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DEVELOPMENT OF VIDEO-ASSISTED WORK AND ENERGY LEARNING TOOLS BY BLENDED-FLIPPED CLASSROOM MODEL TO IMPROVE STUDENTS CREATIVE THINKING SKILLS

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Abstract: This study aims to produce a product in the form of work and energy learning tools by a blended-flipped classroom model. The product is assisted by a feasible, practical, and effective video to improve students' creative thinking skills. The developed products are Lesson Plans, Student Worksheets, learning videos, and creative thinking skills test instruments. The type of research used is research and development using the Dick, Carey, & Carey model. The stages of this research are analysis of needs and objectives, analysis of learning, analysis of students, formulating performance goals, developing instruments, developing learning strategies, developing learning materials, conducting formative evaluations, and revisions. The research subjects were three Physics Education University of Mataram lecturers and a physics teacher at senior high school SMA-IT Abu Hurairah Mataram as validators and 32 students of grade tenth as field trial subjects. The instruments used include validation sheets, observation sheets of learning implementation, student response questionnaires to implement learning, and creative thinking skills tests. The feasibility of learning tools is obtained from expert and practitioner validators' average validity value and percentage of agreement (PA). The device's practicality is obtained from the IJA percentage and positive student response related to the implementation of learning. The effectiveness of learning devices is obtained from the increasing students' pretest and posttest scores, which are analyzed using the N-Gain test. The analysis results show that the instrument is valid, with an average validity score in the very good and reliable category, with a mean PA score of more than 75%. The level of implementation of learning is 100% in the very good criteria, and the student responses showed a positive percentage of 81% in the very practical category. The average result of the N-Gain of students' creative thinking skills is 0.41 in the moderate category. In conclusion, the work and energy learning tools of the blended-flipped classroom model assisted by a video are feasible, practical, and effective in improving students' creative thinking skills.

Keywords: *Development of Learning Tools, Blended-Flipped Classroom Model, Creative Thinking Skills*.

INTRODUCTION

The global society today and in the next few years is in the life of the 21st century, where information is available, and communication can occur anywhere and anytime. The development of science and technology in the 21st century provides new challenges in the world of education to produce quality human resources in the era of global competition. There are several competencies to fulfill 21st-century skills, including creativity, critical thinking, creativity, collaboration, and communication skills, which are referred to as 4C [1].

Creativity is a continuous process that refers to one's ability to process information and produce something new and original. Creative thinking not only looks at the ability to solve problems but identifies how someone finds alternatives to solve a problem. These alternatives require discovering new ideas and details of knowledge that can build someone's ability to overcome an issue [2]. The ability to think creatively, especially creatively in the context of problem-solving, is very much needed in this complex and dynamic era of globalization [3]. Creative thinking skills are needed because they are demanded in the working world [4]. Every profession has its problems that must be solved. Without creative thinking skills, someone tends to use outdated solutions to solve problems, even though sometimes the solutions offered are not following the situation and conditions [5].

Adequate creative thinking skills are expected to be achieved by students through the learning process in the classroom. It is because students who have good creative thinking skills are likely to be able to study problems systematically, face millions of challenges in an organized way, formulate innovative questions, and design solutions that are considered relatively new [6]. The teacher must prepare learning tools before learning as a guide for teachers to organize learning properly. For this reason, learning tools are needed to develop students' creative thinking skills.

Based on observations made at a high school in Mataram, senior high school SMA-IT Abu Hurairah, students' creative thinking skills are still very low. Several things cause the low creative thinking skills of these students. First, the teacher still emphasizes the learning process of understanding concepts rather than developing students' thinking skills and competencies. Second, teachers and students still think that the learning process is teacher-centered and dominated by the traditional teaching method, so

they are not accustomed to carrying out student-centered learning activities. Another factor is teachers' limited time and ability to prepare learning tools and assessment instruments to improve creative thinking skills. As a result, as a fourth factor, the teacher only gives questions whose solutions are directly based on existing physic formulas (close-ended questions).

The preparation of learning tools must be adjusted to the learning model used. One learning model that follows the current development of digital technology and can facilitate an intensive learning process in acquiring knowledge and creative thinking skills is the Blended Learning model. Blended learning is a learning program that blends traditional in-class and e-learning components [7]. Blended learning has been shown to improve critical and creative thinking [8] and increase students' motivation in learning [9].

One type of blended learning model is the flipped classroom [10]. The basic concept of the flipped classroom is that traditional learning activities in the form of delivering material by teachers are carried out at home (outside formal class). Meanwhile, formal class is used to do collaborative and interactive activities [11]. With this model, students learn through a learning video at home or before coming to class. At the same time, classroom activities are mostly used for group discussions in solving problems, advancing concepts, engaging in collaborative learning, and Q&A.

The benefit of the flipped classroom is that it creates active, creative, and responsible learning. Flipped classrooms allow students to learn at their own pace, encouraging students to be actively involved with the learning material and freeing up time in class for more effective, creative, and active learning. Teachers have full opportunities to interact and evaluate student learning, while students take control and responsibility for their learning process [12]. In a flipped classroom, video is an audiovisual medium often used as input for independent study because it is exciting and allows students to re-watch content as needed [13]. Video overcomes space and time because it is accessible anytime and anywhere [14-15].

Based on these descriptions, researchers are interested in developing learning tools using a video-assisted blended flipped classroom model to improve students' creative thinking skills. In development research, the product needs to have quality criteria, namely validity, practicality, and effectiveness [16]. This research aims to produce a work and energy learning tool with a video-assisted blended-flipped classroom model that is feasible, practical, and effective in improving students' creative thinking skills. The learning tools developed in this study were lesson plans, student worksheets, learning videos, and creative thinking skills test instruments.

RESEARCH METHODS

The type of research conducted is research and development (R&D). Educational research and development are based on a development model whose findings are used to design products and procedures, which are then systematically field tested, evaluated, and refined to meet certain criteria of effectiveness, quality, and standards [17]. The design used in this study is the Dick, Carey, & Carey model, which consists of several stages, namely: (1) identify instructional goal; (2) conduct instructional analysis; (3) analyze learners; (4) write performance objectives; (5) develop instruments; (6) develop instructional strategy; (7) develop and select instructional materials; (8) design and conduct formative evaluation; and (9) revise [18].

The research subjects were three lecturers of the Physics Education Department as expert validators, 1 Physics Teacher as practitioner validator, and 32 students of class X MIA 2 at SMA-IT Abu Hurairah Mataram in the 2021/2022 academic year as field trial subjects. The types of data in this study are quantitative and qualitative data. Quantitative data were obtained from the results of validation by the validator using a Likert scale of 1-4, the results of observations of the lesson plan implementation, the results of students' responses to learning, as well as the results of the pretest and post-test of students' creative thinking skills. Qualitative data were obtained from expert validators' and practitioners' suggestions and comments on the learning tools.

The validity of the learning tools by blended- flipped classroom model was analyzed using the following equation:

$$\text{score} = \frac{\Sigma \text{ score on instrument}}{\Sigma \text{ maximum score}} \times 4$$

Four of the validators' average assessment scores were then converted to the learning tools' validity criteria in Table 1 [19].

Table 1. Criteria of learning tools' validity

Average Score	Criteria
3.26 – 4.00	Very good
2.51 – 3.25	Good
1.76 – 2.50	Good enough
1.01 – 1.75	Not good

The reliability of learning tools is determined using the Borich method, known as the Percentage of Agreement.

$$\text{PA} = \left[1 - \frac{\text{A} - \text{B}}{\text{A} + \text{B}}\right] \times 100\%$$

with,
A =higher validator score
B =lower validator score
The learning tools are reliable if they have a coefficient of ≥75% [20].

Analysis of the implementation of learning and student response questionnaires to the learning process was used to determine the practicality of learning tools. The study of the implementation of learning is carried out by calculating the Interjudge Agreement (IJA) from the observer's score on the observation sheet [21], which is formulated as follows.

$$\text{IJA} = \frac{A_Y}{A_Y + A_N} \times 100\%$$

with,
A_Y = activities carried out
A_N = activities that are not carried out
The percentage of implementation is then converted into qualitative data using the criteria in Table 2 [22].

Table 2. Practicality criteria

Intervals (%)	Criteria
IJA $>$ 63	Very good
51 $<$ IJA $\leq$ 63	Good
39 $<$ IJA $\leq$ 51	Pretty good
27 $<$ IJA $\leq$ 39	Not good
IJA $\leq$ 27	Very less

Student responses were analyzed by calculating the percentage of practicality as follows.

$$\%\ \text{Practicality} = \frac{\text{total score from rater}}{\text{total maximum score}} \times 100\%$$

The practicality percentage value is then interpreted based on the student response criteria in Table 3 below [23].

Table 3. Student response criteria

Value Range (%)	Category
81 $<$ score $\leq$ 100	Very Practical
61 $<$ score $\leq$ 80	Practical
41 $<$ score $\leq$ 60	Practical enough
21 $<$ score $\leq$ 40	Less Practical
0 $<$ score $\leq$ 20	Not Practical

The effectiveness of the learning tools is obtained from increasing students' creative thinking skills, which are analyzed by the N-Gain test. The equation that meets the standard gain is:

$$\text{Std } < g > = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}}$$

The n-Gain score is then interpreted into the student's creative thinking skills category based on Table 4 [24].

Table 4. Interpretation of n-gain index

N-Gain score (g)	Category
0.70 $<$ g $<$ 1.00	High
0.30 $<$ g $<$ 0.70	Medium
0.00 $<$ g $<$ 0.30	Low

RESULTS AND DISCUSSION

Identify Instructional Goal(s)

The study begins by analyzing the needs of high school physics teachers through observation which is then used as the basis for developing learning tools. Researchers also examine the phenomena and challenges of 21st-century life on students' need for higher learning achievement. Based on observations, it was found that the learning process was still dominant using a teacher-centered approach. Teachers still emphasize the learning process on understanding concepts rather than developing students' thinking skills and competencies. Limited time in developing learning tools and assessment instruments oriented to improving creative thinking skills causes teachers not to facilitate students to solve real-world problems creatively as an effort to improve students' creative thinking skills. Another obstacle experienced by teachers is the amount of physics topic/material that must be delivered with limited lesson time.

Conduct Instructional Analysis

According to the curriculum, the instructional analysis identifies the main skills needed in the learning process. Based on the results of conducting instructional analysis, researchers identified main competence 3.9 in the Work and Energy topic, which refers to the Permendikbud No. 37 Tahun 2018.

Analyze Learners

Learners analysis was carried out by studying the characteristics of the field trial subject, 32 students of class X MIA 2 at SMA-IT Abu Hurairah Mataram, in the 2021/2022 academic year. This analysis includes the students' cognitive development and creative thinking skills. The various characteristics of these students are known through interviews with their physics teachers regarding the activities and responses of students during physics class.

Based on interviews, it was found that, on average, 32 students of class X MIA 2 were 15-16 years old. According to Piaget's theory of cognitive development, it is in the formal operational stage. The characteristics of children's cognitive development at this stage are abstract thinking, deductive reasoning, solving problems logically using certain methods, and the ability to make certain hypotheses. In addition, based on interviews with teachers, it was found that we're in a low category for students' creative thinking skills, especially in solving physics problems. It is because students are not accustomed to answering open-ended questions. Students also get bored quickly during physics class because of the lack of exciting learning media. The results of this analysis become the

basis for consideration in developing the learning tools.

Write Performance Objectives

Researchers translate Kompetensi Dasar (KD) 3.9 and 4.9 into specific and operational goals as indicators of competency achievement and learning objectives.

Develop Instruments

In this stage, researchers develop research instruments. The instrument, in this case, is related to the operational learning objectives and the product developed. Instruments related to learning objectives are learning outcomes tests, while instruments related to the developed devices are questionnaires, validation sheets, and observation sheets.

The learning outcome test instrument that was developed was a test to measure students' creative thinking skills in solving problems on Work and Energy topic as many as four essay questions based on creative thinking skills aspects. The aspects in question include fluency, flexibility, originality, and elaboration. Instruments related to the product developed were a validation sheet for learning tools, an observation sheet for the implementation of learning, and a questionnaire on student responses to the learning process.

Develop Instructional Strategies

This stage involves selecting the format and determining the appropriate learning strategies or procedures for students to achieve optimal learning objectives. The learning strategy in question is selecting approaches, models, methods, media/tools and materials, learning resources, and learning activities to achieve learning objectives optimally. The researcher developed the Work and Energy topic lesson plans in this case. The lesson plan development refers to the format following Permendikbud No. 22 Tahun 2016.

Develop Instructional Materials

At this stage, the researchers developed media in the form of learning videos for before-class sessions and Student Worksheets for face-to-face sessions previously planned. The learning videos were developed to consist of the introduction part (opening and delivering the learning objectives), the main part (presentation of the material), and the final part (summary, problem example, and closing). After being developed, the video is uploaded to YouTube so students can easily access it. Student worksheets consist of cover, column names of group members, basic competencies, learning objectives, instructions, introduction, theory, steps/experimental procedures, results, discussions, conclusions, and practice questions that support students' creative thinking skills.

Conduct Formative Evaluation

Formative evaluation is the researcher's process of obtaining information or data while the product is developed. Its emphasis is on the collection and analysis of data and the revision of the instruction. At this stage, the researcher analyzed the developed learning tools' feasibility, practicality, and effectiveness.

Feasibility of Learning Tools

The feasibility of the learning tools is determined based on the assessment of the validity and reliability of the device through a validation process. Based on the analysis results, the four validators' average score of the validity of the learning tools is obtained in Table 5 below.

Table 5. Average learning tools' validity score

Learning Tools	Average Score	Category
Lesson Plans	3.4	Very good
Student Worksheets	3.5	Very good
Learning videos	3.6	Very good
Creative Thinking Skills Test Instruments	3.6	Very good

Based on Table 5, the average validity score of each component of the learning tools in the form of lesson plans, student worksheets, learning videos, and creative thinking skills test instruments is in the very good category.

The Percentage of Agreement (PA) value for each learning tool is determined based on the average value of the combination of three expert validators and one practitioner validator. The analysis results show the average PA of the learning tools is obtained in Table 6.

Based on the calculation of the Percentage of Agreement, each component of the learning device has a PA value of more than 75% and is reliable. Based on the average validity and reliability scores, it can be concluded that the learning tools developed are suitable for use in learning.

The practicality of Learning Tools

The practicality of the learning tools that have been developed refers to the results of observations of the learning implementation and the student responses to questionnaires. The results of observations on the learning implementation at meetings I, II, and III conducted by observers to determine the product's practicality are shown in Table 7 below.

Table 7 shows the average IJA score for each meeting is above 63%, so the practicality of the learning tools is categorized as very good.

The results of students' responses to the learning process on the Work and Energy topic with a blended-flipped classroom model using the learning tools that have been developed are summarized in Table 8.

Table 6. Average learning tools' PA score

Learning tools	PA (%)	Category
Lesson Plans	92.9	Reliable
Student Worksheets	91.4	Reliable
Learning Videos	93.2	Reliable
Creative Thinking Skills Test Instruments	91.7	Reliable

Table 7. Implementation of learning activities

Meeting	A_Y	A_N	IJA (%)	Category
I	26	-	100	Very good
II	26	-	100	Very good
III	26	-	100	Very good
Average			100	Very good

Table 8. Results of student responses to learning

No	Statement	I Agree	I Don't agree
1	The general description that the teacher explained at the beginning of the lesson helped me to know the outline of the material and the learning objectives achieved	100%	-
2	With the material provided before class starts, the learning time in class becomes more efficient	79%	21%
3	After the learning process, I am more proficient in translating Physics problems and solving them	57%	43%
4	Teacher-centered learning encourages me to play an active role in class and practice my creative thinking skills in solving Physics problems	89%	11%
5	Through teacher-centered learning, exploration and elaboration of the Work and Energy topic becomes wider and deeper	86%	14%
6	The learning model facilitated by the teacher is a new thing for me	82%	18%
7	I am interested in participating in the next learning activity like the one I took today	82%	18%
8	Delivery of material through learning videos helps me understand the physics topics that I study more deeply	61%	39%
9	The language used in the learning videos is easy to understand	79%	21%
10	I'm interested in the display (writing, illustrations, pictures, and animations) in learning videos	96%	4%
11	With the help of learning videos, the learning process becomes more fun	64%	36%
12	The language used in the Student Worksheet (LKPD) is easy to understand	82%	18%
13	The display (writing, illustrations, pictures, and animations) on the Student Worksheet (LKPD) is interactive to me	96%	4%
14	The Student Worksheet (LKPD) makes it easier for me to learn	82%	18%
Response Percentage		81%	19%
Criteria		Very Practical	

The percentage response analysis showed that 81% of students, on average, responded positively to implementing the learning tools. This value is in the very practical category.

Students' responses stated that learning with the blended model of flipped classroom encouraged them to play an active role in class and practice creative thinking skills. Learning time becomes more efficient with the material provided via video before class starts, and the exploration and elaboration process on work and energy topics becomes wider and deeper. The students'

response stated that the learning model was new, and they were interested in learning physics with the learning tools that had been developed. With the learning video, approximately 60% of students stated that the learning process was fun and that understanding the topic became more in-depth. However, some students suggested that the topic be explained briefly after watching the video to understand the topic better. With the student worksheet given in the face-to-face session, as many as 82% of students stated that the topic became easier to understand.

Based on the average IJA and the percentage of positive student responses to implementing the blended-flipped classroom model, it can be concluded that the learning tools developed are very practical to use in learning.

Effectiveness of Learning Tools

Based on the results of the pretest and posttest, it was found that the increase in students' creative thinking skills was in the medium category, with an N-Gain score of 0.41. The acquisition of N-Gain for each aspect of students' creative thinking skills can be seen in Table 9.

Table 9. N-Gain category

Aspects of Creative Thinking Skills	N-Gain Value	Average N-Gain	Category
Fluency	0.91	0.41	Medium
Flexibility	0.27		
Originality	0.13		
Elaboration	0.40		

Based on the N-Gain score obtained, the developed video-assisted learning tools by the blended-flipped classroom model were effectively used to improve creative thinking skills. There is an increase in the four aspects of students' creative thinking skills. These results are supported by research stating that learning with a blended-flipped classroom model can improve students' creative thinking skills and innovation [25] [26].

Revise

The analysis results show that the video-assisted work and energy learning tools used by the blended-flipped classroom model developed in this study are feasible. Still, each product component needs to be revised based on input from experts, teachers, and students. This stage aims to produce a revised draft of learning tools based on expert input and data obtained from field trials.

CONCLUSIONS

The blended-flipped classroom model developed by video-assisted work and energy learning tools is feasible, practical, and effective in improving students' creative thinking skills. It is based on the acquisition of the average validity score of each component of the learning tools, which is in the very good category and the average PA score is more than 75% in the reliable category. The IJA value for implementing learning is 100% in the very good category, and the percentage of students' positive responses to implementing learning tools is 81% in the very practical category. The N-Gain of students' creative thinking skills is 0.41 in the medium category.

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