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Practicality and Effectiveness of Activity-based Worksheets with the ExPRession Learning Model to Train Hands-on Activities on Newton's Law

Tria Anisa, Kartini Herlina*, and Viyanti
Physics Education, Faculty of Teacher Training and Education,
Universitas Lampung, Lampung, Indonesia
*kkartini.herlina@gmail.com

Abstract

This research aims to determine the practicality and effectiveness of worksheets based on the ExPRession learning model to train direct practical activities on Newton's laws. The samples are classes of X Science 4 and X Science 5 at SMAN 1 Gadingrejo in the 2022/2023 academic year. The research design uses the Pretest-Posttest Control Group Design. Applying worksheets with the ExPRession learning model in physics learning effectively trains students' activity skills. This is proven by the results of learning implementation using the ExPRession learning model, reaching 87.30%, and the assessment of students' Hands-on Activity, reaching 78.35%. The results of hypothesis testing also show a higher difference in students' practical activity skills between classes that apply worksheets based on the ExPRession learning model in physics learning. Based on the research results, it was found that implementing activity-based worksheets with the ExPRession learning model impacted training students' hands-on activity skills. This is because learning using various forms of representation can help students' understanding of concepts when solving physics problems. Students are more enthusiastic if the physics learning process is accompanied by simple, practical work. It was concluded that using worksheets based on the ExPRession learning model was effective for training students' hands-on activity skills.

Keywords: ExPRession learning model; hands-on activity skill; student worksheet

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INTRODUCTION

Physics is one of the subjects studied at almost all levels of education. Physics is a form of learning that helps us understand nature and use the knowledge learned concerning individual behaviour (Uki et al., 2017). Physics learning emphasizes student activities-based learning, including scientific thinking skills, laboratory activities, and technology-assisted learning that can equip students with material knowledge. In the learning process, students' activities involve not only their cognitive

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abilities but must consist of activities that require affective and psychomotor abilities (Hoque, 2016). So it will support students' systematic, objective and creative thinking abilities (Pratama & Istiyono, 2015).

Ateş & Eryilmaz (2011) found that the lecture approach associated with some textbooks makes students passive learners and ineffective in learning. Students become accustomed to receiving knowledge rather than producing it (McDermott, 1996). Renner et al. (1985) stated that learning this way does not discover physics concepts; they are only told about the products of physics itself. Abbas & Yusuf Hidayat (2018) also found that feeling bored when studying is one of the factors that influences students' results and the difficulty level in studying physics.

For the learning process in the classroom to be enjoyable and in accordance with the achievement of learning goals, it is necessary to have innovative teaching materials to overcome the saturation of students in learning physics. One teaching material educators use to support the physics learning process is student worksheets. Worksheets that are well designed can help students increase the acquisition of knowledge and skills in both the cognitive, affective, and psychomotor domains. Krombaß & Harms (2008) found that students aged 11-15 years felt helped by using worksheets when studying and were effective in acquiring knowledge during class.

Based on interview results with one of the physics educators at SMAN 1 Gadingrejo, it was found that students needed to be more enthusiastic about learning physics due to the lack of innovative teaching materials used by teachers, causing physics learning to be considered difficult by students. The activities of students in making direct observations and involving students in understanding problems through demonstration activities and simple practices need to be developed in class X Science. One of the activities that can involve students in understanding the problem based on their own experience is a hands-on activity. Lebuffe (1994) claim that students learn better when they can touch, feel, measure, manipulate, draw, record data, and find the answers themselves rather than being given answers in their textbooks.

In science learning, hands-on activity plays an important role in understanding the true meaning of scientific investigations carried out by students. Studies of literature show that hands-on activities help students understand physics concepts. Students who learn using hands-on activities are superior to students who take traditional text-based programs (Erti, 2017). Hands-on activities allow students to explore information, ask questions, analyze and provide their conclusions without being burdensome or boring (Gazibara, 2013). Hands-on activities involve children digging for information and asking questions, carrying out activities and discovering, collecting data analyzing, and making conclusions (Kartono, 2010).

Research conducted by Ikbal & Abdi (2021) shows that learning carried out to measure students' hands-on activity has not significantly influenced student learning outcomes. The need for teaching material in the form of a learning model activity can make it easier for educators to bring up the psychomotor domain to train students in hands-on activity. One learning model that can train students' hands-on activity skills in the physics learning process is the Expression learning model.

The ExPRession learning model aims to develop students' psychomotor abilities, both planning and problem-solving skills, and the ability to understand ill-structured and well-structured problems (Herlina, 2020). The model consists of five learning stages:

orientation, expression, investigation, evaluation, and generalization. Student activities designed in this model syntax are dominated by activities that train students to make multiple representations.

In this study, the concept of Newton's law was chosen because students revealed that they found it difficult to understand physics concepts and how to apply the concepts they had understood to solving physics problems (Docktor & Mestre, 2014). Difficulties often experienced by students during physics learning are when drawing free-body diagrams, representing forces, and determining the resultant force and direction of the object's motion (Supeno et al., 2018). Students memorize without understanding the concept's meaning (Sari et al., 2018). Students who are specialized in using multiple representations show better learning outcomes compared to students who do not use multiple representations to solve physics problems in conventional classes (Kohl et al., 2007).

In a study related to the development of e-worksheets using the ExPRession learning model to train students' minds-on, hands-on and hearts-on skills, which was carried out online during the pandemic, it was found that there had been no implementation of the use of e-worksheets using the ExPRession learning model to train hands-on activity skills in the learning process. More research needs to be conducted previously. Researchers exploited this gap to answer how using an activity-based worksheet with the ExPRession learning model can train students' hands-on activity skills related to Newton's law material.

To overcome these problems, a study entitled The Practicality and Effectiveness of ExPRession Learning Model activity-based student worksheets was conducted to train hands-on activities on Newton's Law. The research purpose of this study was to determine the increase in students' hands-on activity skills by applying activity-based worksheets with the ExPRession learning model based on Newton's law.

METHOD

The research used an experimental design with a pretest-posttest control group design from The Handbook of Research by Campbell (1963). In this research design, the observed group will be given a pretest-posttest before and after being given direct treatment by applying student worksheets based on the ExPRession learning model activity to train hands-on activities. The population in this study were all students of class X Science for the 2022/2023 academic year at the school where the research took place, SMA Negeri 1 Gadingrejo. Sampling from the population using the purposive sampling technique, where the determination of the sample adjusts the needs of researchers, namely as many as two classes from the entire population with the division of one experimental class, X Science 4 and one control class, X Science 5.

The research instruments used in this research are practicality learning instruments, hands-on activity skills instruments, and learning result instrument tests. The instruments are used to determine the implementation of learning by providing treatment using students' worksheets based on the ExPRession learning model. The hands-on activity skills instrument is used to determine the increase in students' hands-on activity skills during learning by using students' worksheets based on the ExPRession learning activity. The learning result instrument test is used during the pre-test and post-test in the form of multiple choice questions with question items arranged according to the hands-on activity indicators that are used to measure learning outcomes before and after using the student worksheet based on the ExPRession learning model.

The data collection technique used in this research uses quantitative descriptive methods. Descriptive, namely by observing the implementation of learning, then the researcher explains the situation being studied. Meanwhile, quantitative analysis is used to measure data using research instruments. The assessment indicator items contained in the practicality of the learning instrument are composed of five items: orientation, expression, investigation, evaluation, and generalization, while hands-on activity skills are composed of 5 aspects of assessment developed by Simpson (1971). There are adapt, respond, sketch, measure, and revise.

This research uses two data analysis techniques, namely descriptive statistical data analysis and inferential statistics. Descriptive statistical analysis was carried out to determine the experimental class's learning implementation achievement and hands-on activity capabilities. Teaching and learning activities are said to be practical if there is ≥ 85% achievement of the learning that has been carried out. The students' hands-on activity abilities were adjusted to the school where the research was conducted, namely SMAN 1 Gadingrejo, with a student hands-on activity ability value of 78.35.

Inferential analysis is a form of quantitative data analysis that analyzes sample data obtained and then draws conclusions through statistical formulas. The inferential analysis used in this research is the Kolmogorov-Smirnov test, homogeneity test, and independent sample t-test. Hypothesis testing is carried out via an Independent Sample T-Test if the data is normally distributed and homogeneous. This test aims to prove differences in the average scores of the collaboration and problem-solving skills of students who are given certain treatments. The hypothesis that will be tested is as follows.

H_0: The hands-on activity abilities of students who use activity-based student worksheets in the ExPRession learning model do not increase compared to students who use conventional student worksheets on Newton's law material.

H_1: Students who use the ExPRession learning model's activity-based student worksheet have increased hands-on activity abilities compared to students who use conventional student worksheets on Newton's law material.

According to Arikunto (2011), decision-making criteria are based on skills values for a two-sided test, namely:

a. If the sig value. or significance < 0,05 then H_0 is rejected and H_1 is accepted.
b. If the sig value. or significance ≥ 0,05 then H_0 is accepted and H_1 is rejected.

RESULT AND DISCUSSION

The results of this research consist of two data obtained by applying the student worksheets based on the ExPRession learning model: the practicality of the ExPRession learning model and the students' hands-on activity skills.

Practicality of Learning

The practicality of learning was carried out by observing the practicality instrument of the ExPRession learning model to the observer and the instrument of students' hands-on activity skills observed by researchers. The results showed that the student worksheets based on the ExPRession learning model were practical to train students' hands-on activity skills. The practicality of learning can be seen from the observations of learning implementation using the Expression learning model. The indicator items contained in the practicality of the learning instrument are composed of five items. The implementation of the ExPRession learning model instrument can be seen in Figure 1.

Rated Aspect	Accomplished		Score			
	Yes	No	1	2	3	4
A. Introduction (15 minute)						
Stage : Orientation 1. Convey learning purposes	✓					✓
2. Motivate students to arouse interest in studying the material discussed, by displaying pictures of phenomena regarding Newton's laws in everyday life.	✓				✓	
3. Ask several questions related to the phenomenon to trigger student predictions and reasoning.	✓				✓	
4. Organize students in groups consisting of 4-5 people.	✓					✓

Figure 1 The implementation of the ExPRession learning model instrument

The results of the average value of applying the Expression model learning are presented in Table 2.

Table 2 Implementation of the ExPRession learning model

Stages	A-1 (%)	A-2 (%)	A-3 (%)
Orientation	87.5	93.7	100
Expression	82.1	85.7	89.2
Investigation	75.0	83.3	100
Evaluation	75.0	83.3	91.6
Generalization	81.25	87.50	93.7

A-1 : Activity 1
A-2 : Activity 2
A-3 : Activity 3

Based on Table 2, it can be seen that the implementation of learning using the ExPRession learning model has increased at each activity. The orientation and generalization stages dominate the implementation of the ExPRession learning model. At the orientation stage, namely conveying learning objectives and motivating students, learning motivation influences students' attitudes towards the physics learning process. Motivation to learn is important in providing enthusiasm and encouragement in carrying out the learning process. This is in line with the findings of Firdaus et al. (2021) that learning motivation influences students' physics learning outcomes in static fluid material. This means that the greater the learning motivation possessed by students, the greater the success of students in learning, so that it can have a good impact on students, namely improving student learning outcomes.

During the learning process, questions arose from students, but the teacher did not answer these questions directly. Instead, they provided feedback that directed students to explore the initial concepts that students had previously so that, in the end, the answers they wanted from the teacher were answered by themselves. Slavin (2010) states that students will more easily understand concepts if they can discuss what they have read with each other.

The ExPRession learning model guides students to solve ill-structured problems that are displayed at the beginning of learning by making predictions and hypotheses. This activity helps students find problems with the phenomena presented and be critical of the material they read. This is reinforced by the findings of Ke & Grabowski (2007) that in learning, students are not seen as passive individuals but as active individuals in constructing the information they get so that it becomes meaningful knowledge.

Training students to make multiple representations will help them in their problem-solving abilities, both in solving ill-structured and well-structured problems. Ill-structured problems arise from a specific context. The main components of solving ill-structured problems include the ability to create problem representations and develop solutions to the problem (Johansen, 1997). Cognitive abilities and creativity in solving problems will increase if children are accustomed to practising their problem-solving skills (Lestari, 2020). The same thing was expressed by Flores et al. (2015), that students are involved in mathematics through representations to visualize, simplify and communicate mathematics, such as diagrams, tables, pictures, graphs, mathematical equations, written text, or a combination of all.

Improving Students' Hands-on Activity Skills

The results showed that the student worksheets based on the ExPRession learning model activity effectively increased students' hands-on activity skills (effect size d Cohen = 1.537) (Cohen et al., 2007). The increase in students' hands-on activity skills can be seen from the results of the N-gain test in the experimental classes after applying the treatment using the student worksheets based on the ExPRession learning model activity. Differences in students' hands-on activity abilities between the experimental and control classes can be seen in Figure 2.

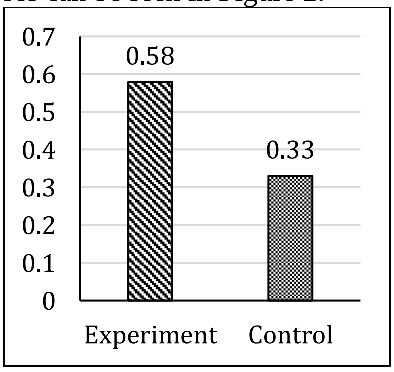
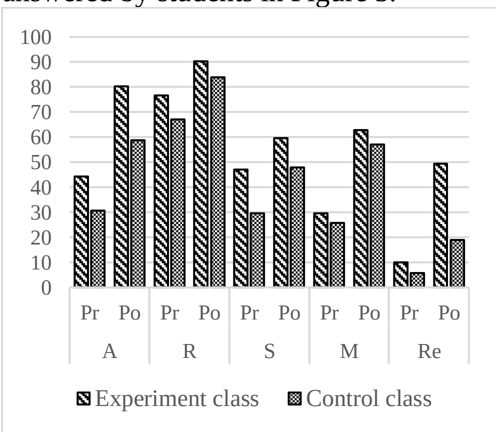


Figure 2 Graph of average n-gain results for hands-on activity

Based on the graph in Figure 2 shows that the learning process in the experimental class with the ExPRession learning model activity based on student worksheets is more effective than the control class, which applies the conventional learning model. In the experimental class, after being given treatment using the ExPRession model activity-based worksheet, an average N-gain was obtained, which was 0.58 in the moderate category. In contrast, after applying the treatment using conventional worksheets, the N-gain in the control class obtained an average N-gain value of which0.33 in the medium category. The students' hands-on activity skills in the experimental class are higher than in the control class. The results of hypothesis testing using the independent sample T-test obtained a sig. of 0.000 > 0.05, which means there are differences in students' hands-on activity abilities between the experimental and control classes.

The instrument used was given to the sample class using 10 multiple-choice questions, with the aim of increasing students' hands-on activity skills on Newton's laws. The items in the pre-test and post-test refer to the hands-on activity indicator, as seen from the average mapping of the items that can be answered by students in Figure 3.



Where:
Pr : Pre-test   Po : Post-test
A : Adapt   R : Respond
S : Sketch   M : Measure
Re : Revises

Figure 3 Hands-on activity capability improvement

The analysis of each aspect of hands-on activity skills in Figure 3 shows an increase in students' hands-on activity skills, with the 'Respond' indicator being the highest. The high acquisition was caused by learning using the ExPRession learning model based on a worksheet in class. In addition, the instrument focuses on making predictions and using representations such as pictures/diagrams, which, in this case, are related to training students' hands-on activity skills. In contrast, in its application, the ExPRession learning model emphasizes the activity of training students to make predictions, formulate problems, make hypotheses, and use multiple representations in the form of pictures/diagrams so that it has an impact on students' hands-on activity abilities in solving problems related to Newton's law concepts.

Student activities observed included five hands-on activity indicators, including Adapt, Respond, Sketch, Measure, and Revises. These indicators were observed during three meetings and experienced a significant increase. Figure 4 shows the average percentage of students' hands-on activity assessment for each hands-on activity indicator using the ExPRession learning model during physics learning activities.

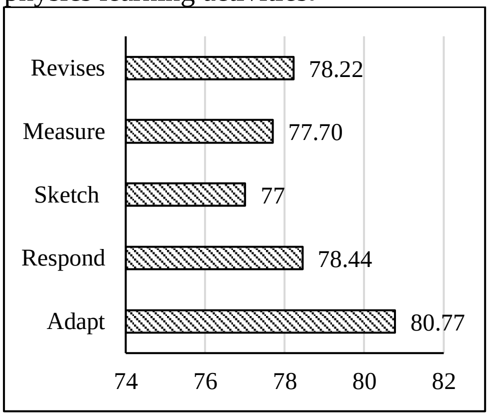


Figure 4 Graph of hands-on activity percentage assessment

Based on these data, it can be seen that the average value of the hands-on activities of students during three meetings is in the trained category, with the assessment of hands-on activities obtaining an average value of 78.35%. Sketch and measure indicators are hands-on activities that dominate the ExPRession learning model. The sketch activity is categorized as a style outlining activity. At this stage, students are guided to be able to make representations of problems in the form of pictures/ diagrams and mathematical representations. Training students to make these various representations will help students in their problem-solving skills. This is in line with the findings (Rosengrant, 2007); if students are in an environment that supports the use of representations, most students will consistently build these representations and then use them to solve physics problems. In this hands-on activity, students can be trained, which will later impact their learning outcomes. Examples of student answers in the activity of making a problem representation in the form of pictures/diagrams by students can be seen in Figure 5 and Figure 6.

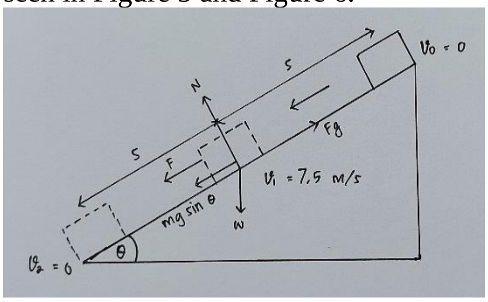


Figure 5 Example of an incorrect answer on the sketch indicator

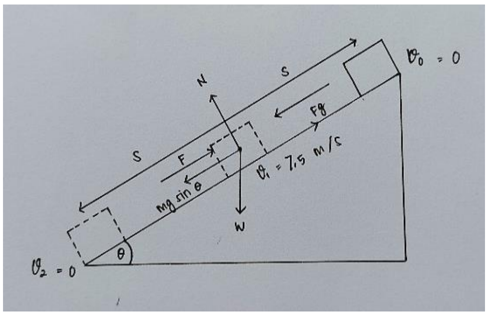


Figure 6 Example of a correct answer on the sketch indicator

In Figure 5, it can be seen that these students, in making graphic representations, have a relationship with the problem being asked. However, there is a mistake in describing the direction of the style, and the information written is unclear (Sketch indicator score = 6). On the other hand, in Figure 6, in making graphical representations, these students have clear, complete, and related information to the problem being asked, in describing the direction of each force acting on the right inclined plane system.

Measurement activities are categorized as investigative activities. At this stage, students are guided to carry out investigations in groups. Each group can carry out investigations to understand Newton's Laws and prove the formulation of the problems that have previously been made. This can make students physically active. This investigative activity is in line with the ability of hands-on activities, where hands-on activities are designed to provide several opportunities for students to carry out, observe, and operate scientific processes so that they can interact directly with scientific tools and materials. Learning activities that optimize direct student involvement in learning will help students improve their performance (Costu et al., 2007).

Based on research, it was found that investigative activities would be better if implemented with hands-on activities because they would enable students to see or directly touch the material they were studying in groups (Ambarita et al., 2019). The higher the involvement of students in experimental activities, the higher the achievement of students' understanding, skills and learning experiences (Divia et al., 2022). Examples of student answers on the measure indicator are shown in Figure 7 and Figure 8.

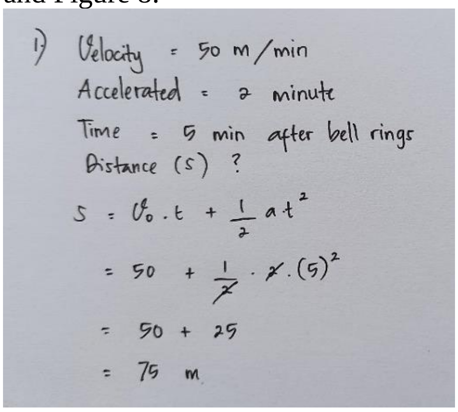


Figure 7 Example of an incorrect answer on the Measure Indicator

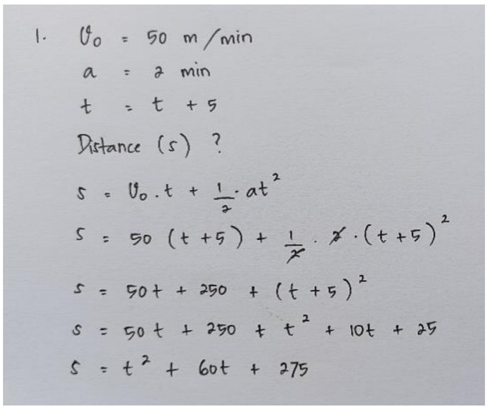


Figure 8 Example of a correct answer on the measure indicator

In Figure 7, it can be seen that this student solved the problem in more than one way, but the calculation process and results were not quite right (Measure indicator score = 3). In Figure 8, these students gave answers in more than one way; the calculation process and the results were correct (Measure indicator score = 10).

The results of the observations are then written in the form of a report on the results of observations, and the relevant sources are listed. Furthermore, students are directed to make a resume by adding representations. Evans & Ellis (2017) state that teachers must always provide feedback on students' work correctly so that students feel comfortable even though they lack understanding. Rehearsal activities play an important role in learning physics so that previously obtained information can last a long time in memory; students must always think, say, and do it repeatedly. Memory as a place for storing information consists of three different types of memory: short-term, working, and long-term (Celikoz et al., 2019). This activity is in line with the opinion of Hoy, 2019); a person does not fully carry out an activity automatically when doing something, but it depends on how much practice he has done.

Based on the study's results, it was found that applying the activity-based worksheets of the ExPRession learning model was better for training students' hands-on activity skills than students who applied conventional worksheets. This is because practical learning focuses more on students solving problems with the assistance of various learning resources that can justify their findings. In addition, students who used activity-based worksheets on the ExPRession learning model played less than students who used conventional worksheets. Properly designed and used student worksheets can serve various functions in different contexts and support students' thinking abilities (Lee, 2014).

Based on the researcher's experience in this research process, there are several limitations experienced that can be factors that influence research results, such as limited research time, energy, and researcher abilities. Apart from that, students experience learning difficulties during the learning process. Future researchers can utilize this to determine whether learning difficulties are caused by the short use of learning media or other factors that must be researched.

CONCLUSION

Based on the results and discussion obtained from this research, it is stated that the practicality of learning using activity-based worksheets with the ExPRession learning model is effective in training students' hands-on activities. This can be seen from the results of the practicality test using observation sheets; the adequacy of learning using the ExPRession learning model in the experimental class reached 87.30%, with the category being very well implemented and the assessment of students' hands-on activities achieved with the score is 78.35% in the good category.

Activity-based worksheets with the expression learning model are effectively used to train students' hands-on activity skills. This can be seen from the hypothesis test results, which showed a difference in students' hands-on activity abilities in the experimental class, which was higher than in the control class. During learning, students look happy and enthusiastic when the physics learning process is accompanied by a simple practicum compared to students who learn only by listening to teacher explanations and observations through pictures. The ExPRession learning model trains students to be able to solve problems using multiple representations so that students understand physics concepts better.

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