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Work and Energy: The Development of Learning Media Based on Smart Apps Creator to Enhance Critical Thinking Skills

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ABSTRACT

This study aims to assess the feasibility of Smart Apps Creator-based interactive learning media, its implementation in learning, the improvement of students' critical thinking skills, and student responses to its use. The research follows the ADDIE model, which includes the stages of analysis, design, development, implementation, and evaluation. The research population consisted of all students of class X IPA 4 at SMAN 6 Tambun Selatan, with a total sample of 30 students. The research instruments included media validation sheets, observation sheets, critical thinking skills tests, and student response questionnaires. The results indicate that Smart Apps Creator-based interactive learning media is feasible, with an average validity percentage of 87%, classified as very valid. The implementation of learning, based on observation sheets, achieved an average percentage of 91%, interpreted as very good. The use of Smart Apps Creator-based interactive learning media enhances students' critical thinking skills, with an average N-gain of 34.93%, classified as moderate. Student responses to the media were highly positive, with an average score of 81.67%, categorized as very interesting. These findings suggest that Smart Apps Creator-based interactive learning media is an effective tool for improving student engagement and critical thinking skills.

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Introduction

The learning landscape after the COVID-19 pandemic has undergone significant changes, requiring the integration of various digital applications to support teaching and learning processes. Teachers are expected to be creative and innovative in designing learning experiences that leverage technological advancements while fostering student engagement (Napsawati, 2020). Moreover, teachers must enhance students' higher-order thinking skills (HOTS), particularly critical thinking, to help them develop analytical reasoning and problem-solving abilities (Hasannah & Suprapto, 2021).

Physics, as a branch of natural science, involves a problem-solving approach that encourages students to analyze data, gather information, and construct valid arguments based on scientific principles (Herayanti et al., 2018). However, studies indicate that Indonesian students still struggle with mastering HOTS-oriented questions, which hinders their ability to think critically (Permata & Muslim, 2019). Research by Hendi et al. (2020) demonstrates that interactive learning media can significantly improve students' critical thinking abilities, as reflected in higher test scores when such media are utilized. These findings suggest that integrating interactive learning media into physics education can be an effective strategy for enhancing students' cognitive skills.

Interactive learning fosters an engaging and dynamic educational experience, encouraging students to actively participate in discussions, ask questions, and explore concepts independently (Abdullah et al., 2021). This approach enhances comprehension and retention by making lessons more engaging and accessible (Nurhayati & Muharamsah, 2020). The effectiveness of interactive learning depends on the use of well-designed learning media that facilitate meaningful interactions between students and instructional content.

Interactive learning media refers to digital tools that facilitate the transfer of information from teachers to students by utilizing technology-based applications (Dasmo et al., 2020). Such media act as intermediaries that stimulate student engagement and improve their understanding of the subject matter. When integrated effectively, interactive learning media enhance knowledge retention and contribute to achieving learning objectives (Abdullah et al., 2021; Yanto, 2019). One essential component in modern education is the development of technology-assisted learning media, which can significantly impact the quality of student learning experiences (Nurdyansyah, 2019).

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One promising tool for developing interactive learning media is Smart Apps Creator (Wati & Nugraha, 2020). This software offers several advantages, such as ease of use without requiring programming skills, cross-platform compatibility (Android, web, and Microsoft), and the ability to incorporate animations and interactive elements (Budyastomo, 2020). Given these features, Smart Apps Creator provides a viable solution for creating engaging and interactive learning materials, particularly for physics education. Utilizing this software, interactive learning media can be designed to help students study anytime and anywhere, thereby fostering independent learning and improving critical thinking skills.

The learning process in this study is structured around the inquiry-based learning model, which emphasizes student engagement in critical thinking and problem-solving activities. This model encourages students to actively investigate phenomena, analyze information, and derive conclusions based on logical reasoning (Nupura et al., 2021). Inquiry-based learning has been shown to improve students' ability to systematically explore problems and develop well-reasoned arguments (Erlinda, 2016).

One of the most challenging physics topics for high school students is work and energy, a fundamental concept essential for understanding motion and mechanics in daily life (Yelensi et al., 2020). Many students perceive physics as a difficult subject, often struggling to apply formulas to solve real-world problems (Nabila & Rachmasari, 2021). Due to the complexity of work and energy concepts, instructional approaches should emphasize real-life applications to enhance students' comprehension and problem-solving skills (Putri & Djamas, 2017). Integrating Smart Apps Creator-based interactive learning media into the physics curriculum is expected to bridge this gap by making abstract concepts more tangible and accessible, ultimately fostering students' critical thinking abilities.

Methods

The research and development approach will be carried out using a quantitative approach and a qualitative approach. This research method uses the Research and Development (R&D) method. ADDIE model (Analyze, Design, Development, Implementation, and Evaluation). The ADDIE model was developed by Dick and Carry. The design used is a one-group pretest-posttest design. This research was conducted in class X Science 4 at SMAN 6 Tambun with a total of 30 students.

The data obtained will be analyzed, namely analysis of expert validation sheets, analysis of observation sheets, analysis of critical thinking skills tests, and analysis of response questionnaires. Analysis of expert validation sheets on interactive learning media will be tested in the field as learning media that has previously been qualified for suitability by media experts' material experts. This is aimed at finding out the level of suitability of Smart Apps Creator-based interactive learning media with the learning process in schools. Analysis of observation sheets that will be tested in the field as implementation during the learning process by physics teachers to determine implementation at each learning stage. Critical thinking skills test analysis from the trial results was analyzed quantitatively using validity tests, reliability tests, difficulty level tests, and differentiating power using anates software. Analysis of the questionnaire sheet for student responses to the use of interactive learning media based on Smart Apps Creator using a rating scale from 1 to 5. The Media Attractiveness Percentage can be calculated using the formula below:

$$\text{Media Attractiveness Percentage} = \frac{\text{obtained score}}{maxsimum\ score} \times 100\%$$

The percentage measurement is the score obtained divided by the total score multiplied by 100%. The results of the student response questionnaire scores can be interpreted in Table 1.

Table 1. Interpretation of student response values

Percentage	Interpretation
80-100	Very interesting
66-79	Interesting
56-65	Quite interesting
46-55	Less attractive
≤45	Very uninteresting

Results and Discussions

The data from both variables gathered in this research was analyzed and organized in Table 2. In class XI MIPA 1, students achieved a minimum score of 30 and a maximum of 70. The preliminary study process carried out not only interviews with teachers and teacher students but also test students' critical thinking skills on business and energy material from previous researchers which has been validated. The results of the critical thinking skills test can be seen in Table 2.

Table 2. Value of students' critical thinking skills

Indicator	Percentage (%)	Interpretation
Elementary clarifications	42	Low
Basic support of an argument	44	Low
Inferences	45	Low
Advanced clarification	46	Low
Strategies and tactics	35	Low

Based on Table 2, the results of the critical thinking skills test show that the critical thinking skills of class X Science students at SMAN 6 Tambun Selatan are still low and need to be improved. Students cannot solve the physics problems given by the teacher, therefore overcome the low level of critical thinking skills students need to use applied approaches, methods, models, and media, one of which is learning using interactive learning media to improve critical thinking skills. learners. Research conducted Hendi, et al. (2020) states that the development of interactive learning media is effective in improving students' critical thinking abilities as seen from the higher critical thinking ability scores when using interactive learning media by getting a significance value of 0.075. Based on these indicates that interactive learning media affects improving students' critical thinking abilities.

The design stage in this research is designing interactive learning media based on Smart Apps Creator. This design stage will create a flowchart and storyboard. Smart Apps Creator software has advantages and disadvantages. The advantages of Smart Apps Creator are that it does not require special skills in programming, the resulting application can be used on various platforms (Android, iOS, laptop, and web), can apply animation according to the imagination required, is interactive, and increases creativity. The disadvantage of Smart Apps Creator is that it requires two-way interaction by adding features and can only be used on Android or iOS phones.

The development stage also carries out validation to assess the feasibility of an interactive learning media based on Smart Apps Creator that will be implemented in schools. This expert validation assessment is carried out by experts consisting of two material experts and two media experts. This expert validation covers six aspects consisting of four aspects for assessment by material experts, namely the relevance aspect, material organization aspect, evaluation/practice questions aspect, and language aspect, and two aspects for media expert assessment, namely the effect aspect for learning strategies and the visual display aspect. The results of data from experts regarding interactive learning media based on Smart Apps Creator obtained from experts are in Table 3.

Table 3. Summary of overall assessments

Aspect	Persentase (%)
Relevance	94
Organization of material	86
Evaluation/practice questions	85
Language	85
Effect on learning strategies	88
Visual appearance	86

The relevance aspect consists of five indicators, namely suitability of material to KI and KD, clarity of formulation of learning objectives, suitability of material to indicators, suitability of material to learning objectives, and the correctness of material concepts viewed from a scientific aspect. The aspect of organizing material consists of seven indicators, namely clarity of material delivery, systematic delivery of material, attractiveness of material delivery, completeness of material, actualization of material, suitability of the level of difficulty and abstractness of concepts with students' cognitive development and clarity of the examples provided. The evaluation/question practice aspect consists of two indicators, namely the suitability of the evaluation to the learning objectives and the correctness of the question concept. The language aspect consists of two indicators, namely the accuracy of using terms and the ease of understanding the flow of material using language. The effect aspect of learning strategies consists of five indicators, namely ease of use, media support for students' independent learning, media's ability to add knowledge, media's ability to increase students' understanding, and media's ability to add motivation to learning. The visual display aspect consists of five indicators, namely suitability of display color selection, suitability of font type selection, suitability of font size selection, accuracy and consistency of button placement based on pattern layout, and design attractiveness.

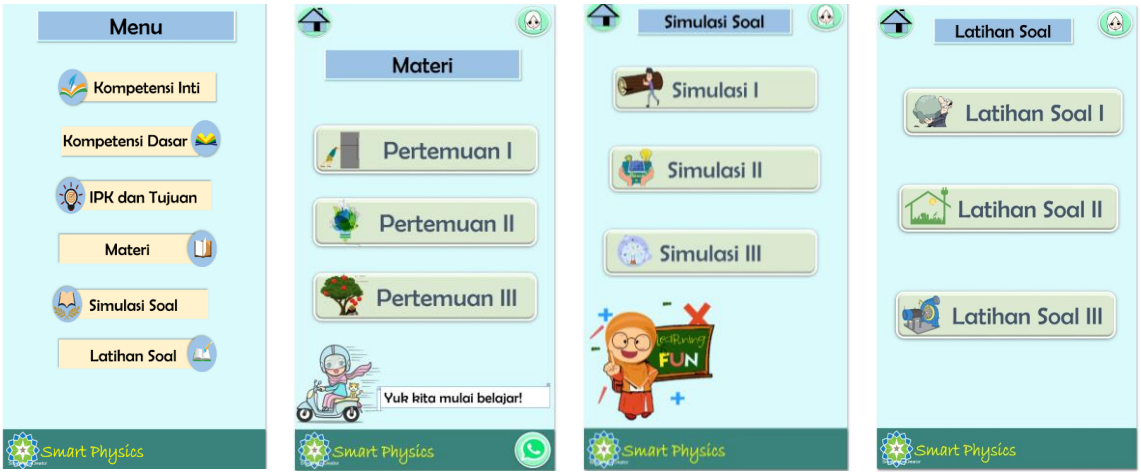
All aspects based on the assessment of material experts, media experts, and field experts with an average percentage of 87% were interpreted as very valid, so interactive learning media based on Smart Apps Creator was declared suitable for use in the learning process, by research conducted by Setya et al. (2019) stated that Android-based physics learning media was declared very good by validators and could be used in the learning process. Media creation has been done, and improvements from criticism and suggestions provided by experts are used to improve Smart Apps Creator-based interactive learning media before conducting research in the field.

The revised product is implemented for students. After the media is declared feasible, the next step is to carry out small-scale trials for students. Response questionnaire for small-scale trials for interactive learning media based on Smart Apps Creator before large-scale trials are carried out in research. The small-scale trial is conducted with students who have previously received instruction on the topic of work and energy. About 25 students filled out response questionnaires for Smart Apps Creator- based learning media from class XI Science at SMAN 6 Tambun.

The small-scale trial results of the student response questionnaire from three aspects, namely learning design, were 91.5%, operations were 88%, and visual communication was 92%. The results of small-scale trial data are a reference for improving interactive learning media based on Smart Apps Creator. The average assessment result in small-scale trials is 90.5%. It can be concluded that this interactive learning media based on Smart Apps Creator is interesting for students to use in the learning process. In line with research by Zulaiha et al. (2021) regarding the analysis of student response questionnaires on learning media, the results of student response questionnaires are in the good category for use in the learning process. According to Siboro et al. (2020) stated that this interactive learning media is effectively applied to physics subjects because it can improve student learning outcomes. This is also in line with Budyastomo (2020) research results which state that an Android-based application using Smart Apps Creator software which is applied to learning material using Android makes learning less boring and increases students' concentration when the teacher explains. The response results from this small-scale trial will be the basis for evaluating Smart Apps Creator-based interactive learning media.

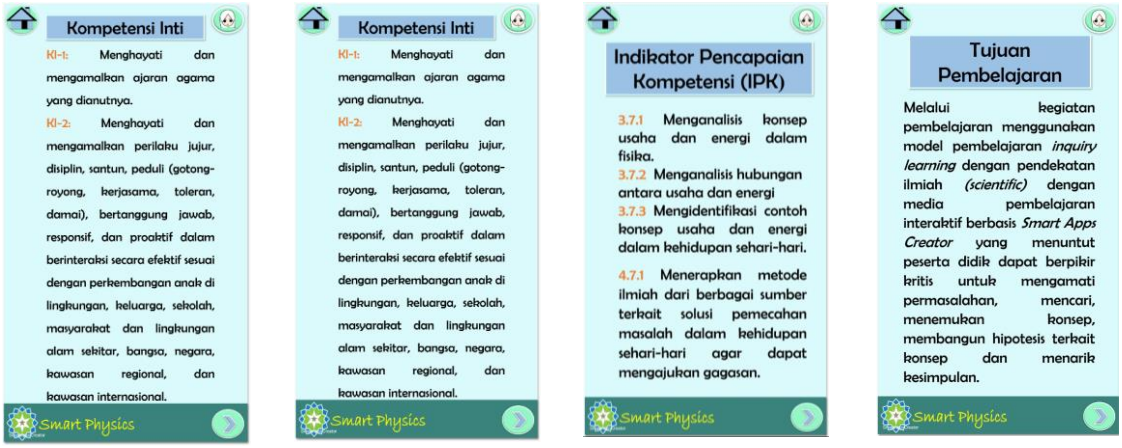
The final design revision of the instructional media is carried out after obtaining feedback and recommendations from experts and conducting small-scale trials. The design of interactive learning media based on Smart Apps Creator is shown in Fig. 1, Fig. 2, Fig. 3, and Fig. 4.

After undergoing expert validation and small-scale trials, this developed interactive learning media can engage students in the learning process, thus, it can be used in the learning process about work and energy. This learning media is one of the most effective and efficient learning media to be used in the learning process. Expert evaluation categorizes the quality of the Android-based physics learning media as excellent, while the trial with students is deemed good. Consequently, this learning media product is considered appropriate for classroom use in the learning process (Setya, 2018). Each phase within this platform serves as a valuable resource for mentoring STEM educators, alongside including a user profile functionality enabling the viewing of student profiles engaging with the learning process.



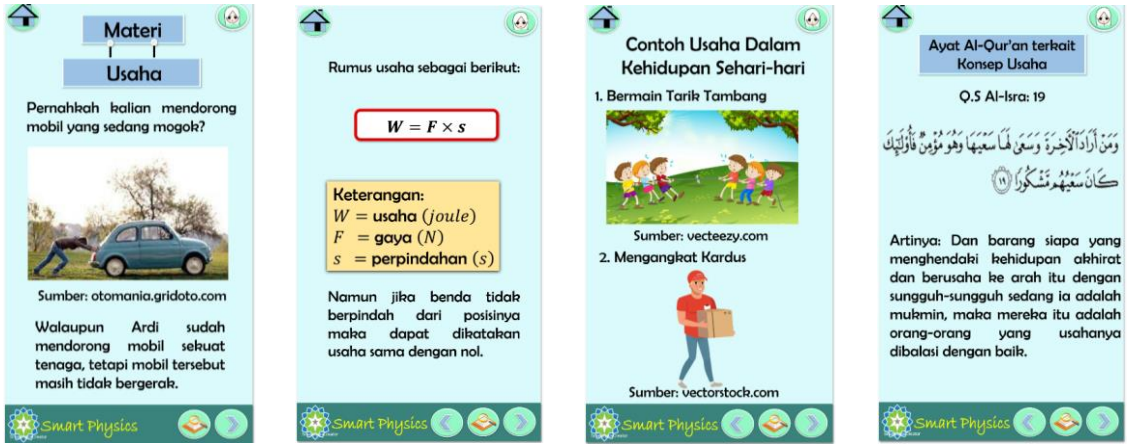
(a) (b) (c) (d)

Figure 1. Menu Display (a) Main Menu; (b) Material Menu; (c) Simulation Menu; and (d) Exercise Menu



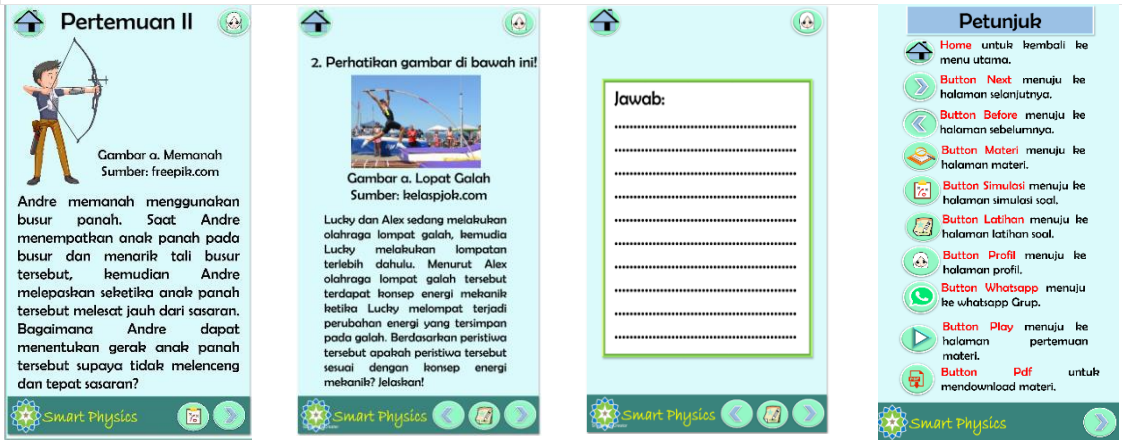
(a) (b) (c) (d)

Figure 2. Learning Components Display (a) Core Competency; (b) Basic Competency; (c) Competency Achievement Indicator; and (d) Learning Objectives



(a) (b) (c) (d)

Figure 3. Learning Material (a) Material Explanation; (b) Formula Explanation; (c) Everyday Life Examples; and (d) Al-Qur'an Verses Related to the Material



(a) (b) (c) (d)

Figure 4. Display (a) Simulation; (b) Exercise Questions; (c) Answering Questions; and (d) Instructions

The response questionnaire in large-scale trials is used to determine students' responses after using interactive learning media based on Smart Apps Creator in the learning process. This large-scale trial was conducted after completing the entire learning process on the topic of work and energy in class X Science at SMAN 6 Tambun. Response questionnaires were distributed to students via Google form after using interactive learning media based on Smart Apps Creator on business and energy material. 30 students filled out the response questionnaire, consisting of 11 people's statements, and covered three aspects as in small-scale trials. The maximum score for the instructional design aspect is 600, and the maximum score for the operational aspect is 450. The results of the response analysis are shown in Table 4.

Table 4. Results of questionnaire response analysis

Aspect	Score	Percentage (%)
Learning design		80.50
a. Ease of understanding the material using learning media	116	
b. Suitability of practice questions in the media with the material presented	125	
c. Independent learning of students with the help of the media	120	
d. Interest in learning with the help of media	122	
Operational		82.67
a. Ease of starting media	126	
b. Ease of navigation provided	123	
c. Availability and clarity of instructions for using the media	123	
Visual communication		81.83
a. The initial appearance of the media	109	
b. Use of fonts in the media that are easy to read	130	
c. Suitability of size, color and Image resolution in the media	127	
d. The language used in the media is easy to understand	125	
Average		81.67

Table 4 shows that the average of 81.67% is included in the category very interesting. It can be concluded that this interactive learning media based on Smart Apps Creator is very interesting to be used in the learning process by students with positive responses. Budyastomo (2020) stated that the Android-based application uses Smart Apps Creator software, which is implemented so that when learning using Android, learning becomes less boring and increases concentration when the teacher explains. This is in line with research conducted by Midroro et al. (2021) regarding the analysis of large-scale response questionnaire trials on students regarding learning media that are suitable for use in the learning process, thereby causing students to be more interested in studying physics subjects. Khasanah et al. (2021) stated that Smart Apps Creator media is flexible and interactive used in learning which can increase students' knowledge, understanding, and skills due to its attractive appearance.

Before carrying out learning, use interactive learning media based on Smart Apps Creator. Students carry out a test in the form of a pretest to determine students' initial abilities in the material on work and energy. Students' final abilities can be seen from the post-test scores at the end of the learning implementation process after 3 meetings. The implementation of learning using interactive learning media based on Smart Apps Creator which was obtained based on the results of the Observation Sheet filled in by the physics teacher as an observer can be seen in Table 5. Based on Table 5, the percentage of learning implementation at each meeting has increased. The average percentage of learning implementation at each meeting is 91% so the learning process in class using learning media is going very well. The increase in students' critical thinking skills on business and energy material using interactive learning media based on Smart Apps Creator can be seen using the pretest-posttest increase (N-gain) test. Analysis of the increase (N-gain) for each sub-material can be seen in Table 6.

Table 5. Implementation of learning

Meeting	Average Percentage (%)	Interpretation
First	80	Good
Second	92	Very good
Third	100	Very good
Average	91	Very good

Table 6. Assessment of the increase (N-gain) for each sub-material

Sub Material	Pretest	Posttest	N-gain (%)	Interpretation
Work	56.00	73,55	39,89	Currently
Energy	45.37	62,41	31,19	Currently
Law of conservation of energy	43.33	64,44	31,15	Currently
Average	48.23	66,8	34,08	Currently

The results of the increase test (N-gain) show an increase in pretest and posttest scores for each sub-material there is an increase from the pretest score to the posttest score. The overall pretest score was 48.23 and the post-test score was 66.8. This shows that the overall N-gain value is 34.08%, which means that students' critical thinking skills through interactive learning media based on Smart Apps Creator on business and energy material have increased critical thinking skills in the medium category. In the law of conservation of energy sub-material, the lowest N-gain value was 31.15%, which includes moderate interpretation. This is because most students are inaccurate in identifying terms from the concept of the law of conservation of energy. The business sub-material obtained the highest N-gain value of 39.89% which is included in the medium interpretation. This is because work material is easy to understand and apply in everyday life, so students more easily develop critical thinking skills to solve various problems. This is in line with research by Siregar et al. (2021) regarding the analysis of improvements in business and energy materials which obtained an N-gain value of 59%, including the medium category. The material is influenced by experience and applied in everyday life by students.

The analysis of the increase in critical thinking skill scores for each sub-indicator of critical thinking skills can be seen in Table 7 and analysis of the increase (N-gain) of critical thinking skills scores on each indicator Critical thinking skills can be seen in Table 8.

Table 7. Assessment of the improvement (N-gain) for each sub-indicator

Critical Thinking Skill Sub-Indicators	Pretest	Posttest	N-gain (%)	Interpretation
Focus on a question	37.78	52.22	23.21	Low
Analyze argument	65.56	72.22	19.34	Low
Ask clarifying question	40.00	73.33	55.55	Medium
Judge the credibility of a source	76.67	86.67	42.86	Medium
Judge observation reports	32.22	51.11	27.87	Low
Judge deduction by comparing different and judging the truth of a conclusion	37.78	47.78	16.07	Low
Judge inductions	51.11	71.11	40.91	Medium
Make judgments about values	51.11	66.67	31.83	Medium
Judge definitions	43.33	64.44	37.25	Medium
Identify implicit and assumptions	60.00	83.33	58.33	Medium
Decide on an action. Interact with other	46.67	66.67	37.50	Medium
Identify rhetorical mechanisms and tactics	53.33	71.11	38.10	Medium

Based on the data obtained in Table 7, shows that the N-gain values for each sub-indicator of critical thinking skills have increased, as evidenced by the pretest and posttest scores. Based on the 12 sub-indicators of critical thinking skills, the sub-indicator "judge deduction by comparing different and judging the truth of a conclusion" obtained the lowest N-gain value of 16.07%, which falls into the low interpretation category. This is because students still have difficulty in deducing and considering the results of deductions in a given problem. In deducing and considering deductions, students are still unable to draw conclusions based on the understood material (Firdaus et al., 2019). The sub-indicator "Identify implicit and assumptions" obtained the highest N-gain value of 58.33%, which falls into the medium interpretation category. This is because students find it easy to identify assumptions in a problem. In identifying assumptions, students with a 5A thinking style can identify an element in a question by making good assumptions based on accurate and reliable information (Firdaus et al., 2019).

Table 8. Assessment of the increase (N-gain) of each indicator

Skill Indicator Critical thinking	Pretest	Posttest	N-gain (%)	Interpretation
Elementary clarifications	47.78	65.92	34.74	Currently
Basic support of an argument	54.45	68.89	31.71	Currently
Inferences	46.67	61.85	28.48	Currently
Advanced clarification	51.67	73.89	45.97	Currently
Strategies and tactics	50.00	68.89	37.78	Currently

Based on the data obtained in Table 8 above, it shows that the N-gain value for each indicator of critical thinking skills can be seen that each indicator has increased with a medium interpretation except for Inferences which is included in the low interpretation. The N-gain results on the inferences indicator which obtained the lowest percentage of 28.48% included low interpretation because students were still less trained in concluding a given problem. This low concluding indicator shows that there is a lack of explanation to conclude a statement (Hunaepi et al., 2020).

The advanced clarification indicator which obtained the highest percentage of 45.97% includes a medium interpretation. This can be seen by students easily answering questions on the advanced clarification indicator by providing further explanations based on concepts from clear reference sources. Indicators that provide further explanation provide increased results because students are trained to be used to solving problems that must be linked to concepts and can provide further explanation of the information obtained (Yuliana et al., 2021).

The normality test used is chi-square because the sample size consists of 30 students, determining afterward compared with. The chi-square normality test using Microsoft Excel software was obtained on pretest data with the result $\chi_{calculate}$ (1.4410) < χ_{table} (9.4877), indicating that the pretest data on critical thinking skills in the subject of work and energy are normally distributed. Posttest data with $\chi_{calculate}$ (2.0009) < χ_{table} (9.4877), indicate that the posttest data on critical thinking skills in the subject of work and energy are normally distributed. After the normality test is conducted with the result of normally distributed data, hypothesis testing is carried out using a t-test. The data is processed and obtained with the result $t_{calculate}$ (8.7519) < t_{table} (1.7011), indicating that the data are accepted and rejected. The hypothesis results indicate that there is a difference in learning using interactive learning media based on Smart Apps Creator to enhance students' critical thinking skills in the subject of work and energy in class X IPA 4 at SMAN 6 Tambun.

Conclusions

The development of interactive learning media based on Smart Apps Creator can be used to improve students' critical thinking skills. Based on the assessment results from experts, the average percentage average 87% with a very valid interpretation. Implementation of learning during three meetings obtained an average percentage of 91% with excellent interpretation good. Based on the overall gain (N-gain) test obtained students with an average percentage result of 34.93% included moderate interpretation. Based on the student response questionnaire, responses were obtained positively with an average percentage of 81.67% including very interesting interpretations. The hypothesis results indicate that there is a difference in learning using interactive learning media based on Smart Apps Creator to enhance students' critical thinking skills in the subject of work and energy in class X IPA 4 at SMAN 6 Tambun.

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