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Assessment Essentials of Problem-based Learning in Improving the Second Basic Physics Learning Result

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Abstract:- This study was conducted to determine the assessment essentials of problem-based learning in improving physics learning result of the second basic physics course. Research and development method were used by following the stages of development research according to Brog and Gall. Retrieval of data in this development research is using small group tests and large groups test and also response questionnaires. The average percentage of the assessment process in the small group and large group test obtained 90.38% and 84.01% and the results of the responses of students in the small group and large groups were obtained 96.6% and 99%. Product development results are at 81% - 100% of feasibility level. The assessment process of second basic physics course needs to be improved as an integral part of the learning process in accordance with the characteristics of learners.

Keywords:- *Problem-Based Learning; Assessment; Research and Development.*

I. INTRODUCTION

Learning and teaching are two activities that are closely related to each other where teaching is teacher activity in order to give lessons to students, in other words teaching activities can not be separated from learning activities. In essence the teaching and learning by how the process runs well or not is very determined by lecturers where lecturers have to encourage and motivate students to learn the way to get knowledge and skills adequate to prepare students as prospective educators, particularly for those who taking the educational program at higher education.

Professional physics lecturers, particularly in educational program have to educate students as prospective teachers by mastering the students' competence to the mastery in the field of physics. Lecturers must maintain their authority in the process of lesson to be taught by using appropriate learning methods to the lesson characteristics, environment, and students' characteristics. They have to assess students activities, and maintain the relationship between individuals both to students and among fellow lecturers and other elements involved in it.

Involvement in the learning process from innovative planning of making unit document of lectures up to its implementation and evaluation play a huge role for educational success. Evaluation needs to be applied within the framework of theoritical assumption test and academic performance [1]. Formative assessment becomes one of the competencies that teachers need to have to regularly measure the ability of students' understanding to be further given feedback [2]. Feedback intervention can improves learning outcomes [3].

To plan a learning, lectures are required to understand the material by matching the model and method used by observing the environment, condition and characteristics of students so that the learning goal can be achieved. The integration of content and processes simultaneously in the design of learning activities offers an opportunity to enhance students' experience in authentic activities, thus students can understand the content better [4]. Goal achievement of education depends on the human resources available in the education component, i.e. educators, learners, administrative staff and other education personnel. In addition, it also need to be supported by adequate facilities and infrastructure.

The demands of studying in higher education require students to learn more independently, discipline in managing time, and carry out more targeted and intensive learning activities that enable skilled students to be productive, creative, and innovative. Learning systems need to encourage the emergence of critical thinking, different reasoning, and problem solving [5]. The main supplies that students need to adapt to these circumstances are having the ability and skills to organize learning activities, control the behavior of learning, and know the purpose, direction, and sources that support to learn.

The empirical facts show that the students average grade of second basic physics was low and most of the students were lacked of basic concept of physics in the comprehensive examination. The students still seem not to live the learning culture in college and have not been able to improve their study motivation in higher education. They even consider lecturer absence as a very pleasant thing, so many of them get low achievement, less in line with expectations.

The description of student learning habits as described above is not suitable for educational purposes. Therefore, it must be addressed at least changed to a better direction in order to produce graduates who are able to learn independently, able to manage their behavior dynamically and flexibly in facing challenges further. Critical thinking ability is not a single factor affecting learning results, choosing appropriate learning strategies is also a factor affecting learning results [6], since learning strategies relate to course performance [7].

The fact that there are most lecturers in learning does not involve assessment in the learning process. It is good for the learning process to be evaluated on what each student is doing, so that the learning process stimulates students to be actively involved in finding the concepts that they are learning. Physics becomes a course that requires reasoning ability, so learning requires abstract illustration abilities. Problem-based learning have to developed primarily in physics to help students develop thinking skills, problem solving, and intellectual skills that learn about the various roles of adults through their involvement in real-life experiences or simulations and become autonomous and independent learners.

The essence of PBL assessment provides assignments to observe phenomena or problems that trigger cognitive imbalances in students and help students to think metacognitively in solving problems to understand the material concepts of physics being taught. Each assignment in the form of student worksheets from observing symptoms, finding concepts, formulating physical principles at these stages is assessed.

Problem-based learning (PBL) is a learner-centered instructional approach where students are actively involved in learning, theory is integrated to practice, and students apply their skills and knowledge in building solutions to a problem through facilitated problem solving [8],[9]. Students treated with PBL have a higher probability of conceptual change than students in lecture-based and self-study [10]. In learning that apply learner-centered, learning arises as a result of negotiation among students, facilitated by people who have more knowledge, and students must be active and full of seriousness [11],[12].

The problems that often exist in education, especially in physics learning was the weakness of the assessment process that occured in the classroom. Student learning activities in the learning process was low because of lack of interaction in teaching and learning activities. Students were less introduced to the concept of physics based on observation or experience that led to the assumption that physics was difficult and tedious and resulted in low learning result.

The development of PBL approach in learning demonstrates the effectiveness and improves the quality of learning and critical attitudes of students, raises self-directed learning behaviors, enhances problem solving skills, and achieves knowledge in accordance with the intended results [13],[14],[15] although on the one hand PBL shows inefficient time in its process [16].

Learning conditions should be improved by applying the assessment process as an integral part of the learning process that matches the characteristics of learners. Assessment is a decision to assess student performance [17] and monitor the academic performance. Academic monitoring of learning achievement has significant correlation with the metacognition [18],[19]. This achievement test is performed to measure one's knowledge of a particular subject [20]. The inovative assessment becomes a demand of a learning impelementation and an indicator of professional lecturer's improvement [21]. Therefore, the researcher feels compelled to directly participate in improving the learning culture through experimental research, which construct the practice and utilization of metacognition, motivation and behavior that is suspected to be effective by applying PBL model.

In accordance with the above background descriptions, researcher is encouraged to undertake a review of the essential assessment of PBL in improving the second basic physics learning result.

II. METHOD

Technically the development of learning design was carried out based on the Research and Development (R & D) model following the development path of Brog and Gall which consists of planning, exploration studies, initial product development, validation, product testing, revision based on field testing and product dissemination. The method of data collection in this study is to validate material experts and media experts, small group tests and large group tests and questionnaires on students' responses to the products developed.

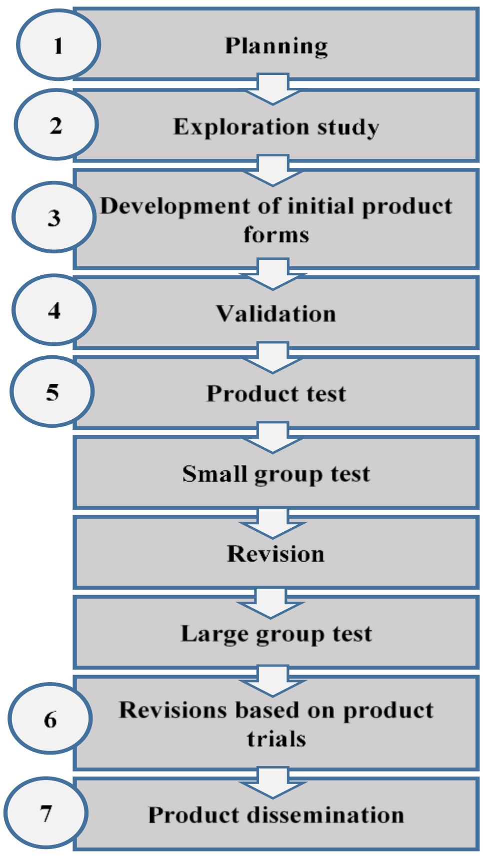

Fig 1:- Flow of research and development (R & D) models

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The research instruments used in this study were: material expert validation sheets and media experts, performance assessments and student response sheets.

The data analysis technique for questionnaire data uses the percentage feasibility formula as in (1).

$$P = \frac{\Sigma \chi}{\Sigma \chi \chi_i} \times 100\% \qquad (1)$$

[22]

P : Percentage
$\sum X$: Total number of respondents
$\sum XX_i$: Ideal number of scores in items
100% : Constant

	Observed Aspects	**Score**		
		1	**2**	**3**
1	Degree of Innovation			
2	Level of creativity			
3	Originality			
4	The level of effectiveness of use			
5	Efficiency of Use			
6	Aesthetics			
7	Benefits for the Department (also provides solutions to problems faced by the Department / Study Program			

Table 1:- General format validation sheet for material experts and media experts [23]

Feasibility categories based on criteria can be seen in Table 2.

Category	Percentage	Equivalen
1	81 % - 100 %	Very feasible
2	66 % - 80 %	Feasible
3	56 % - 65 %	Fair enough
4	41 % - 55 %	Less feasible
5	0 % - 40 %	Not feasible

Table 2:- Criteria for Feasibility Levels [24]

III. PREPARE YOUR PAPER BEFORE STYLING

A. Planning analysis

- Formulation of what the researcher wants to develop a second basic physics learning assessment tool with the aim of: a) developing PBL-oriented performance appraisal devices. b) test the feasibility of the product development appraisal device.
- The goals to be achieved in development research: a) performance appraisal tools oriented to PBL developed have been said to be feasible or valid by material experts and media experts using validation sheets, b) practicum tools and learning devices are said to be feasible by doing process assessment and questionnaire responses of students in small and large group tests.

B. Exploration Study

Activities carried out by researchers in exploratory studies: a) needs analysis, b) curriculum analysis, c) assessment of suitability analysis.

C. Development of the Initial Form of Product

At this stage the researcher conducts a validation test on the initial form of the product to be developed. This initial validation uses 4 experts consisting of two material experts and two media experts. the validation results from two material experts are presented in Table 1.

	Validator	Score	Ideal Score	Percentage of feaibility
1	Validator 1	17	24	70.83 %
2	Validator 2	18	24	75 %

Table 3:- Data on Results of Validation of Early Forms of Products by Material Experts

The results of the initial validation from two media experts are presented in Table 4.

	Validator	Score	Ideal Score	Percentage of feaibility
1	Validator 1	42	48	66.67 %
2	Validator 2	44	48	70.83 %

Table 6:-Data on Results of Validation of Early Forms of Products by Material Experts

D. Validation

After the initial form of the product to be developed has been revised based on the notes from material experts and media experts on the initial validation of the product, the product developed is re-validated before being tested in small groups. The results of product validation by two material experts are presented in Table 5.

	Validator	Score	Ideal Score	Percentage of feaibility
1	Validator 1	42	48	87.50 %
2	Validator 2	44	48	91.67 %

Table 5:- Data on Product Validation Results by Material Experts

The results of product validation from two media expert lecturers are presented in Table 6.

	Validator	Score	Ideal Score	Percentage of feaibility
1	Validator 1	43	48	89.58 %
2	Validator 2	45	48	93.75 %

Table 6:- Data on Product Validation Results by Media Experts

Based on Tables 5 and 6, it can be seen that the results of the validation of two material expert lecturers and two media expert lecturers are in the criteria of feasibility level 81% - 100% so that the developed products are feasible to be tested in small groups.

E. Product Test

At this stage, the researcher conducted a product trial which was developed through a small group test and a large group test to see the feasibility level of the product being developed.

- *Small Group Test*

At this stage the researcher used five students as a small group test. Small group test are carried out by giving process assessments to five students and asking for student responses through questionnaires about the products being developed. The results of the process assessment carried out by researchers towards students obtained a percentage of the average process evaluation of 90.38%. While the results of student responses to the products developed obtained 63.3% of students' responses giving a choice of the category "Strongly Agree", 33.3% responses of students giving the choice of the category "Agree", from the results it was seen that the development of assessment tools this has a good value where the student response indicator is 96.6%. Then 3.3% of students choose the category "Disagree" and no students choose the category "Strongly disagree". The results of the process performance assessment and student responses to the products developed are in the criteria of feasibility level 81% - 100% so that the products developed are feasible to be tested in large groups.

- *Revision*

Before the second basic physics assessment tool was tested on a large group, the product was first revised again to revise the existing deficiencies in the product developed based on records from material experts and media experts.

- *Large Group Test*

At this stage the researcher tests the product developed for large groups or real classes. The results of the performance appraisal in the large group test obtained the average percentage of process performance assessment of 84.0%. While the results of student responses to the products developed were 58.67% of students 'responses giving a choice of "Strongly Agree" category, 40.33% of students' responses giving a choice of "Agree" category, from the results stating that the development of assessment. This has a good value for students on the indicator of responses expressed at 99%. Then there is 1% of students who choose the category "Disagree" and no students choose the category "Strongly disagree". The results of the process performance assessment and student responses to the products developed in the large group trials are in the criteria of feasibility level 81% - 100% so that the product developed is said to be very valid or very feasible to use.

- *Revision based on Classroom Test*

IV. DISCUSSION

Development research conducted consists of several stages starting from the planning stage. At the planning stage researchers find problems that arise in the second basic physics lecture. Departing from these problems then the researcher composes a research plan on the development of tools and tools based on performance assessment using a technology application approach to basic physics material.

To compile the development research scaffold the researcher conducts exploratory study activities where the researcher analyzes the things needed in development activities such as practical tools and learning tools to be developed, curriculum analysis, and suitability of the tools to be developed with the material to be used. After the matter has been considered, the researcher makes the initial form of the product in the form of an assessment syntax which is developed into an assessment tool. The initial form of the finished product is then carried out by the initial validation test. The initial validation test was conducted using four experts consisting of two material experts and two media experts. The results of the initial product validation from two material experts get a percentage value of 70.83% and 75% and the results of the initial product validation results from two media experts get a percentage value of 66.67% and 70.83%. So that the initial form of the

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product is said to be feasible to be developed. The low value of validation from material experts is caused by the basic physics practicum developed that has not been able to show the symptoms of physics in accordance with the theory so that further improvements need to be made from experiment kit to physics concepts and data obtained from experiment kit in accordance with the theory. In addition, the validation results from media experts also get a low percentage value. This is due to the effectiveness and efficiency of the use of the practicum tools and appraisal tools in lecture activities that are not yet known, causing the score from the assessment aspect to be low. Products that have been validated are then revised again to correct deficiencies in the product. The revised development product was then validated again by the material expert lecturer and the same media expert. The results of product validation from two material expert lecturers obtained a percentage value of 87.5% and 91, 67%. While the results of product validation from two media expert lecturers obtained values of 89.58% and 93.75%. Practical tools that have been said to be feasible are then tested on small groups. The development of character-based performance assessment models is known to be valid, so in general the product development of PBL-based performance assessment models is feasible to use.

Product development testing in a small group test using students as many as five students. The results of the performance appraisal in the small group test showed that the average process rating was 90.38%. The high value of the average percentage of the small group test is due to the limited number of students making it easier for researchers to assess student performance in practicing. Limited number of students also causes opportunities for students to play in practical activities to be reduced so that students can remain serious in practicing activities. the results of student responses to the small group test on the product developed obtained a percentage value of 63.3% of students' responses giving a choice of the category "Strongly Agree" (SS), 33.3% responses of students giving a choice of "Agree", from these results it can be seen that the development of this assessment tool has a good value of students towards the indicator of student responses of 96.6%. Then 3.3% of students choose the category "Disagree" and no students choose the category "Strongly disagree". After the product has been tested in a small group, the product is revised again to correct deficiencies in the assessment tool.

The revised product is then tested on large groups or real classes. The results of the performance appraisal in the large group test found that the average performance rating was 84.0%. While the results of student responses to the products developed were 58.67% of the responses the students gave the choice of the category "Strongly Agree", 40.33% responses of the students gave the choice of "Agree", from the results stated that the development of materials This teaching has a good value for students on the indicator of responses expressed at 99%. Then there is 1% of students who choose the category "Disagree" and no students choose the category "Strongly disagree". Based on the small group test and the large group test, the average percentage of student performance assessment is 90.38% and 84.0%. These results prove that the use of PBL and its assessment tools stimulates student process performance.

This study is also relevant to the results of research by reference [25] stating that the involvement of problem solving makes student learning results increase than the using of traditional approach. Process assessment is used to assess student work, include: performance appraisal, authentic assessment, and portfolio assessment. Process assessment aims to enable lecturers to see how students plan problem-solving, to see how students demonstrate their knowledge and skills. Assessment of learning with PBL was done with authentic assessment. [26] define authentic assessment as a form of grade assessment that reflects learning, learning results, motivation, and attitudes toward relevant learning activities. Assessment was done with a portfolio that was a systematic collection of student jobs analyzed to see the progress of learning within a certain time within the framework of achieving learning objectives. Reference [27] suggests that assessment by portfolio can be used for collaborative learning assessment. There are three knowledge structures as the target of assessment of PBLs, among others, conceptual understanding, understanding of principles relating to concept and conceptual relationship and principles to application conditions and procedures [28].

Starting from this view and looking at the stages that students must pass in learning with the PBL model, then the assessment with PBL model implemented in an integrated with the learning process, resulting in optimal learning results. Implementing such learning is expected that students are able to find the concept, theory, and can develop it easily. Teaching-learning processes that involve experience will create effective learning conditions. The transition of learning to PBL encourages students to become more independent, and actively constructs knowledge, and develops competence [29]-[32]. The PBL model with the lecturers' assessment poses the problem of questions along with the tasks that must be done by the students to plan the problem solving in demonstrating the knowledge and skills and this is very motivating the students in learning. Unlike the PBL treated without assessment does not involve the students in the learning process, because most lecturers in the learning only catapult the question of the students answer but there is no follow-up in the assignment in solving the problem.

V. CONCLUSION

PBL-based learning is able to improve science process skills and be able to encourage the realization of the character of student activity in the form of the character of the responsibility of compiling reports, tidying up the tools, and collaboration between groups. With the performance appraisal students educators can assess the competency skills of students at the time of practicum in the laboratory, so that activities related to student performance can be measured. The appraisal tool that has been said to be feasible through a small group test and a large group test is then revised again in accordance with the shortcomings encountered in the classroom test so that it becomes a feasible product to use in the second basic physics lecture. Based on the results of research analysis and discussion, it can be concluded that physics learning results using PBL model treated with assessment is higher than the results of learning physics using PBL model treated without assessment. The learning process must be improved through applying the assessment process as an integral part of the learning process in accordance with the characteristics of learners. Learning with PBL approach does not merely give attention to the acquisition of declarative knowledge, but also the acquisition of procedural knowledge, therefore the assessment is not just enough with the test. Assessment and evaluation in accordance with the PBL model is to assess the work produced by students as a result of their work and to discuss the results of the work together.

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