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THE ANALYSIS OF EFFECTIVENESS OF LABORATORY USE TOWARD PHYSICS LEARNING RESULT AT SENIOR HIGH SCHOOLS IN BANDA ACEH

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Abstract

Curriculum 2013 demands phyisics teachers to use laboratory in supporting the teaching and learning process at school, through laboratory students can apply the theory of physics concretely. The purpose of this study is to find out the effectiveness of laboratory in physics subject at senior high schools in Banda Aceh. This study used descriptive quantitaive approach with surveying method. The population of this study is all senior high schools in Banda Aceh and the sample is 6 schools they are SMAN (2,3,7,14,15, and 16), 140 students and 6 teachers and laboratory chief, the sample was chosen using random stratified disproportionate sampling technique which was categorized based on the school accrediation. The technique used in data collection was questionniare and observation sheet. The data analysis was done using descriptive technique with percentage formula. The result shows that the effectiveness of the use of laboratory toward physics subject learning at senior highschools in Banda Aceh is in the category less effective (56.22%). The indicator percentage in input is 59.23 and in process is 57.67 with "enough" category, while the output is 51.76 with "less effective" category.

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INTRODUCTION

The teaching and learning process based on the curriculum 2013 applies scientific approach where students are supposed to have skills, attitude ability and knowledge through scientific process such as observing, questioning, inquiring, and communicating (As'syakurni *et al.*., 2015; Antomi, 2016). This approach is suitable for to be applied in the teaching process of physics subject because it concerns with the scientific proces such as observing, doing experiments to prove a concept, that can make students more active, objective, and have high curiosity in physics learning (Katili *et al.*., 2013). One of the proper places to build their activeness is in laboratory. Laboratory is a place to do scientific experiments which is equipped with experimental equipments and tools (Fitriana *et al.*., 2014). Laboratory can be said effetive if all facilities are well-equipped and the teachers can apply physics theories being practices and design a good learning time allocation. The effectiveness of a laboratory can be achieved if all input activities (laboratory facilities and equipments), process (time allocation and administrative behaviour) and output (skills and laboratory influence toward the learning results) (Setyaningrum *et al.*., 2013; Mulyasa, 2009:82).

Based on the findings from Katili *et al.*., (2013) in senior highschools in Jembrana Regency, it was found that laboratory equipments are not enough and funtioned less, there is also no laboratory technician, also, the laboratory administration is still far from the standard which has been set by the Regulation of National Education Ministry (Permendiknas) No.24 year 2007. Another research by Rahman *et al.*., (2015) also adds that the absence of the effectiveness was caused by the spectacles faced by the teachers in the laboratory, time allocation of the experiements which always not enough, there is also no laborant who can assist the science experiments. Laboratory effectiveness apparently influences the students learning results as it can be seen in the Banda Aceh National Examination results on the measurement indicator and kinematics; the score obtained was only 49,10 which is low in the national level which is 61,63 in standard. This is in line with the observation that have been done by the authors to several senior highschools in Banda Aceh with the physics teachers, one of the factors tha cause low score is because there is no enough time allocation to apply abstract concepts in real life which is generally becomes the main points in physics subjetcs. Besides, the teachers also cannot use the laboratory and the facilit is also limited so that there is a merge for all science subjects in laboratory use (physics, chemistry, and biology). The effects of this merge is drawn on the time adjustments in occupying the laboratory, so that the time used for physics laboratory is more limited and not effective. This condition is also stated by Darsana *et al.*., (2014) proposing that the intensity in using laboratory have direct impacts toward the learning achievements, hence, if the laboratory is not properly managed, it can disturb the physics teaching and learning process which eventually impacts on the low score achieved by the students.

METHODS

The methodology used in this study was survey method with quantitative approach. In the experimentation phase, te first step was doing observation concerning the laboratory existence, so that this research is concerned with the data collection on laboratory use in the real process. The population is this research is all senior highschools is Banda Aceh. There were 6 samples chosen they are SMAN (2,3,7,14,15, and 16) Banda Aceh along with the students who were doing laboratory experiments—included within 6 classes or 140 students, 6 teachers and laboratory chief in year 2017/2018. The sample was taken using random stratified disproportion based on school accrediation which is A and B. The data collection process used questionnaire and observation sheets. The questionnaire was the one adapted based on Permendiknas No.24 year 2007 about laboratory Standard in part of facility and equipments. While in the part of laboratory organization, it was based on Permendiknas No.26 year 2008. In the part of time allocation, administrative behaviour, and learning results were adapte from Mba & Ikem (2012). The observation sheet used in this research was assessed by observers in each experiment activity. The scoring sytem is done by giving weight score to every activity based on the score in the following Table 1.

Table 1. Skill Category in Using Laboratorium

No	Skill Score	Category
1	$X \geq 53.41$	Extremely high
2	48.64 $48.64 < X \leq$ 53.41	High
3	$43.87 < X \leq 48.64$	Medium
4	$X \leq 43.87$	Low

(Source: Azwar, 2012:147)

The questionnaire used in this study was formulated based on Permendiknas was validated by two experts to correct the fitness between te content and indicator, while the questionnaire taken from Mba & Ikem (2012) was revalidated using construct validation using SPSS 23. The data analysis used was by implementing descriptive technique with percentage to figure out the laboratory use effectiveness. Below is provided the categorization and the standard in the part of input and process are based on Riduwan (2010:89) in Table 2, while the measurement for output was based on Litbang Depdagri in Yuniastari & Ratna(2015: 563) in Table 3.

Table 2. Standard of Laboratory Completeness

Rasio Completeness (%)	Achievement Level
81-100	Extremely good
61-80	Good
41- 60	Enough
21- 40	Less
0- 20	Extremely less

(Source: Riduwan (2010:89)

Table 3. Standard of Effectiveness

Rasio Effectiveness (%)	Achievement Level
80 – 100	Very effective
60 – 79.9	Effective
40 – 59.9	Less effective
0- 40	Not effective

(Source : Yuniastari & Ratna, 2015: 563)

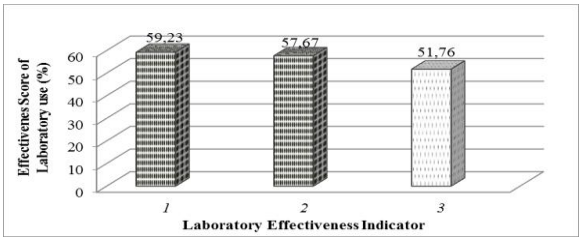
RESULTS AND DISCUSSION

Based on the effectiveness theory proposed by Gibson *et al.*., (1985:30) in the system theory, an organization has own an important element that depicts input and output showing the beginning step of the organization. In this study, organization element of laboratory sheds lights on the effectiveness based on three cycles, they are input, process and output. The data obtained from each indicator is a measurement to set to set the accomplishments in the using of phyisics laboratory in senior highschools in Banda Aceh. Regarding the scientific approach, the implementation of curricuolum 2013 can be implemented through the the use of laboratory effectiveness (Darsana *et al.*., 2014). Data on the indicator effectiveness can be seen in Table 4.

Table 4. Results of The Effectiveness in Using Laboratory

No	Indicator	Component (Laboratory)	Score Component (%)	Category
1	Input	Facility	78.17	Good
		Equipment	53.70	Enough
		Organization	45.83	Enough
2	Process	Administrative behaviour	55.21	Enough
		Time Allocation	60.12	Enough
3	Output	Skill	47.53	Medium
		Learning results	55.99	Not effective
Average			56.22	Less effective

On the Table 4 above, it can be learned that te average result id 56.22% and this lies in the category 'less effective'. This result is obtained by measuring the effectiveness indicator in using Laboratory which was classified into three aspects, they are input, process, and output. The result can be seen in Figure 1.



Category:
1. Input = Enough
2. Process = Enough
3. Output = Less effective

Figure 1. Results of effectiveness indicator

1) Analysis on the Input Indicator

Based on Figure 1, it is gained that input laboratory using is already in the huge category which is 59.23%. The part of input is still far from the minimum standard 100%, because as drawn in Table 4 that it is obtained only the

facility component in "good" category consisting laboratory building, good room criteria, power installation, good lighting and ventialtion. In the furtniture component, education toold, education media, and other equipments are also huge which is 53.70%. This is because there are still lackness in the equipments. Then, in other schools, it was found that there are also fire extinguishers, first-aid box, rubbish bin, clock, so the situation is not appropriate. Another point being seen in the furniture component is the vailability of cahirs, desks, cupboards for tools and equipments are all in "enough" category, there is very few laboratory with washing tub and this is what makes the condition less proper. Rosdiana *et al.*., (2016) said that a laboratory is not really effective if it does not have a washing tub, power termianl, and bad lightings. The equipments component is important because in Permendiknas No.24 year 2007 states that a Laboratory has to possess a complete equipment to carry out experiments (Katili *et al.*., 2013; Elseria, 2016). This equipment components is very influencing toward the physics experiments, because if they only have the building without the equipments, the experiments cannot be conducted.

This can impact on the students learning results in the part of output, because the quality of output is also determined by the inner components of the laboratory such proper equipment usage (Olufunke, 2012).

The input also has to be seen through the management of the laboratory (Mulyasa, 2009:84). According to Hamid (2011) management in and organization in related with the human resources consisting of the manager and the members. A good laboratory management should also provide some workers in the laboratory such as the chief, technician, and laborant (Indrawan, 2015:60). An organization should also have a good time management, structured management, and appropriate rules. What was found at highschools in Banda Aceh is that there are no tehnicians and laborants. A laborant is very important in helping the experiment activities. This is in line with the results by Rosdiana *et al.*., (2016) stating that a factor that block a teaching and learning process in laboratory at MA Nurul Hikmah is that they do not have tehnicians and laborants in their laboratory.

2) Analysis on Process Indicator

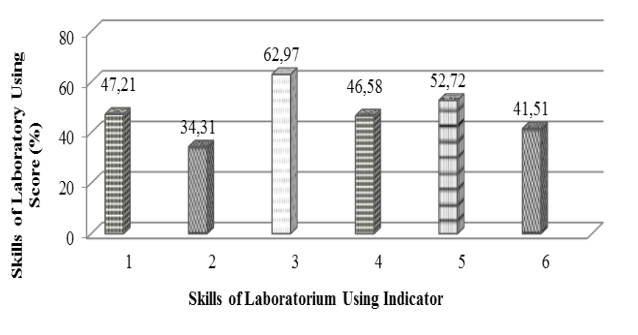
The part of process obtained a percentage of 56,22 % with category "enough", this part includes administrative behaviour and time allocation. Based on the data shown in Table 4, research on administrative behaviour is seeing how involved is a teacher in uisng the laboratory, one of them is in carrying out the experiments. The result from this element is huge which is 55,21%. This is because everytime the teacher wants to use the laboratory, they have to confirm the head of laboratory so that the room can be opened, because laboratory is not open every day. Then, when the teacher used the laboratory, she had to prepare the equipment herself or sometimes being helped by her students. Actually, there have to be laborants who can assist in helping to prepare tools and equipments. There is no laborants at the schools which can be seen in the input data and the percentage for this element is 0,00% which means that all senior highschools in Banda Aceh do not have laborants and technicians. This has become a huge obstacle for teachers, because they have to prepare everything before they begin and clean everything after they finish and this results in the subsidized time allocation for experimenting. A reserach finding by Darsana *et al.*., (2014) also agrees that 87% of the obstacles that is faced by chemistry experiments teachers is the absence of laborants and technicians

In the time allocation, the result is also high which is 60.12%, this is because all schools only follow the weekly timetable when they want to have experiments, so that they only have experiments if they have physics on their timetabe; only one school that sets a partial timetable for laboratory schedule. Basically, there have to specific time allocation for laboratory in every semester. The teacher also informed that when it is the schedule for physics—commonly on Monday morning or after breaktime—the experiment time is not enough. This is in line with the finding from Sukmawati (2013) that the physics experiments in Pekan Baru is also less effective because the time allocation is always not enough so that a plan ahead the experiments is profoundly needed.

3) Analysis on Output Indicator

The result obtained in output is 51.76 and this is not effective. This is seen from the element of students skill and national examination result based on the indicator on physics concepts which demands experiments in the teaching concept Measurement. The less

effective condition in the output can be seen that students skills are in the medium category and the overall average is 47.53. The aspects being assessed is the skill to observe, question, apply, inquire, serve, and create. Below, in Figure 2, can be seen the skill score based on Table 1 above.



Category:

1. Observing = Medium
2. Questioning = Low
3. Applying = Extremely High
4. Inquiring = Medium
5. Serving = High
6. Creating = Low

Figure 2. Results of Skills of Laboratory Using Indicator

Based on Figure 2, it was found that that the low skill in the process of questioning is because the students are rather passive when they were supposed to ask questions, so that their curiosity in experiment is low. In component creating, the score is also low because the students are still lacking knowledge in naming the advantages of the experiment that they have done and they are not yet able to asociate it with the daily life contexts. The observing category is in the medium, because only some of the students that observed, fit the observation, and record the data from the experiments while the others only sedentary seated. In the component of inquiring is also medium, because there are a lot of studentd in groups who are still confused in classifying data that they want to analyze and measure, and also they lack of knowledge in finishing the analysis. In component of serving, it was obtained high category, and the students can employ the data in tables, they are enthusiastic in presenting the results, and they can make conclusions. In the component of applying, the score is very high and this means that they have prepared all the equipments, they become more active in setting the equipments and carrying out the esperiments according to the experiment guidance sa well as they are able to record the phenomena that happen in the experiments.

The overall skill showed that the students are in the medium category when analyzing the data. This is in line with the results found by Handayani *et al.*., (2016) that the highest increase in the science skill process is in planning the experiment which is 50.83% and the lowest increase is in the concept application which is 27.99%. One of the causes is the lackness of students skill as they are not familiar with the equipments in the laboratory, so that it is difficult to apply in daily life context. The skill result is obatined during the explanation of Measurement, some of the students are lack of calipers and multimeters. This leads to a condition where they have to take turn with other groups. The less effective condition concerning the students skill is also have relation with the input component which is the equipment lackness and other facilities. This is in line with the result found by Nuada & Fauziyah (2015) stating that there are strong correlation between laboratory facilities and science skills, so that it was found that to increase theit skill, there have to be appropriate laboratory equipments. The importance of skills is as stated by Sutrisno (2010:7) that one of the purpose to use laboratory is to develop students' skills in observing and collecting data. Hirca (2013) further states if there are no expensive equipments to trian students' scientific skills, teachers need to make simple equipments to increase their skill toward better achievement

The overal results in the output component clearly shows that here is no effectiveness because in the input and process component are not effective, either. The output is also in the category "enough". This is similar with the finding of Danjuma & Adeleye (2015) showing that that there is influence betwee availability and usage of teaching materials, such as the laboratory equippments will influence positively otward the students learning results. This is also supported by Nikmah *et al.*., (2017) where it was obtained that there is a correlation between facility preparedness and the results of National Examination with the correlation value is 0,488 and the correlation between laboratory usage and the results of National Examination with the correlation value is 0,782. This shows that the more preparedness in facility and laboratory

usage, the better the results of National Examination is. This is also agreed by the teachers that 83.33% of the teachers agreed the concepts being experimented in the Laboratory leads to the increase in the results of National Examination in physics subject and 80.56% agreed that the use of laboratory influence learning results.

Based on the results elaborated above, it is can be claimed that the obstacles faced by most physics teachers is because there are no laborants that the absence of laborants can lead to less effective laboratory activity. Then, time allocation is another problem that prevent the experiment activities to be well-achieved. All of these obstacles are as mentinoned by Katili *et al.*., (2013) stating that almost 100% of the phyiscs teachers agree that what blocks them from effective laboratory use is the absence of laborants, lack of time allocation, and lack of experiment equipments. The solution that can be made is the using of virtual laboratory which is used in a virtual way, becuase this research use real laboratory. There are two laboratory activities, they are real and virtual (Putri *et al.*., 2017). In virtual laboratory, there is only software available and can be done outside the laboratory building, so that no need for any laborants to help teachers and no need to set a certain time for schedule (Sarini, 2012; Marlinda *et al.*., 2016). Further, the result found by Permana *et al.*., (2016) showed that the use of virtual laboratory on the basis of flash animation on the theme Optics can influence students' ability in understanding the concept of physics.

CONCLUSION

The use of laboratory toward physics learning process in senior highschools in SMAN Banda Aceh in the category "less" effective (56.22%). The percentage on input indicator is 59.23, in process indicator is 57.67 with category "enough", while in the output indicator is 51.76 with category "less effective".

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