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Development of STAFA Interactive Learning Multimedia for Science Subjects in Grade X of Senior High School

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ABSTRACT

Education is the main foundation for facing the flow of globalization and the development of the industrial revolution towards society 5.0. Therefore, the education system continues to transform and expand the use of digital technology. One way to do this is to present digital learning content through the development of interactive learning multimedia. The results of the study indicate that the science learning media used in high school classes remain one-way and teacher-centered. Therefore, the purpose of this study is to develop an interactive multimedia STAFA that is valid, practical, and effective in improving student learning outcomes. This study uses the Research and Development (R&D) method using the ADDIE model. The research subjects were class X E2 students at SMAN 1 Siberut Tengah. Research data was obtained from students, teachers, and a team of experts who were then tested for validity, practicality, and effectiveness. The results of this study are interactive multimedia STAFA that are valid, practical, and efficient. Media experts gave an average product validity score of 97%, material experts 89%, and language experts 99%. All experts gave scores in the very valid category. The results for teacher responses were 95% and for students, 90%, in the very practical category. The effectiveness of media on learning outcomes shows an N-Gain score of 0.60, indicating a moderate and effective effect on the learning process.

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1. Introduction

Education plays a strategic role in developing human resources capable of facing the challenges of the Industrial Revolution 4.0 and Society 5.0. In this context, education serves not only as a knowledge transfer process but also as a means of developing 21st-century skills that require critical, creative, collaborative, and adaptive thinking (Schwab, 2018; Fitria et al., 2025). The development of digital technology has also driven the transformation of learning to be more flexible, interactive, and meaningful through the integration of information and communication technology (ICT) in the educational process (Selwyn, 2016; Balaban et al., 2023; Suryani et al., 2026). (GEM Report UNESCO, 2023) reports that the use of digital technology in learning can increase student engagement, expand access to education, and enhance the quality of science and mathematics learning. The transformation of education in Indonesia is reinforced by Presidential Instruction Number 7 of 2025 concerning the

acceleration of digitalization of learning, which encourages the use of ICT devices such as Interactive Flat Panels (IFPs) and digital learning platforms.

The implementation of technology in schools still faces various obstacles. The use of digital devices is generally limited to presentation media, so learning remains tech-centered. This condition impacts the low quality of science learning and students' understanding of scientific concepts. The results of the 2022 Programme for International Student Assessment (PISA) showed that Indonesian students' scientific literacy remains below the OECD average (OECD, 2023). In practice, science learning is still dominated by lecture methods, textbook use, and minimal exploration and visualization of abstract concepts. Interview findings at SMAN 1 Siberut Tengah indicate that teachers have not yet used interactive learning multimedia due to limited skills and time to develop multimedia. As a result, student engagement in learning is low, discussions are less active, and learning outcomes on global warming remain low.

These issues highlight the need for a learning approach that fosters active student engagement and conceptual understanding. Deep learning emphasizes meaningful learning processes through conceptual linkages, reflection, problem-solving, and the application of knowledge in real-world contexts (Fullan & Langworthy, 2014; Kovač et al., 2025). Similarly, Darmansyah (2021) emphasized that learning should be designed to encourage students to actively explore through observation, discussion, exploration, and reflection. One potential medium for supporting deep learning is interactive multimedia, which integrates text, images, audio, video, animation, and simulations (Ahmad & Seandy, 2024; Yanti et al., 2025). The development of interactive multimedia learning should be grounded in strong theory, such as (Mayer, 2020). cognitive theory of multimedia learning. This theory explains that learning is more effective when visual and verbal information is presented in an integrated manner, according to the principles of coherence, modality, redundancy, segmentation, and contiguity. Previous research by Mulyati et al. (2022) demonstrated that Canva-assisted media was deemed valid and suitable for use in learning. However, this study did not mathematically integrate the deep learning approach or Mayer's cognitive theory. Therefore, this study aims to develop interactive STAFA multimedia for 10th-grade science students in high school, based on deep learning, to improve student learning outcomes.

Research and development (R&D) is a research method used to produce a specific product and test its effectiveness (Sugiyono, 2013). To produce a product, needs analysis and product effectiveness testing are required so that it can function in the wider community. Furthermore, Putra (2012) presents several examples of R&D products, including learning tools such as models, learning media, equipment, books, teaching modules, and evaluation tools. The learning tools developed are interactive multimedia. Interactive multimedia learning, often abbreviated as MPI, is a type of multimedia equipped with a control tool that allows users, in this case, students, to choose the flow of the learning process according to their individual needs (Laia, 2023). The main characteristic of MPI is its ability to combine various media elements, including text, visuals (images or photos), video, audio, and animation, enabling two-way interaction between users and applications.

One application that can be used in developing MPI is Canva. Canva is a free online design platform widely adopted in education (Pidhornyi & Kovtaniuk, 2025; Romero, 2025). This application allows users to create a variety of creative designs, ranging from presentations, posters, and mind maps to documents, infographics, and animated videos. Canva services are also available for free or paid. In the Canva application, researchers developed an MPI that leverages Canva assets. The initial step is selecting a presentation and designing it so it becomes interactive media accessible via a link to students. The researchers named the MPI developed STAFA, which stands for the Study of Physics Science.

2. Research Methodology

2.1 Research Design

This study uses the Research and Development (R&D) method. Sugiyono (2013) explains that Research and Development is a research method used to produce a specific product and test its effectiveness. The product created is an interactive multimedia STAFA in Canva, designed to improve student learning outcomes. The research procedure refers to the ADDIE development model (Branch, 2009) because of its systematic, iterative nature and is widely applied in the development of learning media. The ADDIE model consists of Analysis, Design, Development, Implementation, and Evaluation.

2.2 Participants

The subjects of the research for the validity test consisted of a team of three experts who were lecturers at Padang State University. The subjects for the practicality and effectiveness tests were 22 teachers and students of class X E2 of SMAN 1 Siberut Tengah, located in Siberut Tengah District, Mentawai Islands Regency, West Sumatra Province.

2.4 Data collection technique

The data for this study were collected through interviews, questionnaires, and tests. Interviews were conducted to gain a comprehensive understanding of the learning needs and context. The questionnaire consisted of a series of written questions given to respondents. The questionnaire used a Likert scale format. Sudaryono (2016) explains that a Likert scale is designed to assess individuals' or groups' opinions, attitudes, and views on a social phenomenon. The questionnaire was validated by experts, including validation sheets from media, material, and language experts, as well as questionnaires on teacher and student practicality. Multiple-choice tests were used to measure learning outcomes in the pre-test and post-test.

2.5 Validity Data Analysis

The research data were analyzed quantitatively using questionnaires completed by media, material, multimedia and language experts. The data were presented in the form of quantitative descriptive analysis through tables, graphs, or diagrams (Sugiyono, 2013). The expert validation results were used to determine the validity level of the interactive learning multimedia. The validity score was calculated using the formula:

$$\text{Validity Value} = \frac{\text{number of scores obtained}}{\text{highest score}} \times 100\%$$

The following are the criteria for determining the level of validity:

Table 1. Criteria for Determining Validity Level

No	Achievement Level	Criteria
1	81 – 100	Very valid
2	61 – 80	Valid
3	41 – 60	Quite valid
4	21 – 40	Less valid
5	0 – 20	Invalid

Source: (Riduwan, 2013)

2.6 Effectiveness Data Analysis

The effectiveness data analysis used a pre-experimental method. According to Sugiyono (2013), the experimental method produces a dependent variable that is directly influenced by the independent variable. As a result, this study involved only one experimental group, a pretest-posttest design. Based on the results obtained, the researcher conducted a Gain normality test (N Gain Test) using the formula:

$$\text{N Gain} = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}}$$

The following are the criteria for determining the level of effectiveness:

Table 2. Classification of Gain Normality Values

No	Achievement Level	Criteria
1	$0{,}70 < n \leq 1{,}00$	High
2	$0{,}30 < n \leq 0{,}70$	Medium
3	$0{,}00 < n \leq 0{,}30$	Low

4. Findings

4.1. Analysis

The analysis stage was conducted through observation and open interviews with science teachers at SMAN 1 Siberut Tengah. This stage aims to gain a comprehensive understanding of the learning needs and context before starting the development of learning media. This analysis helps ensure that the design of the learning media development is carried out in line with the learning needs to be met. The following are the results of the analysis that has been conducted: 1) The needs analysis includes interviews and analysis of the education report card of SMAN 1 Siberut Tengah. The results of the interviews showed that teachers use interactive media only occasionally in the learning process due to their limited ability and limited time to create MPI. The education report card of SMAN 1 Siberut Tengah in 2025 received a score of 59.45 with a moderate predicate. One influential indicator is the use of media in the learning process. The use of interactive media should be part of an effort to improve learning quality. 2) Curriculum and material analysis.

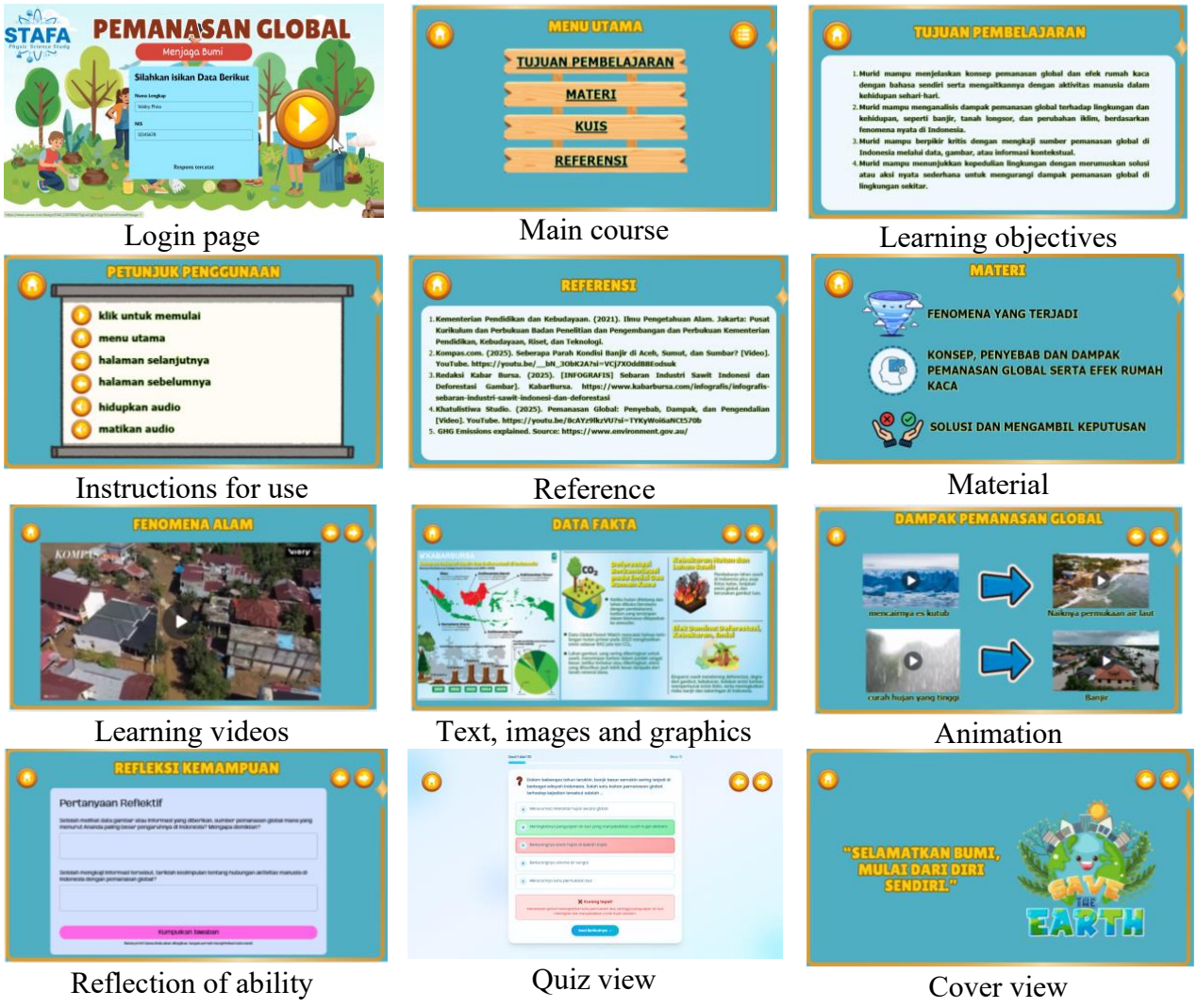
The development of the STAFA MPI is based on the applicable curriculum, namely the independent curriculum or the national curriculum. The subject of this development research is Natural Sciences (IPA), focusing on grade X of high school and the topic of global warming. The development of the STAFA MPI is intended to present the principles of in-depth learning, namely awareness, meaning, and enjoyment. 3) Student analysis. Students also tend to have a higher interest in learning that uses digital technology, presents an attractive display, and provides opportunities for interaction. Therefore, the STAFA MPI was developed to increase engagement and interest in learning through an interactive and visual approach(Li & Yin, 2025; Ahmadfard, 2026).

4.2. Design

The design phase aims to design the structure, appearance, and learning flow of the developed media. The initial phase involves determining the learning objectives. The second phase involves developing the navigation flow and content structure of the STAFA MPI. This flow includes the login page, main menu, learning materials, videos/animations, interactive quizzes, and skill reflections. Next, a storyboard is created to illustrate the appearance of each page in the STAFA MPI. The storyboard determines the layout of multimedia elements, the use

of text, images, animations, and videos, as well as navigation (buttons, menus, and user interactions). After completing this phase, the next step is to begin designing using the Canva application.

Here are the steps for designing the STAFA MPI using the Canva application: 1) Access the Canva application via https://www.canva.com. 2) Accept all cookies by clicking "accept all cookies." 3) Log in using your Gmail account or your belajar.ID accounts for teachers. 4) Enter your account and password. 5) Welcome to the Canva main screen. 6) Select a presentation to begin designing. Next, you will be presented with a selection of template options and a blank template. This is the page where you begin designing the learning flow and storyboard. The following is a preview of the designed media.



Login page | Main course | Learning objectives

Instructions for use | Reference | Material

Learning videos | Text, images and graphics | Animation

Reflection of ability | Quiz view | Cover view

Figure 1. Designed media display

The full view can be accessed at the following link: s.id/STAFAVPPGX or https://canva.link/stafaxpgvp

Source: Personal document

4.3 Development

This stage is the phase in which the product is compiled, and its quality is improved, to produce learning media that meet standards after being revised based on expert feedback. The product validation process is carried out after the initial product creation. It involves three important aspects, namely: media validation by media experts, content validation by material

experts, and language quality validation by linguists. In the development of STAFA interactive learning media, validation involves 3 experts, namely media experts, material experts, and linguists. Based on validation by media experts, material experts, and linguists, the validation summary for StafA interactive learning multimedia is shown in the following table.

Table 3. Media Validation Summary

No	Aspek	Percentage	Kategori
1	Media	97%	Very Valid
2	Material	89%	Very Valid
3	Language	99%	Very Valid

4.4 Implementation

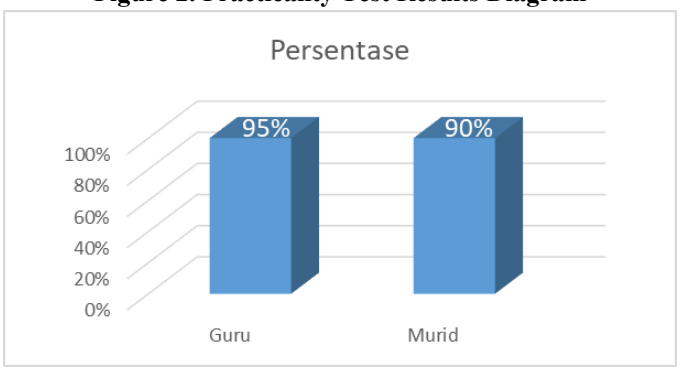
Implementation was carried out to ensure that everything functions smoothly and is accessible to teachers and students (Rahmi, 2026). A practicality test was conducted on two science teachers and a grade 10 student at SMAN 1 Siberut Tengah by administering a practicality questionnaire. The following shows the average percentage of practical test results for the assessed aspects.

Table 4. Average percentage of Practicality Test Results by Teachers and Students

No	Rated aspect	Teachers (Percentage)	Students (Percentage)
1	Ease of use of media	94%	90%
2	Clarity of learning flow	97%	90%
3	Student engagement and learning activities	97%	90%
4	Support for deep and contextual learning	94%	88%
5	Compliance with classroom learning activities	93%	91%
	Average	**95%**	**90%**

Information about the practicality of STAFA interactive learning multimedia can be seen more clearly in the following diagram:

Figure 2. Practicality Test Results Diagram



Regarding the practicality category, teachers' results were 95% in the "very practical" category. Likewise, the students' practicality evaluation showed an average score of 90%, also meeting the "very practical" criteria. A similar study was also conducted by Safitri et al. (2025) titled "Development of Canva Interactive Multimedia to Increase Student Learning Motivation at SMPN 1 Pariangan". The results of the study, in the form of a media practicality test, were 90.63% from teachers and 92.58% from students. The values obtained were in the very practical

category for use. It can be concluded that the use of interactive learning media in Canva is very practical and suitable as a learning medium.

4.5 Evaluation

The evaluation stage was conducted after the research ended, to observe the effect of using STAFA interactive multimedia on the science subject in grade X SMA on the learning outcomes of grade X E2 students at SMAN 1 Siberut Tengah regarding global warming. The effectiveness test was conducted by comparing the pretest and posttest results involving 22 students. The following average values are presented in the following table:

Table 5. Average Pretest and Posttest Scores of Students

Learning outcomes	Average
Pretest	62,95
Posttest	83,41

Based on the Table 5, it is clear that there was a difference in average learning outcomes before and after using STAFA interactive learning multimedia. Improvements in student understanding were also evaluated using a Gain Test analysis method that compares pretest and posttest scores. The Gain Test data can be seen in the following graph:

Table 6. Gain Test Results

No	Gain Criteria	Number of Students
1	High	7
2	Medium	13
3	Low	2
Score		**22**

The Gain Test also demonstrated a difference of 0.60 between students' posttest and pretest scores, indicating a moderate effect size. Based on these data, STAFA interactive multimedia is quite effective for learning. The completion of student learning outcomes is also a critical aspect in evaluating the effectiveness of the learning process. The percentage of completion of learning outcomes clearly illustrates the extent to which students have achieved the expected competencies. The level of completion is an important indicator in assessing the efficiency and effectiveness of an educational program. An analysis of students' pretest and posttest results involving STAFA interactive learning multimedia in learning is illustrated in the Figure 3.

The graph on Figure 3 clearly shows that utilizing STAFA MPI in learning activities can significantly improve student learning outcomes. The findings of this study align with those of Deliana et al. (2023) who found that interactive multimedia created with Canva significantly improves student learning outcomes. The average student score on the pretest was 54.83%. After using multimedia, the average student score on the posttest increased to 90%. This finding is also in line with the development of STAFA interactive multimedia for grade X high school on global warming, which has been proven effective in improving student learning outcomes.

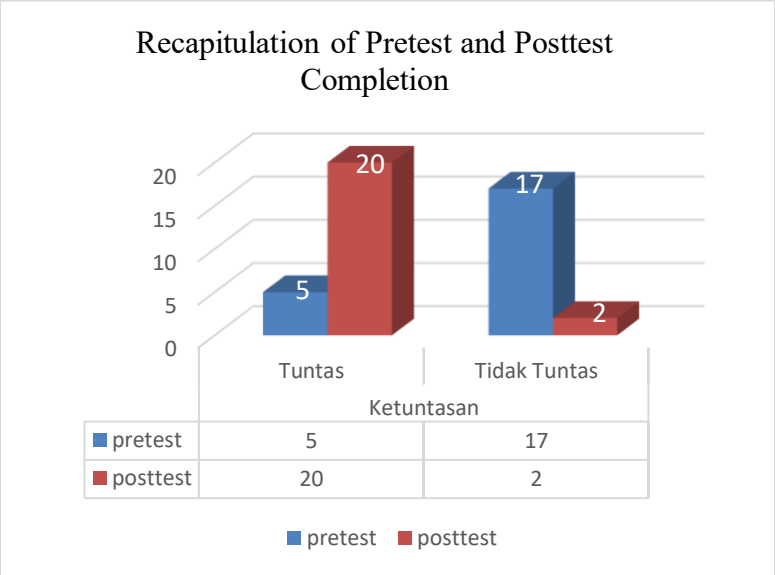


Figure 3. Recapitulation of Pretest and Posttest

5. Discussion

The results of the study indicate that Canva-based STAFA interactive learning multimedia meets the criteria of validity, practicality, and effectiveness for use in science learning for grade X of senior high school. The high validation results indicate that the developed media is appropriate in terms of material, appearance, language, and learning design. These findings indicate that the development of multimedia that combines text, images, videos, animations, and interactive quizzes can support a more structured and engaging learning process for students, in line with previous studies that state that Canva-based interactive multimedia has a high level of validity, practicality, and effectiveness in improving the quality of learning and student engagement (Mailando et al., 2023; Assalam et al., 2025).

The development of the STAFA MPI aligns with Richard E. Mayer's multimedia learning theory, which emphasizes integrating visual and verbal information to support learning. Presenting global warming material through visualization and animation helps students understand abstract concepts more concretely and in context. This is crucial because global warming material requires not only memorization of concepts but also an understanding of real-life cause-and-effect relationships (Viyanti et al., 2025). Practical results show that the media is easy to use for both teachers and students. The simple interface, clear navigation, and flexible access make the learning process more interactive and student-centered. This situation indicates a shift from teacher-centered to student-centered learning. Students become more active in exploring the material, taking quizzes, and reflecting on their learning, making the learning process more meaningful (Firmansyah & Purnama, 2022; Jessica Alfa & Asrizal, 2024).

In terms of effectiveness, MPI STAFA has been proven to improve student learning outcomes. The increase in posttest scores compared to pretest scores indicates that interactive multimedia can help improve understanding of science concepts. The N-Gain results, which are in the moderate category, indicate that the media is quite effective in learning. However, these results are influenced by several factors, including limited implementation time, varying initial student abilities, and adaptation to the use of digital media in learning (Armiyati & Asih, 2025).

The findings of this study align with previous research that found Canva-based interactive multimedia can improve student motivation and learning outcomes. However, this study has the advantage of integrating deep learning principles and Mayer's multimedia theory into media development. Thus, the STAFA MPI not only functions as a medium for conveying information

but also supports active engagement, conceptual understanding, and a more meaningful learning experience (Rumiyati et al., 2025; Yunita & Irawan, 2025). Overall, STAFA interactive learning multimedia can be a relevant alternative digital learning medium to support educational transformation in the digital era. This medium can create more interactive, enjoyable, and contextually relevant science learning, potentially improving the quality of learning and student outcomes.

6. Conclusion

Based on this research, the development of interactive multimedia STAFA for the science subject in grade X SMA using the ADDIE model was successful. The interactive multimedia was validated by media experts (97%), material experts (89%), and language experts (99%). The results of the practicality test showed practical values of 95% among teachers and 90% among students, which were categorized as very practical to use. The effectiveness test, which examined student learning outcomes using the Gain test, yielded a score of 0.60, placing it in the moderate category. This indicates that interactive multimedia STAFA is an effective medium for learning. This study also suggests the need for a clear strategy for teachers to integrate interactive multimedia into the learning process, ensuring optimal learning outcomes. Recommendations for further research include conducting trials with a wider student population and developing interactive multimedia for other materials or subjects. This is expected to help train students' digital literacy in facing technological developments. Thus, this research is expected to provide benefits as an effective and enjoyable learning medium in improving student learning outcomes.

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