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Practicality and Effectiveness of Student Worksheet Using Inquiry-Based Learning Assisted by Basic Mathematics Skills to Develop Critical Thinking Skills

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Abstract:- The purpose of this research is to find out the practicality and effectiveness of student worksheet using IBL assisted by basic mathematics skills to develop critical thinking skills. The method used was quasi-experimental designs with pretest-posttest type. The practicality was obtained through the results of observations of the learning implementation and student responses questionnaire. The effectiveness was obtained through pretest-posttest data analyzed by N-gain and effect size. The results of the observation of the learning implementation and student responses questionnaire were included in very good and very high categories. N-gain test in control and experiment groups was considered in low and medium categories. While, the effect size obtained was in very strong category. In general, the result shows that the student worksheet has met the criteria of practicality and effectiveness.

Keywords:- *Student worksheet, IBL, Mathematic Skills, Critical Thinking Skills.*

I. INTRODUCTION

One of the Education For ALL (EFA) targets declared in Dakkar, Senegal is to improve the quality of education so that student learning outcomes can be recognized and measured (Unesco, 2000). This is followed up by the government through one of the learning system improvement programs (Forum Koordinasi Nasional PUS, 2013). The implementation changed the direction of learning including physics learning which was carried out with scientific inquiry (BSNP, 2006). Inquiry-based learning (IBL) is a learning process which is carried out through investigation as the scientists work scientifically. In other words, IBL can strengthen the relationship between learning and research (Spronken and Walker, 2010).

Physics learning which has been conducted should be student-centered and no longer teacher-centered. Physics learning should be emphasized in three domains, namely cognitive, affective, and psychomotor (Dimyati and Mudjiono, 2006). Physics learning is conducted with a series of experiential activities that allow students to discover existing knowledge through inquiry process. It is because physics is one part of the Natural Sciences which studies the symptoms, events or natural phenomena, and reveals all the secrets and laws of the universe (Suparno, 2007). Students work in the learning process by formulating problems and hypotheses, collecting, and analyzing data to test the hypotheses, concluding, and communicating the results obtained. This is very necessary, because one of the goals of science learning is to develop students' critical thinking skills (Bailin, 2002).

Generally, thinking can be defined as a representation of cognitive processing in the brain that may occur both consciously and unconsciously and may not always follow the laws of logic (Frensch and Funke, 2002). While critical thinking consists of mental processes, strategies, and representations used to solve problems, make decisions, and learn new concepts (Sternberg, 1986). It can be said that people who struggle mentally to find solutions to a problem which is faced in everyday life are also thinking critically.

Critical thinking is the careful application of reason in the determination of whether a claim is true (Moore dan Parker, 2009). It is because people who have critical thinking skills not only see a problem from one side, are open to new evidence even though it contradicts the idea, do rational reasoning, prioritize evidences to support their claims, draw conclusions from the facts that exist, can solve the problems, etc. (Willingham, 2007)

Critical thinking skill is one component of several components of high-level thinking skills (Winocur, 1985). Also, in this era, the linear science and technology (IPTEK) developed rapidly along with the rapid development of information both in quantity and diversity. However, the quantity of this information is not necessarily qualified and correct, so it requires the ability to select and evaluate the validity of data and information sources. Therefore, the students are required to have critical thinking skills. Critical thinking skill is divided into 5 groups of indicators, namely: (1) elementary clarification; (2) basic support; (3) making inference, (4) Advanced clarification; and (5) strategic and tactics (Ennis, 1985).

The facts that occur indicate that students' critical thinking skills in Indonesia are still low. This condition is caused by the teachers who do not implement the curriculum direction. Preliminary research conducted in several State Senior High Schools in Bandar Lampung show that physics learning is not in accordance with curriculum direction (Riawan and Suyatna, 2015). This is shown in Table 1 which provides information concerning the condition of the learning activities occurred was started

by connecting the material which will be studied on natural phenomena that occur. The data show that 80% of teachers have carried out this activity and 85% of students justified it. This is the first step taken in implementing IBL.

Learning Activities	Response (%)			
	Teachers		Students	
	Yes	No	Yes	No
Fenomena related to materials taught	80	20	85	15
Fenomena can cause problems	20	80	30	70
Giving temporary answers	0	100	10	90
Collecting data and information	0	100	12	88
Describing the findings and information	0	100	15	85
Explaining the materials, the examples of question, and practice questions	100	0	45	65

Table 1:-Student and teacher questionnaire analysis related to learning activities

The phenomena were presented more in notification form, and they did not reach to the level which makes the students ask. In fact, asking is the heart of the success of IBL (YouthLearn Initiative, 2009). It is proven that 80% of teachers are aware that the phenomena given do not cause problems that make students try to solve them. However, 20% of students feel that what has been delivered by the teachers is a problem. This is the potential that can be processed so that students are able to build their knowledge.

Further learning activities are explaining the materials, giving question examples, and doing exercise. It is proven that 100% of teachers do not facilitate the students by giving them temporary answers, collecting data and information to build their knowledge, and describing what are found. Therefore, it can be said that the teachers have not carried out the curriculum instruction. Further facts based on preliminary research are shown in Table 2.

Type of Problem	Response (%)			
	Teachers		Students	
	Yes	No	Yes	No
Students are not active	70	30	80	20
Students' mathematics skills are low	80	20	90	10
Students' motivations are low	70	30	60	40

Table 2:- Problems in the learning process

Table 2 illustrates that 80% of the students are passive in learning activities. This condition will not develop students' critical thinking skills. Whereas, in this era, people whose mindset are trained are needed to play a role in the development of this era (Education Paradigm Team, 2010). The opposite might occur when the teacher gives students the opportunity to explore various information. However, this exploration activity will not run smoothly if there is no guideline namely student worksheet which is suitable for IBL, which provide the descriptions and instructions or rules that can help students to complete each stage of learning (Kirschner, Sweller, and Clark, 2006)

The use of student worksheet in the learning will make it easier for students to read and absorb the messages contained in it and make it easier for teachers to assess the activities carried out by the students (Töman, Akdeniz, Çimer, & Gürbüz, 2013). Student worksheet can enable students in learning to find and develop concepts as well as to motivate the students to improve their cognitive abilities (Marrysca, Surantoro, and Ekawati, 2013). If learning activities and cognitive abilities are good, then student worksheet can also optimize critical thinking skills (Damayanti, Ngazizah, and Setyadi, 2013).

Student worksheet eases teachers to manage the learning from teacher-centered to student-centered (Darmojo and Kaligis, 1993). This is because student Worksheet is the medium for teachers to guide their students to discover concepts through their own activities or in workgroups. The use of student worksheet in learning will make it easier for students to read and absorb the messages contained while making it easier for teachers to assess activities carried out by students (Sunyono, 2008). However, the student worksheet used must meet the student worksheet organization requirements in the form of didactic requirements, construction requirements, and technical requirements (Darmodjo and Kaligis, 1993).

Another problem faced by the teachers in physics learning is student's low mathematics skills (Rusilowati, 2006; Wijayanti, 2010), where 80% of teachers stated that students' mathematics skills are low. This situation makes the students difficult to understand the concepts of Physics (Semela, 2010; Sadler and Tai, 2001). While physics theories can be in the form of mathematical model of several physical phenomena which are written in mathematical terms (Quale, 2011). This complexity will cause 70% of students to have low motivation.

Physics studies natural phenomena which occur and then it take benefits for life. The fact is that physics takes many measurements of physical entities for something which is visible and interprets geometric terminology and the structure of something not visible (Ataide and Greca, 2013). Therefore, it is very natural if in the future, the existing phenomena are expressed in mathematical equations. Physics has an essential meaning for interpreting functions that exist in the world and mathematics is the language used to express, handle and develop concepts and theories of physics and it even often used to determine most of the content and meaning (Tzanakis, 2002). Mathematics is the language of science and it unites all subjects of science (Olatoye, 2007). Therefore, the students must have sufficient basic mathematics skills to study physics.

If IBL is implemented in learning, students not only recall the existing knowledge, but it rather emphasizes in discovering existing theories through scientific work. This process will accustom the students to practice critical thinking and communication skills. In addition, IBL can develop good attitude because it facilitates students to engage in investigations of values which are embedded in humans in the process of building knowledge (Steed, 2009). Thus, physics learning which uses IBL provides progress for the increase of the number of students who can solve personal problems and even national problems, and are ready to face the future happily (Nuangchalerm, 2014).

IBL is a learning approach where the students, in the learning process, solve the problems (problem-solving) as the scientists do through the process of thinking and acting scientifically (Nuangchalerm, 2014). Therefore, in the process, IBL involves the students in learning, formulating questions, investigating and then building understanding, meaning and new knowledge (Alberta Education, 2004).

IBL approach is intended to help the students to ask questions. Thus, the teachers should have the ability to ask good questions which can be answered through investigation. It is because asking students to conduct investigations can improve their critical thinking skills not only about their own work, but also about the results of the research in general (Wyatt, 2005). Good questions have characteristics such as: (1) Questions must have the answers; (2) The answer may not be a simple fact; (3) The answer is not known yet; (4) Questions must have several objective answers; and (5) Questions may not be too personal (YouthLearn Initiative, 2009).

The learning steps of IBL approach are: (1) Questioning; (2) Defining terms; (3) Acting; (4) Discussing; and (5) Summarizing (Nuangchalerm, 2014). However, it is not much different from the inquiry model which is commonly known, namely: (1) planning (2) collecting data (retrieving); (3) Data processing (processing); (4) compile information (creating); (5) sharing; and (6) evaluating (Alberta Education, 2004).

The solution to the problem above is student worksheet of development result which is suitable for IBL. It is because the appropriate student worksheet will maximize IBL activities (Suyatna, 2015). In addition, to overcome the low mathematics skills, the basic mathematics skills are inserted in the worksheet. The final goal of the student worksheet is the development of students' critical thinking skills. However, the product which has been developed will be good if it meets the criteria of practicality and effectiveness (Nieveen, 2010). Therefore, to find out the quality, the student worksheet of development result needs to be tested for its practicality and effectiveness.

II. METHOD

The method used was quasi-experimental design model with pretest-posttest type design. The pretest-posttest design according to Creswell (2012) is shown in Fig. 1 below.

Select Control Group	Pretest	No Treatment	Posttest
Select Experimental Group	Pretest	Experimental Treatment	Posttest

Fig. 1:-Quasi-experimental designs with pretest-posttest type design according to Creswell (2012)

Based on Fig 1, the initial step taken was determining the experimental and control groups. Before being treated, the experimental and control group received the initial test (pretest) so that the pretest value was obtained. The next stage, the sample was given a treatment in the form of learning with IBL using student worksheet of development result for the experimental group and IBL without student worksheet of development result for the control group. During the process of applying the student worksheet in the learning, the observation of learning implementation was carried out. After being given treatment, the two groups were given the final test (posttest) so posttest value was obtained. The last thing to do was disseminating the student response questionnaire to the experimental group to see the students' response after the implementation of student worksheet in learning. The location of the research was conducted at Senior High School 6, Bandar Lampung.

A. The Practicality of the Student Worksheet of Development Result

The practicality of student worksheet of development result was described based on the results of the student response questionnaire and observation of the learning implementation. This questionnaire contains students' responses towards language, writing, appearance, content, benefits of student worksheet, and IBL used in learning. The data analysis technique from the expert validation test was calculated by the equation below adapted from Ratumanan &

Laurens (2011) and interpreted as a qualitative statement based on Table 3.

$$p = \frac{\text{Number of scores gained}}{\text{Total scores}} \text{ x } 100\%$$

Percentage (%)	Qualitative Descriptions
	Criteria
80.1-100	Very High
60.1- 80	High
40.1-60	Moderate
20.1-40	Low
0.00-20	Very Low

Table 3:-The interpretation of the questionnaire percentage according to Arikunto (2010)

Learning Implementation Observation Sheets were used to observe learning difficulties by observers. This sheet contains the observer's assessment towards the learning implementation and the accuracy of the duration of learning activities which are in accordance with what was written in the lesson plan. The technique of analyzing data from observations of the implementation of student worksheet in learning is according to the implementation of the stages of learning in lesson plan. Each aspect will be given a score of 0 if the learning stage is not implemented and the score of 1 if the learning stage is carried out, and the total learning implementation score is calculated by the equation adapted from Ratumanan & Laurens (2011) below and interpreted into qualitative statements according to Table 4.

$$p = \frac{\text{Number of stages carried out}}{\text{Total number of stages}} \text{ x } 100\%$$

Learning Implementation Score (%)	Qualitative Descriptions
	Criteria
$p \geq 90$	Very Good
$80 \leq p < 90$	Good
$70 \leq p < 80$	Fair
$60 \leq p < 70$	Poor
$p < 60$	Very Poor

Table 4:-The implementation of Learning Criteria Adapted from Sudjana (2005)

Student worksheet of development result is stated to be practical if the results of student responses analysis are at least considered in high category and analysis of the results of the observations is at least in good category.

B. The Effectiveness of Student worksheet of Development Result

The effectiveness was described based on the results of statistical analysis of the pretest and posttest data by conducting several statistical tests including: the N-gain test was carried out to find out the effectiveness of student worksheet towards the improvement of critical thinking skills before and after using the student worksheet of development result in the experimental and control groups. Furthermore, to determine the difference of N-gain between the experimental and control groups, independent sample t-test was carried out with the condition that the N-gain data of the two groups were normally distributed. If the data are not normal then the Mann Whitney test will be conducted. According to Hake (1999), the increase in pretest and posttest can be calculated using the following equation:

$$< g > = \frac{(\% < S_f > - \% < S_{i>})}{(100 - \% < S_i >)}$$

Information:
<g> = gain factor
<Si> = average score of initial test
<Sf> = average score of final test

The criteria of gain factors <g>:
<g> > 0,7 = high
0,3 ≤ <g> ≤ 0,7 = moderate
<g> < 0,3 = low

If the results of N-gain test indicate an increase in each indicator of critical thinking, then the effect size of the student worksheet using IBL assisted by basic mathematics skills will be sought. According to Olejenik and Algina (2003), effect size is a measure of the magnitude of the variable effect towards other variables, the magnitude of differences and relationships which is free from the influence of sample size. While, according to Huck (2008) and Moore (2007), it is stated that effect size can be considered as a measure of the meaningfulness of research results in practical exposure. Effect size can be calculated using Cohen, Manion, and Morrison (2007) equation below:

$$d = \frac{\bar{x}_E - \bar{x}_C}{SD_{Pooled}}$$

With SD_{Pooled} which can be calculated by using the equation below.

$$SD_{Pooled} = \sqrt{\frac{(N_E - 1)SD_E^2 + (N_C - 1)SD_C^2}{N_E + N_C - 2}}$$

Information:
d = Effect size
$\bar{x}_E$ = The average of experimental group
$\bar{x}_C$ = The average of control group
SD_{Pooled} = Standard deviation of control and experimental groups combined
SD_E = Standard deviation of experimental group
SD_C = Standard deviation of control group
N_E = Sample total number in experimental group
N_C = Sample total number in control group

In this research, the results of effect size calculation were interpreted using the criteria of Cohen, Manion, & Morrison (2007) as shown in Table 4 below.

Effect Size Score	Qualitative Descriptions
	Categories
0.00 – 0.20	Weak Effect
0.21 – 0.50	Modest Effect
0.51 – 1.00	Moderate Effect
> 1.00	Strong Effect

Table 4:- The criteria of effect size

III. RESULT AND DISCUSSION

A. The Practicality of Student worksheet of Development Result

The observation of learning implementation was carried out by the observer during the teaching and learning process. The Observer saw and assessed whether the learning activities which used student worksheet of development result in accordance with the lesson plan. The implementation of learning activities can be seen in Table 5 which is shown below.

The first learning activity carried out is reading the phenomena presented in the student worksheet of development result. This activity ran according to the time allocation. The second activity is making the teachers to be more contextualize in demonstrating the phenomena in the student worksheet. Both plates were weighed using a spring balance. After that those two objects were inserted into a beaker that has been filled with water and then they were weighed again. This was conducted to provide various physical information to the students. Students collected information obtained from reading these phenomena and demonstration activities. These activities were carried out according to the time allocation in the lesson plan.

The third activity is reading student worksheet and submitting the problem statement. In this activity, students were discussing problems with friends in their groups and there were some who asked about making a problem statement. The students seemed to have difficulty in making problem statements. It can be seen from the time spent which problem statements. It can be seen from the time spent which was longer than the time allocation in the lesson plan. However, the question or the formulation of the problem is the key to the implementation of IBL (Nuangchalerm, 2014), so it becomes very important. Moreover, the questions can give positive impacts to the learning process and it is a way to develop critical thinking skills (Dori and Herscovitz, 1999).

Learning Activities	Implementation	
	Yes	No
Reading the phenomena contained in the student worksheet	1	
Observing the demonstrations of phenomena and collecting information, facts and data.	1	
Proposing the formulation of the problems	1	
Analyzing information, facts, and data	1	
Making hypothesis	1	
Choosing tools and conducting experiment to fill in the first data in the student worksheet	1	
Choosing tools and conducting experiment to fill in the second data in the student worksheet	1	
Choosing tools and conducting experiment to fill in the third data in the student worksheet	1	
Analyzing the experimental data	1	
Drawing conclusion	1	
Presenting the experimental results	1	
Solving the problems	0	1

Table 5:- Learning implementation data

The fourth activity is analyzing the information, facts, and data obtained through observing the phenomena carried out through discussion. This situation was conducted to realize interactions with the environment which involve cognitive processes (Shah, 2012). The students did reasoning by connecting various data and facts obtained to understand the phenomena which were presented comprehensively as the basis to make hypotheses. This is in accordance with the opinion of Willingham (2007) who stated that rational reasoning related to the facts that exist can solve the problem.

The fifth activity carried out by students in accordance with student worksheet of development result is making temporary answers from the formulation of the problems made. The teachers monitored student activities by approaching each group. It was observed that the students discussed enthusiastically in their respective groups. This activity was carried out according to the time allocation.

The sixth and seventh activity are choosing the experimental tools which have been provided on the table according to the data given in the student worksheet. This activity is the phase of conducting the experiment. Students weighed a load of 100 grams in the air followed by weighing it in the water and salt solution. Then, the students weighed the weight of the spilled fluid. This activity was carried out to find the difference in weight data from objects weighed in the air with the object weighed in the fluid to prove the difference in weight equals to the weight of the spilled water. This activity ran according to the time allocation. While, the eighth activity is conducting the experiment to determine the density of the salt solution which had been used. This measurement was carried out according to the time allocation given.

The ninth activity is analyzing experimental data. The students connected the data and facts that occurred through the assistance of the questions in the student worksheet. Students carried out the student-centered learning. Students were facilitated in learning because all the learning activities carried out were contained in the student worksheet (Töman, Akdeniz, Çimer, & Gürbüz, 2013). Students looked enthusiastic and active in discovering Archimedes' law concepts. This is in accordance with the research conducted by Marrysca, Surantoro, & Ekawati (2013) which concludes that student worksheet encourages and motivates the students to be more active in finding and learning the concepts. In this part, the basic mathematics skills were included. It was because in this activity, the students found many physics equations that required an understanding of integers, decimal numbers, fractions, and squared numbers. It cannot be denied that mathematics becomes a language and tools which are used to develop concepts and theories of physics (Tzanakis, 2002; Al-Omari & Miqdadi; 2014), so that in studying physics, the students must possess mathematics skills.

The tenth activity carried out by students based on student worksheet is drawing conclusions based on data analysis. The students discussed with friends in the group and wrote the conclusions obtained. This activity aims to develop critical thinking skills whose one of the indicators is drawing conclusions (Ennis, 1985). This activity was carried out according to the planned time allocation.

The eleventh activity is the presentation conducted by group representatives. The teacher selected a group who was willing to present the results of group work. It was seen that almost all groups volunteered, because the teacher invited the group who volunteered themselves first. This activity was complemented by question and answer and guidance given by the teacher. The duration used is in accordance with the plan made.

The twelfth activity is solving the problems that existed in the student worksheet in accordance with the conclusions obtained. However, this activity was not carried out until it was finished. It was because of the plan allocated. This condition was caused by the activity of submitting the problem statement which requires additional time.

Therefore, from 12 learning activities planned, it turns out that only 11 activities have been carried out. This situation provided information that the implementation of learning activities was based on the observations of 91.67%.

Statement	The Result of Analysis		
	Average Score	Percentage (%)	Category
The language is easy to understand	3.33	83.33	Very high
The sentences are unambiguous	3.30	82.41	Very high
The activity guidance is clear	3.48	87.04	Very high
Font type, size, and space are proper	3.52	87.96	Very high
Early use of the student worksheet is interesting	3.41	85.19	Very high
The presentation style is not boring	3.44	86.11	Very high
Each page is understandable	3.33	83.33	Very high
Encouraging to think and find the answer from experimental results data	3.15	78.70	High
The assistance of basic mathematics skills help in developing mathematics skills	3.52	87.96	Very high
Always re-examine the results of work and draw conclusions	3.37	84.26	Very high
Can give conclusion and take important ideas	3.30	82.41	Very high
Can connect student worksheet with the life reality	3.44	86.11	Very high
Able to find out buoyant force equation without asking to teacher too much	3.15	78.70	High
Get knowledge by following a series of activities	3.37	84.26	Very high
Believe that it the contents are easily understood	3.22	80.56	Very high
Believe that it can make students pass the test	3.41	85.19	Very high
The contents are useful	3.48	87.04	Very high
Hoping that other materials have this kind of student worksheet	3.59	89.81	Very high
Happy to learn physics with this student worksheet	3.63	90.74	Very high
I am happy to learn using IBL	3.59	89.81	Very high
The Final Average Score	**3.40**	**85.05**	**Very High**

Table 6:- The recapitulation of the results of the student responses questionnaire towards the post-learning using the student worksheet

If interpreted from the implementation criteria, this percentage is included in a very good category. The results of the students' response questionnaire have been shown in Table 6. Students' responses related to the ease of understanding the language used in the student worksheet reaches 83.33% and it is included in very high category. Language is a tool which is used to convey all the meanings contained in the student worksheet. When the language presented in the student worksheet is easy to understand, students will easily learn by processing information obtained both cognitive, affective, and psychomotor. It is because learning is a complex internal

process which consists of cognitive, affective, and psychomotor domains (Dimyati & Mudjiono, 2006).

Student responses related to the unambiguous sentences used in the student worksheet of development result do not reach 82.41% and they are included in the very high category. Sentences with multiple meanings or ambiguous will cause a decision wrong. Unlike these student worksheet, student responses towards the trust of being able to learn the contents well reach 80.56. They are included in the high category. Even further, the students' responses towards the trust that they will succeed in the test after studying Archimedes Law using this student worksheet reach 85.19. And they are included in the very high category.

Student responses related to the clarity of the student worksheet so that students will easily carry out activities reach 87.04%. While students' responses to the selection of fonts, sizes, and spaces that make it easy to read the student worksheet reach 87.96%. Both of these are included in the very high category. The clarity in terms of writing or sequence is needed so that the students can understand the commands in the student worksheet. Therefore, student worksheet makes it easier for students to read and absorb the messages contained (Sunyono, 2008).

Students' responses towards the existence of sense of attractiveness at the beginning in using student worksheet and its attractive presentation reach 85.19% and 86.11%. As the result, these achievements are included in the very high category. While, the response towards the understandable statements, words and sentences in each page reach 83.33% and they are included in the very high category. Responses related to statement that the students think and find answers from experimental data more often reach 78.70%. They are included in the high category. This shows the responses of students to think critically, where students think a lot to get the answers from the formulation of the problems by completing supporting evidences to claim the truth. This is an implementation of critical thinking according to Moore and Parker (2009). This is also seen from the response of students towards the checking of their work results which reach 84.26%. They are included in very high category. While, the responses of students to conclude and take important the ideas regarding Archimedes Law reach 82.41% and they are included in very high category.

Student responses towards the statements which stated that basic mathematics skills can help in developing mathematics skills reach 87.96%. They are included in the very high category. According to the physics learning which has been experienced by researchers, the duration of learning runs out to explain basic math problems such as fractions and algebra. With the basic skills of mathematics juxtaposed in the data analysis section, students who have low basic math skills are helped. This is seen from the students' response towards the statement that they are able to understand the equations of buoyant force without asking many questions to the teacher which reach 78.70%. These responses are included the high category. Basic math skills are very much needed in learning physics. This is in accordance with the opinion of Olatoye (2007) which states that mathematics is the language of science and it unites the subject of science. While, according to Uhden, Karam, Pietroca, and Pospiech (2012), mathematics helps in gaining the insight concerning the concept of physics well.

Students' responses towards the statement which stated it is able to connect the contents of student worksheet with life reality reach 86.11%. These are included in very high category. Good learning is a learning which is able to connect learning activities with student experience. Therefore, it is important to provide learning activities that connect the concepts and life reality. This is in accordance with the opinion of Madhuri, Kantamreddi, and Prakash (2012) which stated that connecting learning material with life reality enables students to appreciate and relay concepts with life reality. Hence, when using the student worksheet, students will get knowledge easily. It is in accordance with the responses of students which reach 84.26%. These are included in the very high category. It indicates that the student worksheet of development result has benefits for the students. Student responses show that the benefits of the student worksheet which reach 87.04%, These responses are included in very high category.

Students' responses towards the expectations of making more student worksheet with other materials in it reach 89.81%. These are included in very high category. This is a statement of advice for making similar worksheets for other material. This is supported by student responses related to feeling happy with IBL which reach 89.81%. It is consistent with the responses of previous statements. It is true that physics learning must be carried out according to its nature, namely with scientific inquiry according to the direction of the curriculum as scientists discover theories of physics. Therefore, the students will feel happy to learn physics in accordance with student responses related to feelings of pleasure in learning Archimedes Law material using the student worksheet of development result which reach 90.74%.

Based on the implementation of learning and student response questionnaires above, two things are found namely: (1) the implementation of learning using student worksheet of development result reaches 91.67% with very good category; (2) The responses of students towards student worksheet of development result reach 85.05% with a very high category. Based on these two things, it can be said that the student worksheet of development result has met the practicality criteria. In other words, this student worksheet can be applied and get positive responses from the students. This is in accordance with the opinion of Plomp (2013) which states that the practicality aspect can be achieved when the teacher and target group of students consider the product being developed can be used and there is evidence which proves that the products can be used.

These conditions indicate that teachers and students are facilitated to use the student worksheet of development result in the learning. student worksheet helps teachers in the learning process in conveying learning messages and the students are helped by getting information clarity. In addition, the teachers are also able to cope with the students who possess low mathematics skills with mathematical assistance that is included in the student worksheet and students can learn independently about this. It is because the practicality of this student worksheet of development result is achieved if the teachers and students can easily apply the student worksheet in learning. This is in accordance with the research conducted by Dewi, Sadia, and Riatiati (2013), Priyanti, and Suastra (2015), Novia, Hufri, and Dwiridal (2017) which stated that practical aspects are achieved because teachers and students can apply the learning media.

In addition, because of this, students' interest in using the student worksheet is also the reason for achieving the practical aspects of the student worksheet of development result. This interest emerges because the learning which uses this student worksheet of development result involves the students directly at each phase of IBL. This involvement starts from observing phenomena, proposing problem formulas, making hypotheses, conducting experiments, analyzing data, and drawing conclusions. This is in accordance with the results of the research conducted by Jaya, Sadia, and Arnyana, (2014) that the practicality is resulted because of students' interest in the methods used in learning and because the learning process in inquiry provides direct experience. It is with direct involvement only that the students will have meaningful learning practices.

Based on the explanation of practicality above, it can be concluded that the practicality of the student worksheet of development result is achieved due to several things, namely: (1) teachers and students can apply the student worksheet of development result easily in learning; and (2) student interest towards the student worksheet is very high.

B. The Effectiveness of Student Worksheet of development result

The criteria of effectiveness are described from the results of the pretest and posttest statistical test data of students in control and experimental group. The result of N-gain analysis are shown in Table 5. Classically, based on Table 11, the N-gain of experimental group is 0.63. It is included in the medium category. While, the N-gain of the control group is 0.29. And it is in low category. If we pay attention to it, the N-gain of experimental groups is two times greater than the N-gain of the control group.

Group Interval	Frequency of N-gain	
	Control Group	Experimental Group
0.11-0.25	10	0
0.26-0.40	13	0
0.41-0.55	5	10
0.56-0.70	0	7
0.71-0.85	0	6
0.86-1.00	0	4
Classical N-gain	0.29	0.63
Category	Low	Moderate
Minimum N-gain	0.14	0.41
Maximum N-gain	0.50	1.00
Total number of students	28	27

Table 7:-The recapitulation of N-gain calculation results

The results of independent sample t-test for N-gain showed a significant difference in the average of student learning outcomes in the experimental and control groups. This condition occurs because in learning which use student worksheet of development result, student are more focused in conducting inquiries. Students are required to find the answers for the formulation of the problem raised by guiding questions that have been compiled in the student worksheet. With targeted inquiry, students can effectively understand the problem to be solved.

In addition, the assistance of basic mathematics skills is an accurate solution to overcome students' weak mathematics skills. In accordance with the law of the single variable by Ary, Jacobs, Sorensen, and Razavieh (2010) that if two situations are the same in all respects except for variables added or removed from one situation, then each differences that arise between the two situations can be related to that variable. The experimental group has a higher average because the students use the student worksheet in learning using IBL. This is in line with the research conducted by Septiani, Purwoko, and Aisyah (2012) which concludes that the learning outcomes of students who use student worksheet with IBL are included in good category. Likewise, the results of the research conducted by Kusmana (2008), Pramono (2008) and the research of Marrysca, Surantoro, and Ekawati (2013) which conclude that learning with IBL can improve student learning outcomes.

Therefore, it can be concluded that learning which uses student worksheet and IBL model can improve student learning outcomes. Meanwhile, the development of

students' critical thinking skills can be seen from the results of N-gain analysis per critical thinking indicator in Table 8.

Critical Thinking Indicators	N-gain Analysis					
	Control Group			Experiment Group		
	Pretestt	Posttest	N-gain	Pretestt	Posttest	N-gain
Elementary clarification and basic support	43,0	63,6	0,36	38,5	78,8	0,66
Making inference	38,6	56,4	0,29	41,1	80,0	0,66
Advance clarification	39,5	53,6	0,23	38,9	79,4	0,66
Strategic and tactics	29,5	46,6	0,24	36,7	70,7	0,54

Table 8:-The recapitulation of N-gain per critical thinking indicator

Based on Table 8, it is seen that the N-gain values of elementary clarification and basic support of control and experimental groups are 0.36 and 0.66. Both of them are in the moderate category. Elementary clarification and basic support indicator have N-gain for the control and experimental groups of 0.29 and 0.66 in the low and medium categories. Advance clarification indicator has N-gain value for the control and experimental groups of 0.23 and 0.66. It is included in the low and medium categories. Whereas, strategic and tactics indicator have N-gain value for the control and experimental groups of 0.24 and 0.54. It is included in low and medium categories. In plain view, all indicators of critical thinking skills have increased. This is in line with the results of research conducted by Rahma (2012), research conducted by Satria, Purnomo, and Martini (2014) and research conducted by Kristanto and Susilo (2016) which stated that inquiry learning is able to improve students' critical thinking skills.

The Mann Whitney test on all N-gain per indicator data shows that there is a significant growth of critical thinking skills in each indicator. This result is in line with the research conducted by Riyadi (2008) which concluded that IBL can develop students' critical thinking skills. While, the opinion of Qing, Jing, and Yan (2010) stated that the implementation of learning with IBL can improve the critical thinking skills of prospective teachers.

The results of the N-gain statistical test indicate that there is an increase in thinking skills in each indicator. However, how much growth that occurs is measured using the effect size. The results of the calculation of the effect size are shown in Table 9 below.

Critical Thinking Skills	**Effect Size Analysis**	
	Effect Size Score	**Category**
Analyzing Arguments	0.83	Moderate effect
Asking and Answering Questions	1.22	Strong effect
Making and Considering Induction	1.20	Strong effect
Making and Considering Decision	1.01	Strong effect
Mean	**1.065**	**Strong effect**

Table 9:- The results of calculation of effect size per critical thinking indicator

Based on Table 9, the value of students' argument analysis skills is 0.83. This is included in the moderate effect category. The skills of Asking and answering questions have an effect size of 1.22 which is included in the strong effect category. Making and considering induction skills gained an effect size of 1.20 which is included in strong effect category. While making and considering decisions skills obtained an effect size of 1.01. It is included in the strong effect category.

If it is calculated, the results of this effect size has an average of 1.065 which is included in the strong effect category. These results indicate a measure of the effectiveness of the student worksheet of development result which grow critical thinking skills. This is in line with the opinion of Cohen, Manion, & Morrison (2007) which states that effect size is only a way to calculate the differences between two groups. For example, if one group has experimental treatment and the other has not (control), then effect size is a measure of the effectiveness of treatment. This strong influence is caused by students who dominate the learning activities or student-centered. Students are actively involved in all learning processes while being able to build their own knowledge with the assistance of student worksheet.

Direct student involvement causes students to use their power and efforts to think critically in solving problems raised in learning activities. Students are required to find out information that is useful for themselves to solve the problems, so that it will be easier to understand the problems raised. Therefore, it can be said that the effectiveness of the student worksheet of development result is achieved because students are directly involved in learning starting from observing phenomena to drawing conclusions. This is in line with the research conducted by Jaya, Sadia, and Arnyana (2014). Effectiveness is resulted form the learning by conducting inquiry activities so that students are actively involved in learning directly, students do not just accept and memorize the information provided by the teacher, but students are required to actively find out the concepts through learning activities.

The analysis above gives several things, namely: (1) the average N-gain of the experimental group is significantly greater than the control group's; (2) the average N-gain per indicator of critical thinking in the experimental group is greater than the control group's; and (3) the effect size of the use of student worksheet of development result is included in very strong category of the development in critical thinking skills. Therefore, it can be concluded that the student worksheet of development result using IBL assisted with basic mathematics skills have met the effectiveness criteria.

The student worksheet of development result has met the expected target of critical thinking skills development. Thus, the effectiveness of the student worksheet of development result is resulted from the student worksheet which are able to develop students' critical thinking skills. This is in line with the statement of Nieveen (2010) which states that the effectiveness aspect is fulfilled if the student worksheet of development result can reach the expected target. Another thing that causes the effectiveness of this student worksheet is the attractive appearance of the student worksheet so that it gets positive responses from the students. This condition creates the interest of students in learning to use student worksheet that impacts the students to be voluntarily and actively involved in the learning process directly. This is in line with the research conducted by Dewi, Sadia, and Riatiati (2013) and the research conducted by Priyanti, Sadia, and Suastra (2015) which conclude that the effectiveness of learning media is resulted from the positive responses of the students which give an impact to the students to be actively involved in the learning process

Based on the explanation above, it can be concluded that the effectiveness of the student worksheet of development result are that: (1) the students are directly involved in learning starting from observing phenomena to drawing conclusions; (2) student worksheet are able to develop students' critical thinking skills; and (3) the appearance of the student worksheet is attractive so that it got positive responses from students.

IV. CONCLUSION

Based on the data analysis and discussion described earlier, it can be concluded that the student worksheet using IBL assisted by basic mathematics skills to develop critical thinking skills has fulfilled the practical criteria based on the results of the observations of learning implementation which stated it was very good and the student response questionnaire was very high. In addition, the student worksheet have met the effectiveness criteria with the average N-gain in experimental group which is significantly greater than the control group's, the average N-gain per indicator of critical thinking in the experimental group is greater than the control group's, and the effect size of the student worksheet of development result is very strong.

SUGGESTIONS

Based on the discussion and field findings that have been presented, if the condition of the students in learning physics has critical thinking skills and low basic mathematics skills, then student worksheet which use IBL assisted by basic mathematics skills as the researchers have developed should be applied. However, in its development, it is necessary to make a guideline to the formulation of the problem in the form of coherent guiding questions including space to accommodate quantitative data obtained through the presentation and observation of the learning phenomena contained.

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