

# Multidimensional Science Education on Performance Assessment Comprehensively with Collaborative Project Learning Based Model: Philosophy Perspective

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**Abstract:** Competency-based learning requires an assessment instrument capable of comprehensively measuring learning objectives in the cognitive, psychomotor and affective domains. Therefore, an alternative assessment model based on performance is needed. The purpose of writing this article was to find out whether it is possible to comprehensively assess performance based on collaborative project learning in multidimensional science education from a philosophical perspective through literature study. Performance appraisal is a continuous assessment process through the process of collecting various activity-based information as an object of assessment in various ways and tools. Based on the results and discussion of the literature review, performance assessment is a continuous assessment process using various strategies and methods (multi-methods) where in this article the author combined collaborative project-based learning methods. Project-based learning provides opportunities for students to explore content and learning experiences using various ways that are meaningful to themselves and to conduct experiments collaboratively by combining various interrelated subjects. Exploration of authentic and complex problems based on tasks that have been designed to produce joint work for reporting project results. Collaborative project learning between subjects is essentially a learning system that allows students to actively seek, explore, and discover concepts and principles authentically by involving various groups as assessors through self-assessment and Peer Assessment. The comprehensive performance appraisal process is a multidimensional process and information is obtained from the assessment process on aspects of cognitive skills, attitudes, critical thinking, process skills and products as an integral part of the learning process by empowering students and educators.

**Keywords:** Performance assessment; Comprehensive; Collaboration project learning; Multidimensional science education; philosophy.

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## INTRODUCTION

Assessment instruments that can reveal a person's level of performance have not been fulfilled by the form of objective assessment (model paper and pencil tests), such as multiple choice, true-false, short answers and matchmaking. This is because these assessment tools which are often called conventional assessments are more suitable for measuring abilities in the cognitive domain. On the other hand, competency-based learning requires an assessment instrument that can comprehensively measure the

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three domains of objectives. Therefore, an alternative assessment model is needed, namely the assessment based on student activity or performance. The phenomenon of teachers having been trained, facilities have been added, and books have been provided, but the quality of the output (student learning achievement) has not increased, becoming a problem that must be addressed immediately. One of the reasons why various efforts to improve the quality of education are ineffective is that the planning cycle is too long.

Ball and Forzani (2007) criticize the failure of efforts to improve the quality of education. Because so far research has focused more on phenomena related to education, not on things that occur in the dynamics of learning, research is needed that addresses problems that exist primarily in education, namely research that is research-based problem-solving. Furthermore, according to Djemari, (2008), improving the quality of graduates can be achieved through the implementation of a systemic and holistic learning outcome assessment process. Based on the description above some problems arise related to the system and procedure for assessing student learning outcomes in competency standards-based learning.

School graduates must have competence, therefore there must be a relationship between competencies developed in school and skills in the world of work. There are three categories of skills, namely basic skills, higher-order thinking skills, and affective skills and traits. Basic skills include verbal communication skills, reading, basic arithmetic and writing. Higher make a decision. Affective skills and traits include: being responsible, positive attitude, interpersonal skills, work in a team, confident, flexible, adaptable, enthusiastic, motivated, self-disciplined, self-regulating, honest, with integrity and able to work without supervision.

The approach to the assessment of occupational science education skills should be in the form of a multidimensional assessment. Multidimensional assessment is an assessment process that includes assessed job skills integrated in qualification and related competency units. Therefore, job skills should be assessed in the context of the activities involved related to a systemic and holistic assessment process to describe the progress of student competency achievement.

## METHOD

In writing this article, the author used a study literature that was reviewed from various sources, especially from articles published in international journals and national journals, both those that have been indexed by Scopus and journals that have been accredited by SINTA. related to the topic or material of the article, data from various sources is reviewed, criticized and processed into a study for writing scientific articles.

## RESULT AND DISCUSSION

### *Multidimensional Science Education Philosophy*

The science product dimension (*scientific knowledge*) is related to the ontology aspect which is a competency regarding mastery of concepts, principles, laws, and theories in science which is the result of human invention to understand and explain nature along with the various phenomena that occur in it. The indicator of this dimension in science learning is being able to explain phenomena that have been observed or have occurred, able to predict events that will occur, and can be tested with similar experiments.

The science process dimension (*scientific processes*) is an aspect of epistemology in philosophy, its competence is about the method of acquiring knowledge, which is called the scientific method. This method in science is now a combination of the induction method and the deduction method. Indicators in science learning include: finding problems and formulating problems, observing and collecting relevant data, classifying data, formulating hypotheses, testing hypotheses, and making generalizations.

Dimension of Science Attitudes (Scientific Attitudes) related to the aspect of Axiology, having competence about beliefs, opinions and values that must be maintained by a scientist, especially when seeking or developing new knowledge and indicators in science learning, including curiosity, the attitude of wanting to get something new (originality), the attitude of cooperation, the attitude of not despair (perseverance), the attitude of being open to accept (open-mindedness), the attitude of introspection (self-criticism), the attitude of responsibility, free thinking attitude (independence in thinking), self-discipline

### Performance Assessment

Assessment of student performance in classroom learning is an assessment process that relies on student activities. Operationally, performance assessment is defined as “the process of gathering data by systematic observation for making decisions about an individual” (Berk, 1986). There are five key components included in the above definition, namely: process, data collection, systematic observation, decision, and individual. The definition of this assessment is the process of showing the existence of a certain time so that the performance assessment does occur at one point in time. The second component, data collection shows that performance appraisal uses many methods and tools. Thus, assessing performance requires creativity and strategy in choosing the right tool at the right time. Third, performance appraisal is a systematic observation. This indicates the need for careful planning before the assessment is carried out and emphasizes the aspect of continuity. This means that the appraiser as much as possible directly observes the subject.

The fourth element, the decision shows that this assessment is used as the basis/ reason for determining the status. The last one is individual. This confirms that the target of the assessment is an individual, not a program or a group of people. The above definition clearly illustrates that performance appraisal is not a momentary activity that uses only one tool. However, it must be a long-term assessment involving various tools and methods as well as systematic direct observation.

According to Popham (1995), performance-based assessment has a minimum of three characteristics;

- a. Multiple criteria, meaning that the performance of students is assessed based on more than one criterion. For example, the student's ability in language English is assessed for its ability in aspects of accent, syntax, and vocabulary.
- b. Specified based on prespecified quality standards, namely on each criterion by which student performance is assessed, clearly defined in the ongoing evaluation of performance quality and student work.
- c. The assessment is an opinion (judgmental appraisal), meaning that performance-based assessment cannot be separated from the factor of a person's level of expertise (subjectivity). This is different from multiple-choice tests which can use an assessment program without being influenced by one's expertise so that it is more objective and the level of reliability is quite guaranteed.

Thus, a brief description can be obtained, that the What is meant by performance appraisal is the process of collecting various activity-based information from a person as an object of assessment in various ways and tools to determine a person's status. Performance appraisal is a process that takes a long time and is continuous. The forms of performance assessment instruments can be varied, such as progress charts, work sample tests, and portfolios. Progress records are generally in the form of a graph containing a list of daily activities, achievement scores, and student names. This graphic form cannot be used directly to measure students' abilities. This record is very useful for educators to evaluate the learning process that has taken place.

A work sample test is defined as a test situation, in which a person who is being tested demonstrates one or more practical work activities sampled from actual work. The portfolio is a collection of student work in a certain period. As someone studying clothing design, then he can present the results of his design. For teachers/instructors, a portfolio is very helpful in observing the development of students' abilities over time to time (Grant, 2002).

Competency-based education systems require various types of evidence (sources of evidence) which indicate that a student has reached a certain standard of competence in a certain period. According to Purcell (2001), sources of evidence used in competency-based education can be in the form of observation, testimony (witness testimony), documents or authentic work, oral questions, written tests, project work, case studies, assignments field assignments (workplace assignments) and simulations of field activities (simulation of workplace activities).

According to f Deming et al. (1993), two stages need to be done in carrying out the performance assessment. First, define the purpose of the performance assessment to be carried out. To help identify this objective, some questions must be answered: a) what concepts, knowledge, and skills will be assessed? b) what should know student? c) at what level should students perform? c) knowledge type what will be judged: reasoning, memory, or process? Second, choose the type of activity. Several things must be considered in choosing the type of activity, namely: the time required, the availability of facilities, and how much data is needed.

### *Collaborative Project Assessment*

Assessment is carried out to assist teachers in measuring the achievement of standards, evaluating the progress of each student, providing feedback on the level of understanding that has been achieved by students, helps teachers in the next learning strategy. Assessment of collaborative projects between subjects is an assessment activity of a task that must be completed in time certain. The task is in the form of a series of activities ranging from planning, data collection, organizing, processing, presenting data, and reporting. Project assessment can be carried out in one or more basic competencies, can be carried out in one subject, several subjects, and subject clusters as well across unequal subjects. There are at least four things that need to be considered, in project assessment, namely: (1) Management ability, The ability of students to choose topics, find information, manage data collection time, and write reports carried out in groups. (2) Relevance The suitability of project tasks with subject matter content, taking into account the stages of knowledge, understanding, and skills in learning. (3) Authenticity, Great Project what students do must be the result of their work by considering the teacher's contribution is in the form of guidance and support for projects carried out by students. (4) Innovation and creativity, Projects carried out by students contain elements: of novelty (current) and finding something unique, different from the usual. Assessment is the process of collecting and processing information to measure the achievement of student learning outcomes. The implementation of the assessment in Senior High School refers to the Educational Assessment Standards and other relevant assessment regulations, namely the criteria regarding scope, objectives, benefits, principles, mechanisms, procedures, and learning outcomes assessment instruments students who are used as a basis for assessing student learning outcomes in primary and secondary education.

Regarding the assessment, there are several things to note including the following: (a) the assessment carried out by the teacher should not only be an assessment of learning (assessment of learning), but an assessment for learning (assessment for learning) and assessment as learning (assessment as learning); (b) assessment is directed at measuring the achievement of basic competencies (known with KD) in Core Competencies (known with KI), namely KI-1, KI-2, KI-3, and KI-4; (c). The assessment uses reference criteria, namely an assessment that compares the achievements of students with the specified competency criteria. Results The assessment of a student, both formative and summative, is not compared with the results of other students but compared with the mastery of the specified competencies. The specified competency is minimum learning completeness which is also known as the minimum completeness criteria; (d). Assessment is carried out in a planned way and sustainable, meaning that all indicators are measured, then the results are analyzed to determine the basic competencies that have been and have not been mastered by students, as well as to find out students' learning difficulties. The results of the assessment were analyzed to determine the follow-up, in the form of remedial programs for students with the competence achievement below: completeness and enrichment programs for students who have met completeness. Assessment results are also used as feedback for teachers to improve the process of learning (Hutchings, 2007).

### *Psychomotor /Skill Aspect Assessment*

Performance or performance or performance is a form of action physically, either in the form of body movements or limbs in doing something. So, relating to the psychomotor domain in Bloom's taxonomy or relating to the term sensorimotor in Bloom's new taxonomy. On the other hand, there is a performance that is a combination of psychomotor/sensorimotor abilities and cognitive abilities, for example, the performance of people dancing while singing because he has to show skills gestures must also use the brain's ability to remember what was sung. In addition, there is also a purely cognitive performance because it only relies on the ability of the brain. A performance in certain respects is very simple because it shows only the motor aspect. For example, when a student is asked to make a movement walking with straight steps, bending the body to form a right angle, stretching their arms straight out to the sides, lifting weights to chest level, etc. The criteria for stating right or wrong on such performance are also very easy. Motor performance in the form of complex movements, for example, rolling around on floor gymnastics while catching a ball or rattan circle. The criteria for stating true or false become more complex because of the combination of movements in it (Hutchings, 2006).

Complex psychomotor performance has a series of stages which are work steps/procedures. Therefore, in determining right or wrong, it is seen from accuracy in carrying out a stage and can also be seen from the sequence of stages it goes through during carrying it out. For example, students who are

asked to measure the body temperature of their partner students using a manual thermometer can be judged right or wrong when they held the thermometer when lowering the mercury to the lowest extent, where they place the thermometer on the body of the party being measured, the position of the thermometer, the length of time he uses to stick a thermometer on the body of the party being measured, and so on until how the position of the eyes when reading the scale on the thermometer, the numbers mentioned are there on the thermometer scale, and finally insert the thermometer into its case. Maybe the sequence is right but at some stage, he did it wrong. It is also possible that each step is correct but the order is wrong. Brain-related performance is a performance that involves mental processes or mental processes thought processes to produce a product. This performance can be said completely involve mental processes if the results are realized in written form (Hutchings, 2007).

Performance in the form of composing activity plans, scientific essays, free essays, prose, poetry, and the like what is written in writing is written (paper and pencil tests). However, the written test is to express the results of thought in the form of a written product so it is also called the written skill test. The skill writing test is of course different from a written test whose purpose is to measure mastery of knowledge. This can also be suspected from the characteristics of the item. Skills written test items are "commands" instead of in the form of a "question". Command words such as "compose", "make" and the like is a feature of the written skill test item that distinguishes it from the written test to measure knowledge mastery. Thus, the written test of measuring skills the performance of students in producing products. It has also been explained that the cognitive domain includes the ability to remember (to know), understand (to comprehend), apply (to apply), analyze (to analyze), evaluate (to evaluate), synthesize (to synthesize), imagine (to imagine) and to create (to create) (Alquraan et al., 2010).

Students can only perform a performance if they can remember, understand, and apply the existing work steps. They also must have the ability to analyze cause-and-effect relationships so that they can take into account the risks/errors that may occur from each alternative action to be taken. They must also have the ability to evaluate to determine whether the action or decision taken is appropriate so that they can synthesize a sequence of appropriate actions to generate a new work step. One must also be able to imagine to think about the consequences that will occur far in the future with the conditions that would occur, and he must be able to create a new work step to produce a new product accompanied by hypotheses and a design that can guarantee that the resulting product is truly new. Thus, the results of creation can be obtained optimally. For example, someone who is asked to design an experiment must know how to find the problem to be studied, he must understand libraries that are relevant to the problem to be studied. He must be able to choose the research procedures that will be outlined in the research method following the results of the research experimental characteristics that distinguish it from other methods than experiments. Thus, the product in the form of an experimental design that is produced meets the criteria set (Marhaeni, 2005).

Performance measured through *identification tests* leads to products in the form of decisions taken by students when faced with stimuli captured through the five senses. Through the sense of sight, students are asked to identify sentences that do not qualify as sentences in the lesson Indonesian. Students in the field of biology are asked to mention the name of the preparation visible under a microscope or name an animal by looking at it the picture or seeing the real animal, students can also be asked to name an animal after the sound is heard. Learners In the automotive sector, they are asked to identify damage to a machine/motorcycle after their voice is heard. Students in the science field are asked to distinguish between oil and water with the same color using the sense of smell. Students in the culinary field are asked to distinguish the taste/quality between dishes by using their sense of taste. Students in the science field are asked to identify the level of surface roughness of the leaf blade or students in the field of Crafts is asked to identify the roughness level of a woven fabric by using the sense of touch.

Performance measured using a simulation test (*simulation test*) leads to the performance of performing a task. Therefore, what is measured is the accuracy of carrying out the procedure. Through a simulation test, students are asked to demonstrate their ability in situations that are similar to the real situation. Through observation of the demonstration/demonstration displayed will be able to measure the level of competence in doing so. However, the simulation test results will not be identical to the results test when students perform in actual action. The advantage is that through simulation tests, data can be obtained quickly. For example, students in the medical field are measured for their ability to inject injections by demonstrating them inject a doll. Students in the field of agriculture measured for their ability to demonstrate the grafting process (Anderson & Krathwohl, 2001).



The performance measured using a *work sample test* is the performance in mastering procedures and products or just procedures. In this case, students were asked to demonstrate their abilities in real situations. Of course, this test will be suitable for performance that requires a short time. Students in the field of electronic engineering are measured for their ability to assemble an electronic device. Students in the automotive part were measured for their ability to adjust the engine. Learners in the field of biology, the ability to observe the preparations below is measured microscope. Students in the culinary field are measured by their ability to cook a dish, Cook. If the procedure has been mastered by students, only the product can be assessed (Azwar, 2005).

In the learning process, it will be more effective if the criteria for a product are targeted been introduced before. The existence/determination of product criteria to be generated will be a reference for both teachers and students during the learning process mentoring. Thus, the guidance will run effectively and efficiently. For example, students are targeted to be able to compose a diagram/graph. So that If the correct diagram/graph is produced, students need to be introduced first to criteria related to diagrams/graphs. In the context of measurement activities Even for complex work, it will become clear the quality of the product will be assessed if the criteria are stated. For example, if students are asked to arrange or make a scientific essay, the criteria for the scientific essay to be assessed must be known. For example, what is the scope, is it necessary to include an abstract, how long is the page, the size of the paper, the size of the spacing, the structure of the writing of a scientific essay compiled, along with how to write the literature. With clear criteria, it will be clear to scientific essay products that must be prepared by students (Babbie, 2004).

#### *Assessment of Attitude/Affective Aspects.*

The instrument for measuring the attitude/affective aspect is highly dependent on the technique used chosen. There are many techniques such as observation techniques, interviews, inventories, questionnaires, self-reports, peer assessments, and self-assessments. Observation and interviews can be carried out using observation guidelines and guidelines interviews, inventories, and self-reports can use a questionnaire in the form of a questionnaire and a scale. Peer assessment uses the peer assessment sheet. Self-assessment can be using a self-assessment sheet in the form of a student journal. Questionnaires in the form of questionnaires are intended to reveal facts, while questionnaires are aimed at revealing facts in the form of scales such as the Thurstone scale, Likert scale, Guttman scale, and the semantic differential scale to measure perceptions or opinions. Even though it has been reviewed and revised, it does not mean that the assessment instrument is ready to be used. The instrument needs to be tested before use. Trials can be carried out before the instrument is used for assessment data collection This is called a separate trial. The trial can also be carried out simultaneously with the collection of assessment data, which is called a used trial. In separate trials analysis is based on trial data used for instrument improvement. On the test trial used instrument analysis is based on initial data and assessment data is based on eligible instrument items. The things that were tested were not only related to the substance aspect but also related to the readability aspect (Chatterji, 2002).

## **CONCLUSION**

The comprehensive performance assessment is a multidimensional process and information is obtained from the assessment process on aspects of *cognitive skills*, critical thinking, attitudes, process and product skills as an integral part of the learning process by empowering students and educators.

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