{3} \quad (4)$$

Information:

$V$ = Validation (combined)

$NP_{r_1}$ = Value of the first validator process

$NP_{r_2}$ = Value of the second validator process

$NP_{r_3}$ = Value of the third validator process

$TS_{-e}$ = Total empirical score

$TS_{-max}$ = Total maximum score

**Table 2.** Validity Categorization

| Validity Criteria % | Validity Level |
|---|---|
| 80.01 – 100 | Very Valid, Can Be Used Without Revision |
| 60.01 – 80.00 | Valid, Can Be Used but Needs Minor Revision |
| 40.01 – 60.00 | Less Valid, Not Recommended for Use Due to Major Revision Needed |
| 20.01 – 40.00 | Not Valid, Should Not Be Used |
| 00.00 – 20.00 | Very Invalid, Should Not Be Used |

*Questionnaire*

The analysis of questionnaire data is used to determine the practicality of the developed augmented reality-based flashcards. The questionnaire data obtained from the students will be analyzed using a Likert scale to measure the students' attitudes, opinions, and perceptions regarding the use of the flashcards. The questionnaire scores will be presented in percentage

form, according to the criteria in the Table.

**Table 3.** Expert Validation Result Categories

| Category Answer | Statement Score |
|---|---|
| Very Suitable | 5 |
| In Accordance | 4 |
| Enough in Accordance | 3 |
| Less Suitable | 2 |
| It Is Not in Accordance With | 1 |

Percentage from results one-to-one evaluation and small group (HEOS) by Formula 5.

$$HEOS = \frac{survey\ score}{maximum\ survey\ score} \times 100\% \quad (5)$$

**Table 4.** Evaluation Result Categories *One to One* and *Small Group* (Wiyono, 2015)

| Percentage % | Classification |
|---|---|
| 86 ≤ HEOS ≤ 100 | Very Practical |
| 70 ≤ HEOS < 86 | Practical |
| 56 ≤ HEOS < 70 | Less Practical |
| HEOS < 56 | Not Practical |

*Learning Outcome Analysis*

At the stage this, progress participant educate in skills think critical measured through comparison mark between pretest and posttest, which indicate improvement knowledge they to skills think critical after using flashcard media based on augmented reality in learning. Data from pretest and posttest will analyzed with use Formula 6.

$$\text{Value} = \frac{\text{Total score obtained}}{\text{maximum total score}} \text{x}100 \quad (6)$$

After count mark pretest and posttest, steps furthermore is analyze improvement learning using normalized N-Gain.

**Table 5** Category N-Gain Score Index (Wahab et al., 2021)

| N-Gain Value | Category |
|---|---|
| ≥ 0.7 | Tall |
| 0.3-0.7 | Currently |
| <0.3 | Low |

## Result and Discussion

*Stage Planning*

Based on the needs assessment at SMA PLUS Negeri 2 Banyuasin III, it was found that teachers are still limited in their use of learning media, generally only using printed media, PowerPoint, and videos from YouTube. A survey of 59 eleventh-grade physics students yielded an important finding: 90% of the students had never used augmented reality-based flashcards, but 90% were interested in using them. The material considered difficult is dynamic fluids (59%), followed by particle motion dynamics (31%) and kinematics (10%). As many as 92% of students stated that there is a need for the development of augmented reality-based flashcards to facilitate the understanding of physics material.

The learning objectives are created together with the physics subject teacher and based on the learning achievements of phase F of the independent curriculum. In the stage of formulating learning objectives, it includes the main components, namely competencies and the scope of the material. Thus, the formulation of learning objectives is as follows. Understanding the concept of ideal fluids, understanding the basic principles of Bernoulli's Law and applying Bernoulli's Law in everyday life, applying the concept of fluid flow rate in solving everyday problems, applying the Continuity Principle in solving water flow problems in pipes, and applying Bernoulli's Law in everyday life.

*Development Topics*

At this stage, the first step is to find the subject matter of dynamic fluids, which will be explained through the development of AR flashcard media. According to the student book used at SMA PLUS Negeri 2 Banyuasin III and the Kemendikbud Learning Module, the material discussed includes dynamic fluids, their characteristics, the properties and types of fluid flow, discharge, the principle of continuity and its applications, as well as Bernoulli's Law and its applications.

At this point, development is also carried out based on the information obtained, namely by identifying the elements used in augmented reality flashcard-based learning media, which include the use of text, sound, images, animations, and design. In the learning media, these elements are arranged in a sequence of interconnected displays.

The next stage is drafting from the cover to the conclusion. Next, the production of prototypes. At this stage, the augmented reality-based flashcards that have been designed with storyboards are created using the Canva application. The size of the flashcards used has been varied, specifically 9x12 cm. The thickness of the flashcard paper used is 260 with an additional laminating. Next, we design augmented reality using the Assmblr Edu application. At this stage, prototype 1 is produced.

*Evaluation Stage*

At the self-evaluation stage, the first prototype of the augmented reality-based flashcard that has been created was then evaluated by the researcher with the

assistance of the supervising lecturer to assess and re-examine several aspects, namely media appearance, content, critical thinking indicators, language use, and design. Then, prototype 1, which was deemed satisfactory by the researcher and the supervising lecturer, proceeded to the expert review stage for validation.

At the expert review stage, prototype 1 developed by the researcher is tested for validity through the expert review stage. At this step, the researcher sought the assistance of five experts to evaluate five elements of validity: media appearance, content, critical thinking skills, language, and design. Data from the expert review were collected using the walkthrough technique and then analyzed using the Guttman scale. The validation process of prototype 1 has been conducted by five physical education lecturers from Sriwijaya University. Each expert evaluated five different aspects of the prototype. They provided their assessments by checking the validation sheet and offering input in the form of suggestions and comments for improvement. Here are the validation results.

**Table 6.** Media Validation Results

| Validators | Empirical Score | Maximum Score | Average Percentage Validity Every Validator % | Criteria Validity |
|---|---|---|---|---|
| Validator 1 | 11 | 12 | 91.66 | Very Valid |
| Validator 2 | 10 | 12 | 83.33 | Very Valid |
| Validator 3 | 12 | 12 | 100 | Very Valid |
| Validator 4 | 12 | 12 | 100 | Very Valid |
| Validator 5 | 11 | 12 | 91.66 | Very Valid |
| Average Percentage Combined | | | 93.33 | Very Valid |

**Table 7.** Material Validation Results

| Validators | Empirical Score | Maximum Score | Average Percentage Validity Every Validator % | Criteria Validity |
|---|---|---|---|---|
| Validator 1 | 8 | 9 | 88.88 | Very Valid |
| Validator 2 | 8 | 9 | 88.88 | Very Valid |
| Validator 3 | 9 | 9 | 100 | Very Valid |
| Validator 4 | 9 | 9 | 100 | Very Valid |
| Validator 5 | 8 | 9 | 88.88 | Very Valid |
| Average Percentage Combined | | | 93.32 | Very Valid |

**Table 8.** Validation Skills Think Critical

| Validators | Empirical Score | Maximum Score | Average Percentage Validity Every Validator % | Criteria Validity |
|---|---|---|---|---|
| Validator 1 | 12 | 12 | 100 | Very Valid |
| Validator 2 | 11 | 2 | 91.66 | Very Valid |
| Validator 3 | 12 | 12 | 100 | Very Valid |
| Validator 4 | 12 | 12 | 100 | Very Valid |
| Validator 5 | 11 | 12 | 91.66 | Very Valid |
| Average Percentage Combined | | | 96.66 | Very Valid |

**Table 9.** Language Validation Results

| Validators | Empirical Score | Maximum Score | Average Percentage Validity Every Validator % | Criteria Validity |
|---|---|---|---|---|
| Validator 1 | 9 | 9 | 100% | Very Valid |
| Validator 2 | 8 | 9 | 88.88% | Very Valid |
| Validator 3 | 9 | 9 | 100% | Very Valid |
| Validator 4 | 9 | 9 | 100% | Very Valid |
| Validator 5 | 9 | 9 | 100% | Very Valid |
| Average Percentage Combined | | | 97.77% | Very Valid |

**Table 10.** Design Validation Results

| Validators | Empirical Score | Maximum Score | Average Percentage Validity Every Validator % | Criteria Validity |
|---|---|---|---|---|
| Validator 1 | 8 | 8 | 100 | Very Valid |
| Validator 2 | 8 | 8 | 100 | Very Valid |
| Validator 3 | 8 | 8 | 100 | Very Valid |
| Validator 4 | 8 | 8 | 100 | Very Valid |
| Validator 5 | 8 | 8 | 100 | Very Valid |
| Average Percentage Combined | | | 100 | Very Valid |

Validation of augmented reality-based flashcard media was conducted by a panel of five expert lecturers from the Physics Education Study Program at Sriwijaya University, focusing on media appearance, the role of media in learning, and student engagement. The media expert validation results reached an average of 93.33%, categorized as very valid, accompanied by improvement suggestions related to the flashcard cover, images, augmented reality objects, and decoration object choices.

Validation of the learning media content includes four main aspects: curriculum, learning, material, and interaction, with an average score of 93.33%, indicating a very valid category. The curriculum aspect assesses the alignment of objectives, the learning aspect focuses on the effectiveness of delivery, the material aspect ensures content accuracy, and the interaction aspect evaluates the ease of media use, with notes for improvement on the writing of formula descriptions to ensure student understanding. Based on the media's capacity to foster the development of five critical thinking components—giving basic explanations, developing basic skills, drawing conclusions, advanced explanations, and developing problem-solving strategies—the evaluation of critical thinking skills reached an average of 96.66% with a very valid category. Validators offered suggestions for improving the questions in order to further develop students' critical thinking abilities when it comes to comprehending the idea of dynamic fluids. Text readability, information clarity, conformity to Indonesian language rules, and language usage effectiveness were the four criteria used to validate the language component. According to Hyytinen et al. (2013), critical thinking is the application of cognitive abilities or tactics that raise the likelihood of a desired result. It is used to characterize deliberate, rational, and goal-directed thinking—the type of thinking that goes into problem-solving, drawing conclusions, estimating probabilities, and reaching decisions—when the thinker employs techniques that are considerate and efficient for the specific situation and kind of thinking task (Halpern & Dunn, 2021).

The linguist's assessment fell into the extremely valid category with 97.77%. In order to make the dynamic, fluid content easier for pupils to understand, suggestions are made to enhance the language quality, especially in the areas of word choice and sentence structure. With a very valid category that evaluated the presentation order, cover design, flashcard content, font and layout usage, and other elements, design validation reached 100%. In the development process, the researchers faced challenges with the design of the flashcards and the limitations of 3D objects on the assemblr EDU platform. Through the "Observe, Imitate, and Modify" approach and constructive input from media experts, the researchers successfully completed the development of augmented reality-based flashcards for dynamic fluid material.

Next stage one to one evaluation, prototype 1 of the augmented reality-based flashcard has undergone a series of trials before being widely implemented. The first stage is an assessment by experts to ensure validity. Next, this prototype is tested individually to measure its usability. Through student response instruments, the researchers collected data on various aspects of the prototype, ranging from visual appearance, material quality, to its ability to stimulate critical thinking skills. The results from this individual assessment stage serve as the basis for determining the feasibility of prototype 1 in small group trials. To obtain representative data, this study involves three students from class XI.3 SMA PLUS Negeri 2 Banyuasin III as research subjects. These three students were chosen to represent three groups with different academic abilities, namely high (DFR), medium (SA), and low. (RRR). The results of the questionnaire assessment from the three students are presented in Table 11 for further analysis.

**Table 11.** Response Results Learners

| Indicator | Learners | | | Total Score | Maximum Score | Percentage Score | Category |
|---|---|---|---|---|---|---|---|
| | DFR | SA | RRR | | | | |
| Convenience Use | 5 | 5 | 5 | 15 | 15 | 100% | Very Practical |
| Standard Media Presentation | 10 | 10 | 10 | 30 | 30 | 100% | Very Practical |
| Understanding Material | 14 | 14 | 14 | 36 | 45 | 80% | Very Practical |
| Skills Think Critical | 60 | 59 | 57 | 176 | 180 | 97.77% | Very Practical |
| Use Language | 14 | 14 | 14 | 42 | 45 | 93.33% | Very Practical |
| Media Design | 20 | 20 | 20 | 60 | 60 | 100% | Very Practical |
| Average Percentage Participant Educate on One to One Evaluation | | | | | | 95.18% | Very Practical |

Based on Table 11, the results of student responses to the use of prototype 1 in the one-to-one evaluation stage were 95.18%, so it can be concluded that the use of prototype 1 augmented reality-based flashcards meets the criteria of being very practical.

Next stage, small group evaluation. The first prototype has been refined based on expert suggestions and individual trial results. The result is

the second prototype, which was then tested on a small group of students. The goal is to see whether this second prototype is ready for use in learning and whether any improvements need to be made before it is used more widely. This stage is conducted by testing prototype 2 on 9 students from class XI.3 at SMA PLUS Negeri 2 Banyuasin III. The same tools that were used in the one-on-one evaluation stage are employed here. Students were invited to complete a feedback questionnaire at the conclusion of the trial session. The following table displays the feedback from the students regarding the use of prototype 2 augmented reality-based flashcards.

**Table 12.** Response Results Learners

| Indicator | Learners | | | | | | | | | Total Score | Maximum Score | Percentage Score % | Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GAS | FM | TH | NZ | SKA | GTP | MGB | FR | NAS | | | | |
| Convenience Use | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 45 | 45 | 100 | Very Practical |
| Standard Media Presentation | 9 | 10 | 10 | 9 | 10 | 10 | 9 | 9 | 9 | 85 | 90 | 94.44 | Very Practical |
| Understanding Material | 12 | 15 | 15 | 12 | 15 | 14 | 15 | 14 | 15 | 127 | 135 | 94.07 | Very Practical |
| Skills Think Critical | 58 | 58 | 59 | 59 | 55 | 54 | 57 | 56 | 54 | 510 | 540 | 94.44 | Very Practical |
| Use Language | 14 | 14 | 15 | 15 | 14 | 15 | 15 | 14 | 15 | 131 | 135 | 97.03 | Very Practical |
| Media Design | 18 | 20 | 20 | 20 | 20 | 20 | 19 | 19 | 14 | 170 | 180 | 94.44 | Very Practical |
| Average Percentage Participant Educate on Small Group Evaluation | | | | | | | | | | | | 95.73 | Very Practical |

In Table 12, it can be seen that the students' responses to the use of prototype 2 on each indicator are as follows: ease of use at 100% with a very practical category, media presentation standards and critical thinking skills at 94.44% with a very practical category, material understanding at 94.07% with a very practical category, and media design at 94% with a very practical category. Additionally, 97% with a very practical category for the language use indicator. Thus, based on the trial results at the small group evaluation stage, the augmented reality-based prototype 2 flashcards have been declared practical.

Next, field test. Study This measure improvement ability critical think student with compare mark test before and after given treatment. N-gain analysis is used for know how much big the increase that occurred. The results of the N-gain test of the ability think critical student Based on the pretest- posttest data in class XI.3, it is presented in the Table 13.

**Table 13.** Recapitulation Average Pretest, Posttest, N-gain

| Average Pretest | Average Posttest | N-gain |
|---|---|---|
| 43 | 83.20 | 0.71 |
| Category | | Tall |

Results of the average N-gain capability analysis critical think is 0.71 with category tall based on criteria N-gain value (g) > 0.3 with category low, $0.3 \geq g \leq 0.7$ with category currently as well as if $g > 0.7$ is in the category high. Increase the disclose existence improvement results Study before and after Study use flashcard based on augmented reality. This is in line with research conducted by Helen et al. (2023) found that the N-Gain value reached 0.82, indicating that AR flashcards can be used effectively as a learning tool and have the ability to improve student learning outcomes.

## Conclusion

Based on the research on the development of augmented reality-based flashcard media on dynamic fluid material to train high school students' critical thinking skills, it can be concluded that the media has been developed validly with media component assessment scores of 93.33%, material 93.32%, critical thinking skills 96.66%, language 97.77%, and design 100%, all of which fall into the very valid category. The media is declared practical with a practicality percentage of 95.18% in the one-to-one evaluation and 95.73% in the small group evaluation, and it is effective in improving critical thinking skills with an N-Gain score of 0.71, categorized as high, making it suitable for use in teaching dynamic fluid material to 11th-grade high school students.

**Acknowledgments**

Thanks to Unsri Competitive Excellence Grant PNBP Fund for Fiscal Year 2024.

**Author Contributions**

Conceptualization, MP.LM.; methodology MP; software INR; validation, MP. LM. M; formal analysis MP; investigation MP; resources were S; data curation MP; writing—original

draft preparation MP; writing—review and editing LM.M; visualization INR; supervision LM; project administration, S; and funding, S. All authors have read and approved the published version of the manuscript.

**Funding**
This research is funded by the Competitive Superior Grant of the PNBP Fund for the 2024 Fiscal Year, grant number 0013/UN9/SK.LP2M.PT/2024.

**Conflicts of Interest**
There is not conflict of interest in this writing.

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