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Evaluation of The Problem-Based Learning Effectiveness in The Course of Physics Curriculum Analysis

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Abstract. **In physics learning in higher education, lecturers see that there is a gap between teaching knowledge and expected competencies. This study aims to evaluate the application of problem-based learning or PBL in the learning process in higher education. PBL implementation is supposed to be a solution to the problems of lecturers who feel that the material taught is not enough time to be delivered in the lecture. This research used an explanatory mixed-method analysis. The participants of this study were students who took the course of analyzing the secondary school physics curriculum. During the lecture, observers monitor the learning process by filling out observation sheets. The questionnaire with the Likert scale was used to determine the level of student acceptance of PBL after attending lectures. Interviews were conducted with lecturers and observers related to the implementation of learning and the results obtained. From the existing data processing, the level of PBL implementation is 89% (Very Good), and students can receive PBL as an appropriate method of 82.4% (Very Good). This result is a supporting reason for the application of PBL in improving student competence.**

Keywords: problem-based learning, curriculum analysis, physics education, learning strategy

I. INTRODUCTION

Problem-based learning (PBL) is an instructional method that gives all learning via solving an authentic problem [1]. Problem-based learning (PBL) was developed in the 1950s to respond to criticism that traditional lecture failed to prepare medical students for problem-solving in clinical settings [2,3]. As such, PBL is believed to enhance students' critical thinking skills, increase motivation, and improve social skills through group work [4,5,6]. PBL can serve as a catalyst for shifting beliefs by helping preservice teachers reflect on their beliefs while obtaining new knowledge, engaging in problem solving, critical thinking, collaboration, and decision-making [7,8,9].

The Problem-Based Learning (PBL) approach is essentially the management of teaching and learning activities that focus on engaging students actively and creatively in the learning process. Problem-based learning (PBL) is a student-centered instructional approach that is implemented at many universities worldwide [10]. This PBL approach is as an approach that many experts said to be the best suit for the implementation of learning on the campus to cope with the rapid growth and development of science and technology [11]. The PBL tutorial group, because it is purposefully embedded within the broader PBL process, creates opportunities to meaningfully develop knowledge, attitudes, and skills pertinent to collaborative learning [12].

Evaluation can be an attempt to improve the part of a poorly organized program. Evaluation contains two meanings: qualitative descriptions of learners' behavior and quantitative description of measurement results. Evaluations also use assessment methods that require quantitative description information (e.g., test score) and qualitative information/descriptions (e.g., notes on learners' behavior and educators/lecturers in learning). This assessment is intended to know the extent to which a program is successfully implemented, the success of a program is determined by several factors: lecturer factor, teaching method, curriculum, means, and administrative system [13].

Evaluation is a process in which an educational and training procedure is compared with its predetermined goals to find out their fulfillment [14]. Evaluation has been defined by Oerman and Gaberson [15] as "a process of making judgements about student learning and achievement, clinical performance, employee competence, and educational programs, based on assessment data[16]. Keating [17] defined evaluation as "a process by which information about an entity is gathered to determine its

worth" and involves making "value judgements about learners, as value is part of the word evaluation".

Learning Science is not just memorized the concept and principles of Science, but with learning Science, students are expected to have attitudes and abilities that are useful for him in understanding the changes that occur in the environment. Khairudin and Soedjono [18] suggest that the purposes of learning Science are to develop cognitive, affective, psychomotor, creativity and to train critical thinking of the students. For the purposes of learning Science above, it appears that the results of learning science are expected to reflect the ability of students to behave and behave well in understanding the natural phenomena that occur around him [19]. The authors will implement the PBL approach in learning. It covered all the criteria following the above explanation because so far the implementation of the PBL approach is rarely used in the learning process on campus. The lecturers complained of the lack of knowledge of the application of the strategy of PBL and the time provided still relatively little, but the material that must be served quite a lot. The result of this research that physics learning can improve the student's (problem-solving skills based on multiple representations) in Indonesia.

Based on the above description it is necessary to apply a combined evaluation of quantitative and qualitative methods using Mixed-method Research because will consider that assessment requires both quantitative and qualitative information. Mixed method research produces more general facts in researching the research problem because researchers have the freedom to use all data collection tools according to the type of data required. The quantitative or the qualitative is only limited to certain types of data collection tools just.

Mixed method research can answer research questions that cannot be explained by only quantitative or qualitative research. Example: are participants' opinions obtained from interviews and measurement results with certain instruments should be separated? (This question will be answered by mixed method research, that the data collection tool is not limited to one tool only). "What can explain or clarify the results of quantitative research? (Mixed method research answer, qualitative data explain/elucidate the effects of quantitative research).

II. RESEARCH METHODOLOGY

The type of research conducted by the authors is "explanatory mixed-method analysis." The author used the kind of research mixed methodology Research. Mixed Method is a method that combines qualitative and quantitative approaches regarding methodology (as in the data collection phase). Mixed Method also referred to a technique which provides philosophical assumptions in pointing directions or provides guidance on how to collect data, analyzing data, and combining quantitative and qualitative approaches through several phases of the research process.

The strategy of mixed methods used in this study is the order of quantitative and qualitative analysis, the purpose of this strategy is to identify the concept component (sub-concept) through quantitative data analysis and then collect qualitative data to expand the available information [20].. The point is the unification of quantitative data and qualitative data to obtain a complete analysis as shown below:
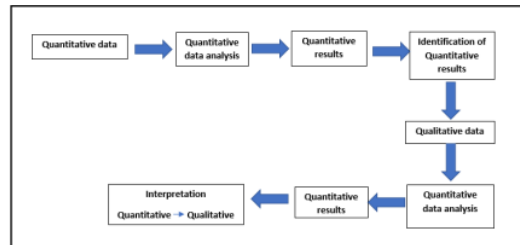

Figure 1. Explanatory Design on Mixed Method

The population of this research is university students who take the physics curriculum study course. For sampling, the researcher uses the considerations which put forward by Arikunto [13], "If the subject is less than 100, it is better to take all until the research becomes population study. Furthermore, if the number of subjects is large, it can be considered between 10-15%, or 20-25 % or more. Researchers used a total sampling technique, in which all populations were used as research samples.

To obtain the data needed in the study, the authors use data collection using questionnaires to gather data and to dig data about something related to the implementation of the process skill approach. This data supported by data from the interview. The researcher interviewed the lecturer, observer, and students as a primary data supporter about the condition of learning and the results of learning. Interviews were conducted to supply the data obtained from the questionnaire and to clarify the desired results.

The data obtained in this study will be analyzed through the following stages:
1. The data collected through the quality assessment scale in the form of letters are converted into qualitative values of test and non-test assessment instruments with the following steps:

The type of data taken in the way of qualitative data is changed to quantify with the provisions that can be seen in the following table:

TABLE I. GRADING SCALE

Grade	Score
SB (very good)	5
B (good)	4
C (enough)	3
K (Bad)	2
SK (very bad)	1

After the data collected, it is calculated to find the average score by the formula,

$$\overline{X} = \frac{\sum X}{N} \quad (1)$$

Where:

$\overline{X}$ = average score

$\sum X$ = Sum score

N = number of items

2. Change the value of each aspect of the criterion of the test and non-test assessment instruments from quantitative to qualitative values following the criteria of the ideal rating category with the following table [21]:

TABLE II. CRITERIA IDEAL ASSESSMENT CATEGORIES

No	Qualitative scoring range	Qualitative criteria
1	$> (M_i + 1.8\ SB_i)$	SB (very good)
2	$(M_i + 0.6\ SB_i) < \ \le (M_i + 1.8\ SB_i)$	B (good)
3	$(M_i - 0.6\ SB_i) < \ \le (M_i + 0.6\ SB_i)$	C (enough)
4	$(M_i - 1.8\ SB_i) < \ \le (M_i - 0.6\ SB_i)$	K (Bad)
5	$\le (M_i - 1.8\ SB_i)$	SK (very bad)

Where:

M_i : The ideal average can be searched by using the formula

M_i = ½ × (maximal score ideal + minimal score ideal)

SB_i: the formula can search ideal standard deviation

SB_i = (½ × ⅓) × (maximal score ideal - minimal score ideal)

Ideal maximum score = $\sum$ item criteria × maximum score

Ideal minimum score = $\sum$ item criteria × minimum score

Calculate the overall value of the quality of the test and non-test physics test instruments by calculating the average score of all assessment criteria. The resulting from the interview will be analyzed and reported qualitatively.

III. RESULT AND DISCUSSION

A. Results

The evaluation study of the implementation of Problem-based learning approach using the Mixed Method Research aims to evaluate the learning activities of students in physics high school curriculum study courses. In this study, the respondents are lecturers, observers, and students. This research uses 3 instruments, namely:

assessment instrument by lecturer and observers, questionnaires of student response, and pre-learning, implementation, and post-learning interview guideline used to obtain data about how the learning process in the class seeing from the administration of learning, the model used and how the results and the quality of implementing problem-based learning approach applied by the researcher.

This data retrieval is conducted from March 2017 until May 2017. After the data collected then grouped into each type of variable and observed for the calculated percentage. The data obtained can be presented in the form of presentation as follows:

1. Validation of Instruments

Assessment instrument by lecturer and observer and questionnaire response student have two validations. This assessment includes a questionnaire aspect that meets the criteria of good judgment. The validation results are following what the researcher wants. The assessment instrument and the student response questionnaire are valid as evidenced by the analysis using CVR and CVI with the result is 0.99. The assessment instrument and the student response questionnaire have excellent validation and can be used even though several assessment instruments and questionnaires are revised.

2. Data from the Observer

This assessment includes a series of learning processes starting from preparation, opening, core activities and closing by researchers. Assessment is done by filling out the instrument's assessment of the ability of the researcher to manage the learning in the classroom.

Based on the data of the results of the assessment of the ability of lecturer to manage the learning in the class conducted by the observer, it is known that the average score for evaluation at the first and second meetings is 0.8 and 0.85 with the percentage of 80% and 85%, third meeting is 95% with approximate criteria very good (agree). This result proves that other lecturers agree and the lecturer succeeded in implementing the problem-based learning approach in the learning process. This method is the application of collaboration lecturer said by Chan [22]. Lecturers can form the 11 support group to assist each other concerning students" resistance to the changeover to PBL, technical difficulties, sharing of ideas and experiences in developing PBL problems, and last but not least moral support.
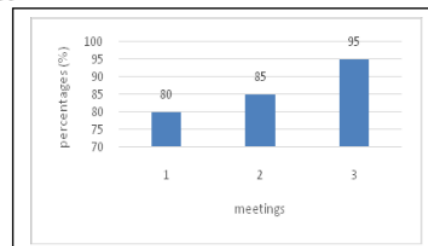

Figure 2. Data from observer

Assessment of the ability of researchers to manage to learn in the class gave some criticism and suggestions by the observer of what is still lacking. The criticism and suggestions given are as follows:

(a) When giving explanations to the Student, please don't turn your back on Student.
(b) Please provide more motivation to the students.
(c) When performing simple experiments in the classroom, please make the work steps clear so that the students can complete the task well.
(d) The researcher has mastered the material well.
(e) Lecturers pay more attention to the feedback about the content being studied.
(f) The utilization of time has not been sufficient, so that no representative of the group who presented the results and the post-test still has not run well.
(g) With the implementation of problem-based learning approach Students have been active drawing and observation results and researchers can provide feedback.

3. Data from student response questionnaire

The questionnaire student response is compiled using a Guttman scale which consists of two alternative answers are "yes" and "no." Students can choose the answer/response by cross-marking (x) on one of the available answer alternatives. Based on data analysis results in the appendix that the percentage of student response to the implementation of problem-based learning approach obtained by the average rate of 80.2%, with criteria approached very good (agree) This score proves that students agree and happy with the implementation of problem-based learning approach in the learning process.

4. Lecturer Interview

Data obtained from interview instruments for lecturers beginning at pre-implementation of learning include teaching experience and years of service. Students' learning outcomes during this time are quite good, although there are still some students whose value are less than the maximum. The methods often used in learning are lectures and discussions, and responded well to students.

Data obtained from the lecturer interview at the time of implementation of problem-based learning approach includes administration of learning is properly and complete enough, only in lesson plan not entirely show the evaluation of learning. Strategies, methods, and models conducted by researchers are excellent and appropriate. It can be adequately implemented the students will get high results. The lecturer has well enough to control the PBL and class, although not yet fully motivate the students, so there are still some students who tend to be reluctant to pay attention / lazy, lecturer strategy needs to be developed and improved again, especially concerning providing motivation.

Data obtained from lecturer interview Instrument at post implementation of problem-based learning approach by researcher include the application of problem-based

learning approach has been successfully done and produced good quality so that it can make student active in the following learning although usage time still less efficient. However, the student's response to learning is very positive and communicative.

Student learning outcomes, increase, this is evidenced by the value of good evaluation results and results of student responses in the form of questionnaires in which almost the entire field questionnaire Students agree and feel happy with the learning process, and the majority of students recognize more easily understand the material, and more active-communication during the learning process.

The suggestion given by observer either from pre, implementation, or post learning is that the researcher has understood the material and has mastered the class well. However, the researcher should be able to pay attention to the time management so that all learning activities can be done following the planned time, and gives a little time to the students to record the formulas given so that students have a record. However, researchers have successfully implemented the learning process with the Problem Based Learning approach (PBL).

5. Observer Interview

Interviews were done to 3 observers who observe in the implementation of PBL. Data obtained from interviews of the observer started at the pre-implementation of learning by researchers includes preparation of instructional administration by researchers, are completely enough and feasible to use within lesson plan, media support and evaluation of learning. However, the lesson plan should be added to strengthen the purpose and objectives of learning. The problem-based learning approach that observers know was only limited to students that more active in the learning process.

The data obtained from interviews observer instrument that started at the time of the implementation of learning by the lecturers in the approach, method, and model of learning are useful. The lecturer has mastered the class and students becomes active, skilled, communicative, although when the discussion lecturer has not been able to control students well. In the next learning, the lecturer must pay more attention to teaching materials and materials that will be delivered in systematically arranged.

Data obtained from the interview observer which in the post-implementation of learning the lecturer, include the successful lecturer applying the problem-based learning approach in the lesson proved by the response of students who are active and able to follow the experience well. Also, the results of student learning have increased. Suggestions from observers to lecturer of all activities undertaken are the preparation of teaching improved again, more efficient in time and volume is more balanced from the voice of students.

6. Student interview

The interview was done with 5 students who follow the course. Data obtained from the student interview at the pre-implementation of learning includes how the lecturer teaches. The method used is the lecture method, the students can understand what the lecturer says, because in teaching the lecturer master the class well, helpful and material explanation accompanied by examples in everyday life and reinforced by examples of problems. Media used lecturer in learning is the powerpoints, complete with the picture to make students interested to pay attention.

Data obtained from interview instrument students who attend in the implementation of learning by the lecturer. "Students happy with simple experiments implemented in the learning process because with the experiments, some students easily understand the material and some students answer depending on the subject matter and core." In the implementation of PBL students are very fond of group discussion and can work together well, because with the discussion of the group they can work together to give opinions and can make conclusions.

Data obtained from student interviews at the time of post-learning implementation includes "lecturer successfully implements PBL in learning." It can be seen from Students who are very fond of simple experiments given by the researcher, and students acknowledge that with the implementation of PBL in the learning process can increase student interest to more often learn, and its value increases.

B. Discussion

Implementation Problem-based learning approach in learning is made to overcome some learning problems in lectures. Application of the Problem Based Learning Approach in this lesson is an approach done in the classroom by lecturing students to participate in obtaining the ability to observe actively, classify, interpret, predict/predict, apply activities, and communicate. Implementation of problem-based learning approach and then measured the level of success and its quality to get a practical learning approach to make students more active so that the application of problem-based learning approach worth implementing in the learning process.

The problem-based learning approach meets the qualifications worthy of use in the learning process based on the results of the assessment by the Lecturer, Observer and Student response. Here is the data in the evaluation of the implementation of the problem-based learning approach:

TABLE III. IMPLEMENTATION SCORE OF PBL

No	Assessor	Average score	Criteria
1.	Lecturer	85.0%	Very Good (Agree)
2.	Observer	88.9%	Very Good (Agree)
	Average	86.9%	Very Good (Agree)

The average assessment of the implementation of problem-based learning approach implemented by the lecturer is 86.9% by the close to "agree" category which means that the lecturer and observer have agreed to the implementation of the problem-based learning approach following what is listed on the assessment sheet. Thus, it can be concluded that the application of problem-based learning approaches in the learning process by the lecturer successfully done. This is a sample of Problem-based learning (PBL) that provides generative contexts for prospective and certified teachers to work together in small collaborative groups [10].

The result of the assessment shows that there is a lack of time utilization, where the lecturer is still unable to manage the time, so that there are always activities according to the criteria of problem-based learning approach that has not been done, such as posters and the student has not communicated/presented the discussion result at while experimenting. The same results were given by Isna et al. [23]. She observes that some students lack of attention and there is limited time in the learning process using PBL.

Implementation of the problem-based learning approach has met the criteria based on the results of the questionnaire on student response. Every aspect of the questionnaire of almost all of the 30 students answered "Yes" and few responded "No," from the results of the student's answer it can be concluded that the implementation of the approach has reached the criteria of approximation. The result of the student response questionnaire show the average score of 80.2%. This result shows that with the implementation of problem-based learning approach to learning helps and facilitates students in understanding the material. Also, with implementation also did able to increase student interest in understanding the material. These results match with the research done by Afolabi et al. [1], that student taught with problem-based learning technique performed significantly better than those taught with the conventional method and recommend PBL to use in schools to teach various concepts.

IV. CONCLUSION

From the results of research that has been done can be concluded that the learning process with Problem Based Learning approach through learning done. The average assessment of the implementation of problem-based learning approach implemented by the researcher is 86.9 with the approximate to "agree" category which means the implementation of problem-based learning approach in the learning process successfully done.

Education Study program who always support us in the process of this research.

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