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Effectiveness of Implementing the Friction Box Teaching Aids on Students Sciences Process Skills

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Abstract: This research was conducted to determine the effectiveness of the implementation of the friction force box teaching aid on students' science process skills. The research subjects were class X students of MA Miftahul Ulum Bettet Pamekasan. This type of research is experimental research with the one group pretest-posttest design method. Increasing students' science skills (KPS) can be analyzed using the normal gain test, which is equal to 0.55 in the moderate category. This shows that the friction force box teaching aid can improve students' KPS. In addition, an analysis of student responses was carried out in using the friction style box teaching aid which showed that the teaching aid was very suitable for use in the learning process.

Keywords: Effectiveness; Students sciences process skills; The friction box

Introduction

The essence of physics is physics as a product, physics as a process and physics as an attitude. Physics as a product is a collection of knowledge in the form of facts, concepts, principles, laws, formulas, theories and models. Physics as a process, in this case is closely related to phenomena, conjectures, observations, measurements, investigations and publications so that it should be successful in developing students' scientific process skills. With this ability will train the students to do everything based on scientific procedures (Arrohman et al., 2021). Physics as an attitude is a scientific attitude consisting of an attitude of curiosity, care, responsibility, honesty, openness and collaboration. This attitude emerges after carrying out observation, measurement and investigation activities which require mental processes and attitudes that originate from thinking (Murdani, 2020).

Learning physics as a process should be able to develop science process skills in students. Science process skills (KPS) are scientific steps that can train students to discover something through experiments or practicums (Riyadi et al., 2018). Sciences process skills are the basis of scientific inquiry and intellectual development for learning science concepts, develop concept, developing facts, and develop a sense of responsibility so many efforts to improve science process skills, there are learning using STEM student worksheets through floor cleaning formulations (Maulana et al., 2023), Inquiry-based learning models (Panjaitan et al., 2020), application of inquiry-based learning modules (Yusra et al., 2021), by practice at basic electronic practicum (Ikbal et al., 2022), blended learning strategy in plant tissue culture course (Harahap et al., 2019), inquiry-based teaching material that integrates local resource (Damopolii et al., 2019), inquiry-based flipped classroom model (Tan et al., 2020), guided inquiry model through virtual laboratory (Gunawan et al., 2019), multimedia physics practicum reflective material based on problem solving (Kurniawan et al., 2019), The virtual lab-assistes guided discovery learning model (Azhar et al., 2023), practical video demonstration for Photosynthetic Materials (Arrohman et al., 2021).

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According to Frans in Collette et al. (1994), aspects that can be developed in KPS are observation, collecting data, developing hypothesis, experimenting and concluding. Meanwhile, according to Sutrisno, the types of process skills are observing, classifying, taking measurements, asking questions, formulating hypotheses, experiments, and interpreting information (Murdani, 2020).

The important things that the students can understand how scientific knowledge is constructed and the progress of science and processes in science is using KPS (Yapıcıoğlu, 2021). Below are presented the indicators for each aspects of the science process skills (KPS).

Table 1. The Indicators for Each Aspects of the Science Process Skills

The Science Process Skills	Indicators
Observation	1. Use appropriate sensory tools 2. Give an explanation of what was observed 3. Choose the appropriate form of observation 4. Note similarities, differences, regularities 5. Make observations within a certain period 6. Note exceptions/or unexpected things that explain a pattern 7. Identify (identify according to a certain pattern)
Classifying/Categorization/Series	1. Give a sequence to the events that occur 2. Look for similarities and differences 3. Determine grouping criteria 4. placing them in certain groups based on criteria 5. choose (separate by a certain number of groups) 6. grouping based on certain characteristics found in observations 7. separate in various ways
Measuring/Taking Measurements	1. Choose an appropriate money measuring instrument 2. Estimate more precisely 3. Use measuring instruments with certain precision 4. Find measurement uncertainty
Asking question	1. Ask as many questions as possible 2. Identify questions that can be answered by scientific discovery 3. change the question into a form that can be answered by experiment 4. formulate questions based on hypotheses (answers can be proven)
Formulate a Hypothesis	1. try to explain observations in terms of concepts and principles 2. be aware of the fact that there are several possibilities to explain a symptom 3. use explanations to make predictions from what can be observed or proven.
Experiments	1. formulate the problem 2. Identify control variables 3. compare the independent variable and the dependent variable 4. Design a way to make observations to solve problems.
Interpreting Information	1. draw conclusions 2. using a key or classification 3. realize that conclusions are tentative 4. generalize 5. make and seek justification for temporary conclusions 6. make predictions based on certain patterns or benchmarks
Communicate	1. follow the verbal explanation 2. explain the activity orally; using diagrams 3. use tables, graphs, models, etc., to present information 4. choose the most appropriate way to present information 5. appreciate the differences in the audience; and choose the right method 6. listen to reports, respond and provide suggestions 7. Contribute suggestions to discussion groups 8. use indirect sources to obtain information 9. use appropriate information technology.

The use of theaching aids in schools is very minimal due to the lack of teaching aids. In this research, a friction box prop was implemented in the learning process to improve students' science process skills at one of the MA in Pamekasan. A friction box prop is made in portable form in order to easy, practice and effective to carry to the class. The tool is equipped with an arc for measuring the slope of inclined planes and boxes with layers of different levels of roughness.

In the previous experiment has been developed physics properties on frictional materials have been developed ultrasonic sensor based but the sensor devices cannot be used because it is less accurate (Kurniawan et al., 2018), video tracking-based practicum guide product (Astro et al., 2021).

A teaching aids is a tool that is usually not in the form of a set, if used it can make it easier to understand a concept indirectly (Jamzuri, 2021). According Wijaya et al. the types of teaching aids can be classified into several parts, namely: drawings, sketches, images projected with an Opaque Projector, diagrams, charts, original objects, models, examples or specimens, simple imitations tools or mock ups, dioramas, and exhibitions (Juwairiah, 2013).

The benefits of teaching aids for students are: student learning motivation is higher because learning activities are more interesting and not boring, students activities are more comprehensive and more active because they can be done in various ways such as observing, asking or interviewing, proving or demonstrating, testing facts, etc., students can understand and appreciate aspects of life in their environment so that they can form a person who is familiar with the life around them, can provide selective examples, can stimulate analytical thinking, and can create a learning situation that is free from burden or pressure (Juwairiah, 2013).

Besides that, there are benefits to using teaching aids for teachers, including: they can provide guidance in formulating learning objectives, they can provide systematic teaching, they can facilitate lesson control, they can help with accuracy and thoroughness in presentation, can raise self-confidence in teaching, can improve the quality of teaching (Juwairiah, 2013).

Apart from that, teaching aids can develop students skill. The props used in this research are real object props in the shape of a box which were made to make it easier for students to understand the concept of frictional force. With this tool, it is hoped that it will be able to stimulate students' thoughts, feelings, attention and interest during the teaching and learning process. Learning with teaching aids means optimizing the function of all students' five senses to increase the effectiveness of learning by hearing, seeing, feeling and using their minds logically and realistically (Dewi et al., 2019).

A visual aid is an object that can be used as a support for physical science activities. Theaching aids can be designed by the teacher using readily available materials. There was activity to assisted the physics teacher making teaching aids in Pasaman Barat Regency to support Physics learning as an merdeka curriculum implementation (Mairizwan et al., 2022).

There are some example of experiment that using teaching aids can improve the student's ability and student's interest. The video tracking based practicum guide product is effective to increase students interest in the frictional force material (Astro et al., 2021), Picture and picture application integrated with Guided Note Taking (GNT) through the optimization of teaching aids utilization affects biology learning achievement in cognitive, affective, and psychomotor domains (Khasanah et al., 2022), utilize standing wave resonance tube teaching aids helps the students understand the concept of standing waves materials (Mirza et al., 2022), implementation IoT-based media using the STEM-based ISLE model can improve student learning outcomes in the learning process (Hamid et al., 2022), the development of current stick teaching aid is effective to improve students Generic Science Skills (Khoiri et al., 2021), Physics teaching media using speed sensors as speed analysis in real-time based on arduino can increase the ability of problem solving by 2.2 % (Pratiwi et al., 2020), simple light diffraction props assisted by tracker application with camera module and arduino UNO can increase students science process skills (Wijaya et al., 2022).

Besides that, Archimedes Law Material E-Module on Motion Systems can improve students concept understanding (Yanarti et al., 2022), Video-Assisted Multi-Representation Approach Learning Tools can improve students critical thinking ability (Rahman et al., 2021), microcontroller-based experimental sets can improve the quality of learning in schools (Qomariyah et al., 2020), the teaching aids for children with disabilities as a mathematical-thinking-imaginative product can achieve joyfull learning (Sugiman et al., 2020), the science KIT teaching aids for earthquakes science can improving students collaboration and creative thinking (Atun et al., 2021).

Method

This research is experimental research in the form of pre-experimental research in the form of a one group pretest-posttest design which is depicted in Figure 1.

Figure 1. This type of experimental research is in the form of one-group pretest-posttest design

Information: O_1 is an initial test, to determine the student's KPS level before treatment; X is learning with friction box props; O_1 is the final test, to determine the student's KPS level after treatment (Rahayu et al., 2022).

This research was conducted at MA Miftahul Ulum Bettet Pamekasan in class X MIPA B with 26 students. The research instruments were pretest posttest questions and student response questionnaires. The pretest-posttest questions were made in the form of 18 multiple choice questions with 5 KPS indicators, namely: observing, classifying, asking questions, formulating hypotheses, communicating. These questions are used to determine the increase in student KPS. Meanwhile, the student response questionnaire was used to find out students' opinions regarding the friction box props, including the function, appearance and interest in the friction box props. Figure 2 shows the friction force box prop used in this research.

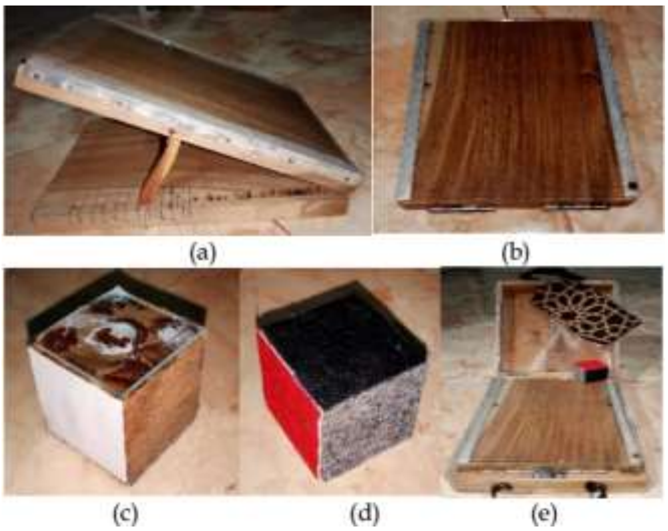

Figure 2. Friction box props (a) side view, (b) top view (c) blocks with layers of wood, glass and paper, (d) blocks with different layers of fabric, (e) props storage box

The effectiveness of using teaching aids on student's KPS can be seen from the knowledge (cognitive) aspect. The increase in student learning outcomes in the cognitive aspect can be analyzed using the normal gain test. Gain is the difference between the pretest score and the posttest score, while normal gain is a test used when you want to know the results of the improvement that has occurred. The normal gain equation is as follows:

$$< g \geq \frac{S_{post} - S_{pre}}{S_{m\ ideal} - S_{pre}} \quad (1)$$

Information:
g : normalized mean gain score
S_{post} : Average final test score obtained by students
S_{pre}: Average initial test score obtained by students
$S_{m\ ideal}$: Ideal maximum score
Then the gain test results are categorized in a table regarding gain categories as follows:

Table 2. Interpretation of Normalized Gain Score (Hake, 1999)

N-Gain Score	Categories
g > 0.70	High
0.30 < g < 0.70	Medium
0.00 ≤ 0.30	Low

In addition, an analysis of student response questionnaires was carried out regarding the effectiveness of the friction box props. The student response questionnaire contains 5 questions based on a Likert scale. The following is presented in Table 3 regarding scoring of student response questionnaires.

Table 3. Questionnaire Scoring

Information	Score
Very good (SB)	5
Good (B)	4
Pretty good (C)	3
Not good (K)	2
Very not good (SK)	1

The results of the student response questionnaire will be analyzed using the following formula:

$$p = \frac{f}{N} \times 100\% \quad (2)$$

Information:
p = percentage number in the questionnaire data
f = total score that has been obtained
N = maximum number of scores
The results obtained will then be interpreted into categories based on the following table.

Table 4. Practicality Criteria

Evaluation	Interpretation Criteria
$81 < p < 100\%$	Very Practical
$61 < p < 81\%$	Practical
$41 < p < 61\%$	Quite Practical
$21 < p < 41\%$	Impractical
$0 < p < 21\%$	Very Impractical

The teaching aids developed can be said to be practical and effective if the media percentage reaches 61%.

Result and Discussion

The data obtained from this research are: average student pretest score, average student posttest score, and student response questionnaire regarding the effectiveness of the friction box props. The increase in results after applying the friction box props to students is shown in table 5.

In the pretest posttest questions, objective questions are used which contain indicators of students' science process skills (KPS), namely the skills of observing, grouping, formulating hypotheses, asking questions and communicating. The table above shows the average pretest score is 50.19 and the average posttest score is 72.30. This indicates an increase in the N-Gain value of 0.55 in the medium category. It can be concluded that the friction box teaching aid can improve students' science process skills (KPS). Based on the results of data analysis on students pretest answer sheets, it was found that the type of KPS that achieved the highest score was "observing". Observing is a basic ability that students have in the learning process, namely observing projects around them using appropriate sensory tools. In this case, students carry out observation activities and understand the image and types of questions in the KPS questions. Observation is the basic ability to identify the object being observed and combine experience with teory when making observations. So that, during the initial KPS assessment, "observation" obtained the highest percentage.

Table 5. N-Gain Results

	Pre-test	Post-Test
Average	50.19	72.30
N-Gain	0.55	
Category	Medium	

Meanwhile, the type of KPS with the lowest percentage is "asking questions". In this case, students are still not proficient in identifying questions that can be answered with scientific discoveries. Apart of that, students are not yet adept at formulating questions with a hypothetical background. The result of data analysis on students post-test answer sheets, it was found that type of KPS that achived the highest score was "classifying The results of data analysis on students' post-test answer sheets, it was found that the type of KPS that achieved the highest score was "classifying". In this case, students are able to separate or group data using equations in the friction material. Students are skilled in analyzing data using the friction force equation. This ability appears during learning activities using a friction box prop. So the skill of "classifying" becomes one of the supports for developing integrated skills.

In the data analysis of students' post-test scores, the lowest types of KPS were "asking questions" and "formulating hypotheses". However, both types of KPS experienced a significant increase when compared to the pretest scores. This shows that the skills of "asking questions" and "formulating hypotheses" develop during learning activities using the friction box props. Learning using a friction box can stimulate students' analytical thinking and create a carefree learning situation. Student learning activities are more comprehensive and more active so that student learning motivation is higher. Table 5 shows an average N-Gain of 0.55 in the medium category. This shows that the use of friction box teaching aids can improve students' science process skills in high school students. As support data, is showed an analysis of student response questionnaires based on the following table.

Table 6. Students Response Questionnaires

Aspect	Percentage	Information
Practicality	93%	Very practical and effective
Effectivity	85%	Very practical and effective
Subject matter	91%	Very practical and effective
Learning design	945	Very practical and effective

Table 6 show that the friction box teaching aid very practical and effective if used in learning. Besides that, the props can make study easier because teacher can teach friction lesson material easily. The students are more active and enthusiastic, think critically and analytically. They can practice about friction subject well.

Conclusion

The conclusion of this experiment is the friction box teaching aid can improve student's KPS that can be showed from N-Gain score 0.55 with categories medium. The results of data analysis on students' post-test answer sheets, it was found that the type of KPS that achieved the highest score was "classifying". Besides that, the friction box teaching aid very practical and effective if used in learning.

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Author Contributions
E.I.K wrote the article draft, revised and editet the draft article. A.B revised and edited the draft article. A.H that revised and edited the draft table.

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Conflicts of Interest
There is no conflict of interest.

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