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Research paper

Verification Concept of Assesment for Physics Education Student Learning Outcome

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Abstract

Physics learning is one of the principal pillars in learning science and a foundation of technology development, so that required effective physics learning strategies that is with a good assessment technique. The purpose of this article is to discuss about verification of assessment on learning physics. The methodology for this study is a qualitative analysis with study main source obtained from literature review, then clarified through focus group discussion in lecturers scope. The verification concept reviews the effectiveness of learning outcome asesment system based on the indicators of the improvement of student's cognitive, affective, and psychomotor domain. This study showed that the verification of assessment tehnique in learning physics can be done in several approaches, including analytical verification and operational verification. This study recommended that learning physics can work effectively are necessary to apply the design of verified technique assessment so the measurement tool of student's domain can be accounted objectively and academically. This study contributed in providing academic paradigm and operational reviews to see the objectivity of assessment in learning physics.

***Keywords**: Assessment; Learning Outcome; Verification*

1. Introduction

Physics is one fundamental knowledge serving as the backbone for science and technology, making it paramount for humans to study. It is also part of science (1) and could, in essence, be defined by a body of knowledge, ways of thinking, and investigation. The science alone includes facts, concepts, principles, laws, theories, and models. It is seen as both a process and a product, thus in the process of learning, we need to consider effective and efficient learning method or strategies, one of which is through practical activities.

As a subject, physics contains various concepts which are the basis of thinking and formulating higher mental processes to create specific principles and generalizations. To solve problems, students must recognize the relevant rules based on concepts they've understood. This understanding is critical being the way to organize or arrange that very knowledge as well as the basis for advanced reasoning (2). These theories show that physics learning and assessment must develop student's competence in terms of cognitive (knowledge), affective (behavior), and psycho-motoric (skill) areas.

Assessment is one of the main components in the process of learning. Its aims are at identifying the achievability level of learning goals and viewing the effective learning process. The learning and assessment technique keep developing as changes and curriculum amendment occur in hope of learning quality to improve (3). Ideally, the assessment is done using standard principles, procedures, and instruments. Standard procedure means that which takes advantage of specific steps and fair treatment of students under the consideration of time, place, and other factors. On the other hand, a standard instrument is that which is arranged using the rigid instrument-developing procedure with reliable validity according to the competencies there of. Therefore, it is necessary to discuss the approach to conduct what is called as the Verification Concept of Assessment for Physics Education Student Learning Outcome.

This study discusses the verification concept of assessment for physics education student learning outcome that provides a guideline of the verification process of physics education students learning outcome assessment.

2. Literature Review

Before discussing the concept of verification more deeply, it's good to know the definition of verification. According to KBBI, the word verification has an understanding of the truth about the report, statement, calculation of money and so forth (4). In addition, the experts add that verification is the process of checking the suitability of the operational logic model with the logic flow diagram or it can be a process of translating conceptual simulation models into the programming language correctly (5); (6). Based on some of the above understanding it can be concluded that verification aims to prove that something exists or is true, or to ensure that something is true.

Verification is very important to do in various things, for example on a data. In data verification usually the data collected will be processed and then analyzed to be tested by hypothesis. The hypothesis tested using empirical facts in order to get the correct answer scientifically, so it can be said that the data has been verified (7, 8). The verification process is also closely related to the evaluation process, some studies have verified the process to as-

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sess whether the research has been done in accordance with the procedures or research methods after scientifically tested (9-13)
The field of education did not escape the verification process, one of the verified aspects is the instrument test for student learning outcome. An instrument is said to be verified if the instrument can correctly measure student learning outcomes after a scientific trial. This is in line with Salvia's opinion, Salvia explains that the standardized test data is verified, the verification includes valid and reliable assessment (14).
Based on the evidence and the empirical theory, we can know that verification must be done so that our research products are guaranteed quality. Neither does the instrument test for student learning outcome. The instrument must be in accordance with the aspect to be measured and if tested multiple times for the same object will produce the same value (15).

3. Methodology/Materials

The methodology used in this research is that of qualitative with literature review as the main resource, then clarified through Focused Group Discussion among lecturer/ professors. This verification concept evaluates the effectivity of learning outcome assessment based on students cognitive, affective, and psycho-motoric indicators.

4. Results and Findings

Learning is part of someone's change based on his experiences. That change could be seen from two aspects: behavioral and cognitive. Behavioral psychologists like J. B. Watson, E. L. Thorndike, and B. F. Skinner emphasize that learning is behavioral changes, by which someone acts in a particular situation. Meanwhile, cognitive psychologists like Jean Piaget, Robert Claser, John Anderson, and David Ausubel claim that learning is an indirectly unobservable internal process. Meanwhile, those of cognitive see those changes as someone's ability to respond to a situation (16).
There are many learning design models, one is developed by Winarno Surakhmad, Winkel, Hisyam Zaini, Briggs and Wager, Gerlach and Ely, and Kemp. From their models, the patterns and components between one another are different. However, the components include main components such as goals, materials, strategies, media, and learning evaluation (17). Goals are everything to achieve after learning process; materials are substances for students and teachers to learn; strategies are steps for students and teachers to take to achieve learning goals; media is the facility to help to deliver the learning material (18); and evaluation processes to identify learning outcome and its effectivity. Therefore, evaluation is one of the main components in, and thus inseparable from, the learning process.
Generally, evaluation has two main functions: to identify students learning outcome and teacher's assessment result (19). This goes hand in hand with the learning process in physics education department which endeavors to identify at which level the students have achieved learning outcome or determined competencies. On the other hand, teacher's assessment result is related to how able they play their roles as a planner, manager, leader, and learning evaluator (20).
Evaluation is also strongly related to assessment, which includes test and measurement. Anderson's definition of assessment is that it links with the patterns of how teachers make decisions. It is also viewed as an information-collecting process about students which could be used to make a decision in order to carry out learning process. Knowing that assessment is related to decision making and improving its quality, then the teacher must take it seriously by considering those test standardizations (21).
Decision-making process to carry out higher learning process must also consider assessment ethics, well-reviewed preparation, and test standardization. Educationally speaking, tests are one of the ways for measurements; and its arrangement includes rules such as guidance and scoring criteria (22). Tests are one of the instruments used in a research. Meanwhile, measurements are the score-applying procedure on the student's achievement (21).
Basically, assessments have goals: (1) to identify levels of mastery in competence, behavior, and knowledge particularly to be improved in remedial learning and enrichment program; (2) to determine the completeness of student's learning competence in certain period of time, which includes: daily, mid-semester, semester, yearly, and study credits; (3) to determine improvement or enrichment program based on competence mastery for those identified as "lagging" student; and (4) to improve learning process in the next semester.

4.1. Types of Assessment

According to its types, assessments are divided into two (23):
a. *Formative Assessment. This means monitoring how far a learning process has been carried out as planned.*
b. Summative Assessment. This means identifying how far the students have moved on from one learning unit to another. To do this, it is necessary to consider also assessment principles and techniques.

4.2. Assessment Principles

Learning outcome assessments are based on these principles (24):
a. *Valid, meaning the assessment is based on data that reflect measured capability.*
b. Objective, meaning the assessment is based on clear procedure and criteria, unbiased by the assessor's subjectivity
c. Fair, meaning the assessment does not benefit or disserve students due to special needs as well as religious, ethnic, cultural, customary, socioeconomic, or gender background
d. Integrated, meaning the assessment is one inseparable component from learning process
e. Open, meaning assessment procedure, criteria, and basis for decision making is well-known by relevant parties
f. Holistic and continuous, meaning the assessment includes all competence aspects and uses all appropriate competence techniques that the students must endure
g. Systematic, meaning the assessment is done according to plans and rigid steps
h. Accountable, meaning the assessment is reliable in terms of technique, procedure, and the outcome.
i. Educative, meaning the assessment is done for the student's interest and progress in learning process

Appropriate assessment type will very much determine the success of accessing information related to the learning process. The selection of assessment method must be based on the learning outcome target that students want to achieve. Five categories of learning outcome assessment that is appropriate as bases in determining assessment types used by teachers (25). Those five include:
a. *Knowledge outcomes: student's mastery of a particular field*
b. Reasoning outcomes: shows student's ability to extract his knowledge in reasoning and problem-solving
c. Skill outcomes, ability to show certain achievement related to skill based on knowledge
d. Product outcomes, ability to create a particular product based on knowledge mastery
e. Affective outcomes, certain behavioral achievement as the cause of learning and applying knowledge

For the five learning categories above, Stiggins offers four basic assessment techniques (25). Those are:
a. *Selected response assessment, including multiple choices, true or false, mix and match, and fill-in-the-blanks.*
b. Essay assessment. In this category, students are given a set of complex problems which require written answers such as explanation of the problem's solution.

c. *Performance assessment. This is a measurement of student's achievement in the learning process. It is mainly based on Observatory and evaluation activity to the process where skill, behavior, and products are shown by students.*
d. *Personal commitment assessment, including questions raised by professors during the learning process, interviews, discussions, conversations, and short-talks that require student's skill in expressing their responses or ideas.*

In collecting data, the teacher can use some assessment techniques complementarily, based on the assessed competence, as elaborated in the assessment guidance of each subject. Those techniques include:

a. *Work performance test. This includes written skill test, identification test, simulation test, and sample-selecting test. Through this test, students are asked to demonstrate their work performance.*
b. *Observation. This is done to collect qualitative and quantitative data according to assessed competence, both done formally and informally. Formal observation is done using the already designed instrument, while the informal using not-yet-designed instrument.*
c. *Assignment. This is done by projects or homework. Projects are a set of activities that are designed, done, and finished by students outside the class and must be reported in both written and oral forms in a particular amount of time. Homework is assignments to be finished by students outside the class, such as finishing questions and exercises.*
d. *Portfolio. The portfolio is a compilation of student's documents and works in a particular subject organized in such a way to identify their passion, progress, and creativity.*
e. *Written test. This is done in a form of test whose answers include choices and blanks. While the former includes multiple choice, true or false, mix and match, etc., the latter includes fill-in-the-blanks and essay.*
f. *Oral test. This is done through face-to-face communication between students and one or a couple of examiners. The questions are raised spontaneously and, of course, orally. This kind of test requires a list of questions and scoring guidance.*
g. *Journal. Journal is the teacher's note during learning process containing information on student's strength and weakness related to performance or behavior*
h. *Interview. This is done to gain in-depth information regarding student's insights, views, or personality aspect whose answers are given spontaneously and orally.*
i. *Inventory. This is a psychology-scale aspect used to reveal student's behavior, passion, and perception of a psychological object. Inventory includes the Thurstone scale, Likert scale, or semantically-differentiated scale.*
j. *Self-Assessment. This is an assessment technique by asking students to express their own strengths and weaknesses in various scopes.*
k. *Peer Assessment. This is an assessment technique by asking students to express their friend's strengths and weaknesses in various scopes.*

Learning and teaching outcome achievement have relation with learning outcome achievement which is inseparable from the education outcome itself. By paying close attention to that goal, the education is directed to fulfill competency improvement in three domains: cognitive, affective, and psychomotor. The three need to be achieved comprehensively and proportionally. While cognitive goal aims at making someone smart, and effective at making someone noble, that of psycho-motoric at making someone become skilled.

Parallel with education, learning outcome divisions consist of those three domains, pioneered and popularized by Bloom et.al. by proposing the term "education outcome taxonomy" (26). Then, that taxonomy is divided into more levels of each domain. The cognitive domain consists of 6 levels (from the lowest): knowledge, comprehension, application, analysis, synthesis, and evaluation. The affective domain consists of 5 levels: receiving (attending), responding, valuing, organization, and characterization by a value or value complex. Meanwhile, the psycho-motoric domain consists of perception, readiness, guided movements, accustomed movements, complex movements, adjustment of movement pattern, and creativity. By referring to the classification of education outcome thereof (cognitive, affective, and psychomotor), then the ideal education evaluation must cover those three domains comprehensively.

4.3. Verification Process

An assessment would be acceptable if the assessment passes the verification process. The right criteria required is an important aspect in arranging assessment techniques for the verification process. The required criteria should have an ability to improve the assessment conformity to learner's learning outcome. It includes cognitive, affective, and psychomotor aspects. The main objective of this assessment examination is to assure the assessment conforms to learner's learning outcome. Verification process should be done to look for mistakes or inabilities that might occur, and then there will be an improvement

Concepts of verification basically measured by the level of usefulness and usability (27). The way of Verification Concept of Assessment for Physics Education Learner's Learning Outcome is shown in Picture 2. The criteria used to consider the reliability of assessment could be seen from several principles as explained in (Ministry of Education and Culture,2014). The principles are: (1) legitimate; (2) objective; (3) fair; (4) integrated; (5) open; (6) holistic; (7) systematic; (8) accountable; (9) educative.

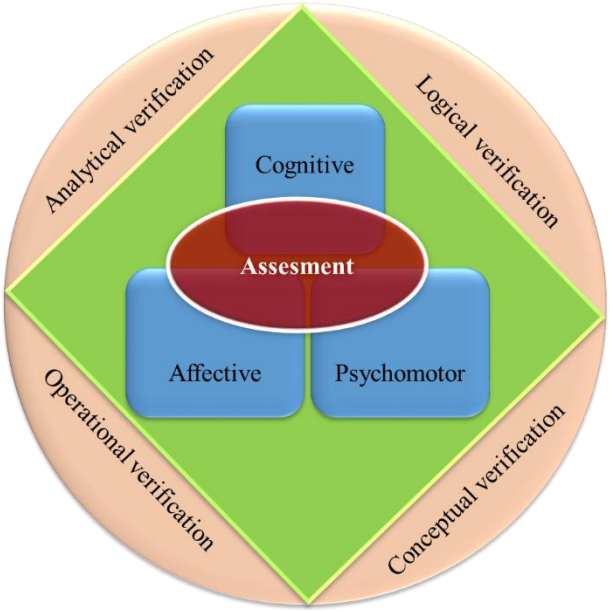

Fig. 1: Verification of Assessment Learner's Learning Outcome

The verification process of assessment starts from domain or skills which will be assessed until the evaluation process. Verification process submitted in this article uses evaluation in three stages of formulation, which are: (1) Learning outcome; (2) Principles and Standards; (3) Assessment Technique.

4.3.1. Analytical Verification

Analytical verification refers to learner's quality and degree of accomplishment through assessment technique which conforms to government's principal and standards. Analytical verification is technically done through analysis of affiliation between learner's learning outcome and assessment technique. Analytical process is a study of assessment technique which would be used in the learn-

ing process. Consequently, learner's learning outcome could be measured as it should be.
Learner's quality and degree of accomplishment between learner's learning outcome and assessment technique is determined by analytical verification. Analytical verification is used to help the observer in accepting or refusing instruments or questions based on consideration of conformity in assessing learner's learning outcome accurately and appropriately. Furthermore, the assessment technique will be accurate and appropriate. Analytical verification gives the observer information about conformity of assessment technique to required learning outcome.

4.3.2. Conceptual Verification

The concept is a set of meaning or characteristic which is related to event, object, condition, situation, or particular manner(28, 29). Conceptual assessment model could be defined as the depiction of assessment model based on point of view, achieved objectives, and the affiliation between learning outcome accomplishment which is measured by the approachment of improvement in cognitive, affective, and psychomotor ability. The degree of relevance from opinions and theories about assessment are used as a reference for assessment formulation which depicts the concrete and real learning outcome.
Conceptual verification requires the lecturers to give the students assessment to review the process of decision making. Conceptual verification assessment is used based on how far the assessment of learning process could explain the description, prescription, and prediction from learner's ability.

4.3.3. Logical Verification

Logical verification is used to examine the conformation between accuracy and conceptual assessment model in depicting the truth from the learner's real ability. In this situation, the paradigm of observation is a translation from conceptual model to relation symbols of inter-variable. In assessment context, logical verification could be done as an evaluation of assessment scale usage. The scale selection of quality score (0-100) or quality letters (A, B, C, D, and F) is one real example of logical verification. Logical verification reviews the assessment ability to consider things objectively with good reason towards the learner's ability correctly and measurably.

4.3.4. Operational Verification

Assessment technique is basically expressed through the formal model. The characteristic of the formal model is a reference to the operational, technical, and mechanical technique of assessment. Operational verification shows easy, qualified, and efficient operational from assessment technique of learner's learning outcome so that the assessment technique used can be accounted for.
The ability of assessment technique to be operationalized in measuring learning outcome is one of operational verification measurements. Operational verification is an analysis of assessment in operational stage of assessment to explain the accuracy of principal and standard in measuring learner's learning outcome. It is used to measure whether or not the students can comprehend the requirements of learning objectives as explained in results and discussion part. The comprehension towards assessment principal and standard needs to be reviewed comprehensively. It is because there might be an obstruction of operational assessment towards the assessment objects. For example, there is an obstruction of learner's domain or skills. Operational verification is an evaluation of assessment principal, assessment standard, and assessment ability compliance to measure the learner's ability.

5. Conclusion

Verification of Assessment for Physics Education Student Learning Outcome is a method to measure the conformity of a technical assessment concept based on stages and criteria to acquire the depiction whether or not the depiction of assessment technique has already appropriate (match) with the assessment principles and learner's learning outcome. Verification of the assessment technique could be done through several approaches; they are analytical verification, conceptual verification, logical verification, and operational verification. Meanwhile, the verification process is done through the process of analysis, conceptualization, modeling, and operationalization. All stages are examined their conformity by using logical thinking, comprehension, experts' opinion, and observer's experience.

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