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MATHEMATICS EDUCATION LEARNING AND TEACHING

Multimodal Interactive Flipbook Arias Model-Based for Critical Thinking Skills

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a b s t r a c t

Multimodal interactive flipbook is a digital-based learning aid which utilizes technological advances with learning materials presented in the text, images, audio, video, website, and web-based or interactive. Thus, this study aims to examine the effectiveness of multimodal interactive flipbooks based on the ARIAS (Assurance, Relevance, Interest, Assessment, Satisfaction) to improve students' critical thinking skills. This development study uses ADDIE model (Analysis, Design, Development, Implementation, Evaluation). It focuses on the Implementation and Evaluation stages to measure the effectiveness of the developed product in improving critical thinking skills. The data collection used a learning outcome test oriented critical thinking skill, then analyzed using descriptive and N-gain statistics. The results show that the interactive flipbook based on the ARIAS learning model is effectively implemented to improve the critical thinking skills of the mathematics education study program students of Universitas Muhammadiyah Sorong, who are significantly less critical to critical.

K e y w o r d s :

INTRODUCTION

Multimodal learning refers to use of various modes or aids in the learning process namely text, images, sound, video, and animation (Hardiyanti & Alwi, 2022). Ravelli and Van Leeuwen (2018) state that multimodal learning maximizes various types of aid and aids in the learning process, such as auditory, visual, reading, writing, and practice. Multimodal learning can help students develop their critical thinking skills (Fahmi, Djatiprambudi, & Handayaningrum, 2021).

Furthermore, learning aids can help educators to represent sentences that cannot be conveyed through words (Meinawati, 2020). The development of learning aid is not only limited to inanimate objects such as books, blackboards, and simple props but also develops on digital aid such as computers, tablets, and smartphones (Setyo, Pomalato, Hulukati, Machmud, & Lestari, 2022). Learning by utilizing various multimodal can be influenced in improving critical thinking skills, which are critical skills to be developed at all levels of education in the current era (Nuraida, 2019), (Setyo, Pomalato, Hulukati, & Djafri, n.d.). Critical thinking skills will help in solving problems, improve communication, increase creativity, build social skills, and increase competitiveness in the job (Muhali, 2019).

One of the aids that educators can use to improve critical thinking skills is the use of multimodal interactive flipbook-based digital books oriented towards improving critical thinking skills (Hardiyanti & Alwi, 2022), (Setyo, Pomalato, Hulukati, Machmud, & Djafri, 2023). Then, multimodal Interactive Flipbook is a digital learning aid that combines several learning in the form of text, audio, images, video, animation, and interactive or web-based (utilizing technology and communication), which allows students to explore and interact in the learning process to master certain material content that can be accessed via laptop / PC / computer or smartphone and does not needed to be printed (Aziza, 2019), (Puspita, Rustini, & Dewi, 2021), (Rihani, Maksum, & Nurhasanah, 2022).

In fact, the data from the needs analysis showed that the critical thinking skills of mathematics education study program students at Universitas Muhammadiyah Sorong are still relatively low. Students' low critical thinking skills are due to the lack of teaching materials commonly used in learning. The observation also shows that 24.3% of lecturers carry out learning materials with PowerPoint. 29.7% of lecturers use the internet, and as many as 13.5% use PDFs and only printed books, using flipbooks as much as 10.8% and other teaching materials as much as 8.1%.

This condition makes students feel that the learning carried out by lecturers is less exciting and tends to be monotonous because it only uses PowerPoint and pdf, classified as learning aid that only maximize text mode and images, so it is less varied. The data from the needs analysis also states that the teaching materials used in the learning process have yet to accommodate the improvement of students' critical thinking skills. The results shows that as many as 54.1% stated rarely, 24.3% often, and 21.6% always stated.

Thus, the flipbook developed and tested for effectiveness in this study is oriented towards the ARIAS (Assurance, Relevance, Interests, Assessment and Satisfaction) learning model (Kurniawati et al, 2017). to improve the critical thinking skills of mathematics education students at Universitas Muhammadiyah Sorong.

METHODS

This study used ADDIE development model (Analysis, Design, Development, Implementation, Evaluation). The design stages of the ADDIE model are as follows;

Figure 10

The Design Stage of ADDIE (Arta, 2022)

The study presents the results of two stages of ADDIE development, namely the Implementation and evaluation stages, to measure the effectiveness of the multimodal interactive flipbook developed. The Implementation Stage is the trial stage of the multimodal interactive flipbook based on the ARIAS model after the flipbook is declared feasible to be tested by the validator, and the evaluation stage evaluates the overall flipbook developed based on the results of the validator's input and suggestions or improvements during the trial implementation.

The subjects in this study were Mathematics Education Students of Universitas Muhammadiyah Sorong at the second semester. They consist of 12 students, such as 10 women and 2 men. The flipbook was developed according to the analytical geometry course. Also, this study used a needs analysis instrument, an observation sheet, a response questionnaire for students, and a critical thinking skills test. The data analysis technique used in this study is a descriptive statistical analysis of the N-Gain test

RESULT AND DISCUSSION

The multimodal interactive flipbook developed in this study utilizes Microsoft Office 365 and the http://heyzine.com platform to create a multimodal interactive flipbook.

The Implementation Stage is the stage test of the flipbook developed by carrying out learning for four meetings before learning is given an initial test (pretest) and final test (posttest) and collecting data on the responses of lecturers and students to the multimodal interactive flipbook developed.

The last stage is evaluation, which is the final stage of all the processes that have been carried out. From the trial stage, an assessment and response were obtained from the questionnaire given to lecturers and students and the critical thinking skills test results. The questionnaire and the critical thinking skills of the test will already analyzed, which can then be used to determine the effectiveness of the multimodal interactive flipbook.

The analysis results use as a reference for whether or not to revise the final stage of the multimodal interactive flipbook. The learning was implemented in five meetings consisting of four lessons and one critical thinking posttest. Presented in Table, as follow;

Table 1
The Results of learning implementation analysis

Meeting	Implementation Percentage	Category
1	86.67	Very good
2	93.33	Very good
3	100.00	Very good
4	100.00	Very good
Mean	95.00	Very good

Based on the analysis of the implementation of learning in Table 1, the average percentage is 95.0 in the excellent category. Thus, the implementation of learning using multimodal interactive flipbooks based on the ARIAS model improves critical thinking skills in the excellent category. The results of observations of learning implementation can be measured using an observation sheet.

Table 2
The result of the analysis of lecturer and student responses

Aspects Responded	Lecturer	Percentage	Category	Student	Percentage	Category
Ease of Use	3	75	Positive	Positive	3.6	highly positive
Interest	3	75	Positive	Positive	2.8	highly positive
Language	3	75	Positive	Positive	3.8	highly positive
ARIAS	3.3	82.5	Positive	Positive	3.7	highly positive
Critical Thinking	4	100	highly positive	highly positive	3.5	highly positive

The analysis in Table 2 shows that the results obtained in ease of use, interest, language, and ARIAS get a positive response. In contrast, the lecturer responds very positively to the critical thinking aspect. The results of the analysis of student responses in the aspects of ease of use, interest, language, ARIAS, and critical thinking received a very positive response. It can be concluded that multimodal interactive flipbooks get a positive response from lecturers and students in all aspects.

The results of the analysis of the effectiveness of ARIAS-based multimodal interactive flipbooks in improving students' critical thinking skills are presented in Table 3.

Table 3
The result of the effectiveness analysis of multimodal interactive flipbooks

Score Category	Score Percentage (%)	Category	Post-test Score (%)	Category
Minimum	5	Lack of Critical	20	Lack of Critical
Maksimal	12	Lack of Critical	95	Very Critical
Mean Score	8.58	Lack of Critical	74.00	Critical

From the analysis of critical thinking skills presented in Table 3, it was obtained that the minimum value, maximum value, and mean value of the pretest score were in the very least critical category. While the minimum value posttest score is in the very less critical category, the maximum value score is in the critical category, and the mean posttest score is in the critical category. It can be concluded that multimodal interactive flipbooks can improve students' critical thinking skills. Calculations were carried out using N-gain, obtained the following results:

$$N - Gain = \frac{74,00 - 8.58}{100 - 8.58} = 0.72$$

Based on the results of the N-gain calculation, a score of 0.72 was obtained in the "g-high" category, it shows that the learning process of critical thinking using multimodal interactive flipbooks significantly increased.

The responses of lecturers and students to multimodal interactive flipbooks were collected using a questionnaire sheet for lecturer and student responses. The Multimodal Interactive Flipbook developed has a positive practicality value, as shown in Table 4 below;

Table 4
. The Result of the Practicality analysis in terms of lecturer and student responses

Aspects Responded	Lecturer	Percentage	Category	Student	Percentage	Category
Ease of Use	3	75	Positive	Positive	3.6	Highly Positive
Interest	3	75	Positive	Positive	2.8	Highly Positive

Language	3	75	Positive	Positive	3.8	Highly Positive

As seen from the results of the practicality analysis in Table 4, the results of the positive category in the aspects of ease of use and interest from the lecturer's response. A positive response was obtained from student responses on ease of use and interest. It can be concluded that multimodal interactive flipbooks are practical for learning.

Based on data obtained from validators who are experts in the fields of aid, material, and language, it shows that the average assessment or validation results from experts on multimodal interactive flipbooks based on the ARIAS model show the validation results of aid experts and material experts in the "High" category and while the results of linguist validation in the "Medium" category using the Aiken's proposed rater agreement index category in table 1.

Thus, the ARIAS-based multimodal interactive flipbook for improving critical thinking is suitable for testing. The flipbook development process is said to be valid, and this is in line with study by (Anak Agung Meka Maharcika, Ni Ketut Suarni, & I Made Gunamantha, 2021) which also made flipbooks for the science learning process in SD / MI. The results of his research showed an average validation of 95.56% in the very valid category. Teacher and student responses to the flipbook were 87.19% in the practical.

CONCLUSION AND IMPLICATION

To sum up, multimodal interactive flipbooks in ARIAS modal-based analytical geometry courses were developed using the ADDIE development model (Analysis, Design, Development, Implementation, Evaluation). Curriculum analysis, student analysis, and multimodal interactive flipbook development analysis are carried out at the analysis stage. The design stage is done by preparing material, selecting reference sources, and making storyboards (preparation of development formats). The development stage is developing flipbooks from Word to PDF and Heyzine to become interactive. The implementation stage involves trials carried out in second-semester students of mathematics education study programs, and the last stage is the evaluation stage. At this stage, an evaluation is carried out to improve the multimodal interactive flipbook based on the revised results of six validators. The analysis results of implementing learning using multimodal interactive flipbooks based on the ARIAS model for improving skills and critical thinking are very good (Table 2).

Furthermore, implementing multimodal interactive flipbooks based on the ARIAS model in analytical geometry courses improves the skills and critical thinking of second-semester students of the mathematics education study program at Universitas Muhammadiyah Sorong. Then, the practicality of multimodal interactive flipbooks based on the ARIAS model in terms of the responses of lecturers and students get responses in the positive category, and aspects of ease of use, attractiveness, language, and language get a very positive category.

In addition, as for this study's recommendations, ARIAS-based multimodal interactive flipbooks can be used as an alternative to improve students' skills and critical thinking

abilities in analytical geometry courses. Then, multimodal interactive flipbooks based on the ARIAS model can be developed to encourage educators to innovate to improve students' skills and critical thinking.

Disclosure statement

There is no potential conflict of interest was reported. The researcher has nothing to disclose.

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