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PROBEXCON IN LEARNING SCIENCE

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ABSTRACT

Conventional learning is needs to be modified in order to generate maximum learning outcomes. Efforts are being made among others by innovation in learning. The innovation starts from the preparation, implementation, evaluation, until the remedial and enrichment. Probexcon (Perdict, Observe, Explain, Conclution) is a one innovation in teaching science. Learning Probexcon implemented through four stages as follows: (1) Creating Predictions. In this activity, students are exposed to a condition and were asked to predict what would happen if the situation is changed. Students are encouraged to take risks in making its and discuss the reasons; (2) Conducting Observations. At this stage students perform observations of the activities that have been planned through experiment or observe the activity demonstrated by others; (3) Make Explain. At this stage students discuss their predictions and observations. Students are mention and explain the differences between the results they expect with what actually happened; (4) Making Conclusions (conclution). Students are the teacher guidance drawing conclusions from the study. The next teacher's job is to give a commitment to equalize the students' understanding of scientific concepts which may differ from those predicted. Learning science with Probexcon expected to improve learning outcomes

Key Word: probexcon, learning science

INTRODUCTION

Teaching is not a static activity, but it is a dynamic interaction among several factors. These factors consist of social conditions, the development of thinking, learning theories, and technology, personal and intellectual aspects of the student. Teachers must be able to integrate all of these factors in order to obtain the possible learning outcomes, it means that the learning methods applied by the teacher can provide opportunities for students to develop their intellectual abilities and meaningful to students.

Material in science has a higher degree of difficult more than the others. This feeling of course, need to be addressed by educators as an effort to improve the mastery of learners in understanding the material presented science.

The fact is that conventional learning methods still dominate in teaching and learning science. Conventional learning common is in the form of lectures, the method of delivery of information by the teacher as a speaker to the students as a group of listeners. The situation is not pleasant, conventional teaching methods can lead to low student interest, because this method is less attractive, hinder student responses, and restrict memory of students. Therefore, it takes learning methods, innovative, and providing a climate conducive to the development of reasoning power and creativity of students.

Identification problems that exist in this study and often happens in science learning, for junior high school are as follows: (1) During this time the students still passive in learning science, (2) Low student's understanding of the concept of change agents , (3) learning method which has been used less interesting, less innovative and less conducive to develop the power of reasoning and creativity of students.

One alternative method that can be applied in teaching and learning science is learning methods Probexcon (Predict-Observe-Explain-Conclution) Probexcon learning method is based on constructivist learning theory which gives students the opportunity to realize what had become of their prior knowledge. They interact with the tool material, make a prediction

(predict), test the predictions through observations (Observe), and then put forward an explanation of the phenomena they encounter (explain). After that, they test and refine the explanation, or even modify it. (Conclution) Make summeriye from explanation above.

Implementation of logical thinking ability is important in Natural Science learning (Purwanto, 2012), so teacher must provide stimulus by making assessments that could establish students thinking pattern such as memorizing, remembering, understanding to apply, analyzing, interpreting, evaluating, and creating so they can form logical thinking ability. Assessing process is a systematic process in collecting, interpreting and using information to increase students' quality (Bekiroglu, 2008). Assessment is viewed as integral part of learning process to support the achievement of learning purpose (Delandshere, 2002).

Generally procedural assessment process of Natural Science uses cognitive test that can measure students' ability to interpret data and obtain a conclusion through scientific process (Wenning, 2007). Natural Science (IPA) relates to how to explore nature logically, so it is not only a mastery of Natural Science collection in form of facts, concepts or principles, but also a process of finding out what are able to do with inquiry process, so the integrated implementation can be done by using theme (Depdiknas, 2006). Natural Science (IPA) learning with Light and Vision theme which is a combination from Physics and Biology uses webbed integrated model which is an integrated learning with thematic approach as the learning basic, so it can motivate and help students to see relationship of each idea (Parmin, 2013).

Inquiry is a process that can be used in learning process by referring to the ways of defining problems from the existing phenomena, conducting trials to answers the problems, finding out information relating to results and communicating them (Vajoczki et.al., 2011). According to Balim (2009), inquiry-based Natural Science learning can construct students' perception skill because it can lead students to understand natural phenomena by cognitive and work skill. Wenning's (2007) research investigated inquiry-based Natural Science learning assessment, and finally produced *Scientific Inquiry Literacy Test (ScInqLiT)*. The research applied inquiry in a Natural Science test instrument containing 40 multiple-choices questions including fields of Physics, Biology and Chemistry based on inquiry indicators. One of purposes of inquiry learning is constructing students' logical thinking skill.

Purwanto (2012) in his research showed that implementation of inquiry in learning and assessing process could determine students' logical thinking up to 34.81%. It shows that inquiry could be implemented in learning and assessing process (Alberta, 2004). The implementation of inquiry in cognitive assessment can be included to questions that lead students to observe, define questions, make presumptions, make a plan, review materials that are understood, analyze and interpret data, and then make a conclusion. Logical thinking skill is a process of collecting knowledge based on reasons or logical reasoning (Sukayasa, 2012). According to Tobin &Capie in Valanides (1997), measuring logical thing skill based on Piaget's mental development theories to divine students into concrete, transition and formal operation stage by Test of Logical Thinking (TOLT), and to assess students' logical thinking doesn't always uses TOLT, but it can use modified test instruments based on indicator components in TOLT. There are five components in TOLT: (1) *controlling variable*; (2) *proportional reasoning*; (3) *probabilistic reasoning*; (4) *correlational reasoning*; (5) *combinatoral reasoning*.

Result of observation and documentary analysis in SMP (Junior High School) 1 Jati Kudus and SMP Negeri 3 Batang shows that Natural Science learning assessment is not fully integrated, still separated between Natural Science materials of Physic and Biology with questions of memorizing and understanding typical, while Natural Science learning actually needs advanced thinking skills, one of them is logical thinking skill. Furthermore, an assessing instruments that can train students' skill starting from memorizing and understanding to apply, interpreting, evaluating, creating and logical thinking, by doing assessment based on inquiry and logical thinking indicators is needed to be used to measure students' logical thinking skill

Based on background problems above, inquiry-based instruments on Light and Vision theme are developed to measure students' logical thinking skill. This research focus on "How is the process of developing inquiry-based Natural Science in Light and Vision theme, and how to know that the developed assessment can measure students' logical thinking?"

Purpose of this research is to develop and determine whether inquiry-based Natural Science assessment can measure logical thinking skill.

METHODS

This research was conducted in Junior High School 1 Pringapus. Samples in this research of grade VIIB, consist of 38 students, 15 male and 23 female. Research design used Classroom Action Research

(CAS). Classroom Action Research is the research conducted by the teacher in the classroom or the school where he taught with an emphasis on the improvement or enhancement of learning processes and praxis. CAS implemented in order to improve and / or enhance the practice of continuous learning which is basically attached to the implementation of professional educational mission carried out by the teacher. The principle of the implementation of the CAS includes four stages, namely planning, action, observation and reflection.

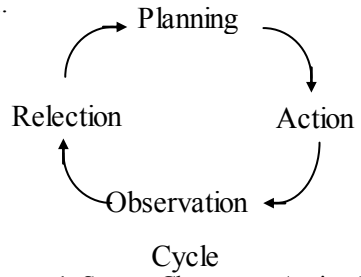

Figure 1. Stages Classroom Action Resarch

Methods of data collection in this research consist of qualitative and quantitative. Qualitative data consists of: (1) documentation; (2) the observation of scientific attitude of students; (3) the observation skills of students; and (4) the results of interviews with the teacher and the student observer. Quantitative data is post tests and assessment of worksheet.

Analysis data used two technic are qualitative and quantitative. Quantitative analysis used to describes the results of observations conducted observer towards learning. Quanlitative analysis used to calculate post tests and assessment of worksheet.

RESULT AND EXPLANATION

Before coming up with result, assessment is validated by experts. Validation by expert includes expert of assessment, Natural Science materials, and language. Expert validation toward the developed assessment includes 2 stages. Stage I validation includes assessment of components completeness in the inquiry-based Natural Science assessment. Validation result by each expert in stage I got average score 10 (100%) and was included in very good criteria, so it could be carried on the stage II assessment. In validation stage I, it received suggestions.

Assessment validation continued to validation stage II after the result of stage I validation was revised. Stage II validation was conducted with three experts: assessment expert, Natural Science material expert and language expert by using modified National Education Standard (BSNP) including: (1) components of content, evaluation and presentation by assessment expert; (2) components of Natural Science content and material by Natural Science material expert; (3) components of language by language expert.

Table 1. below shows that stage II validation by 3 assessment experts gets average score 66 (91.67%). This score is included to very good criteria, so it is valid to measure students' logical thinking skill although there are some parts that should be revised especially in questions which only implement formula and accuracy of inquiry and logical thinking indicator in each question.

Table 1. Recapitulation of Stage II Assessment Validation

No	Validation Expert	Total Score	Average Score	Average Percentage	Criteria	Description
1	Learning Assessment	198	66	91,67%	Very Good	Valid
2	Natural Science Material	150	50	98,03%	Very Good	Valid
3	Language Expert	219	43,8	84,23%	Very Good	Revisions on 9 assessment points
	Average			91,31%	Very Good	Valid

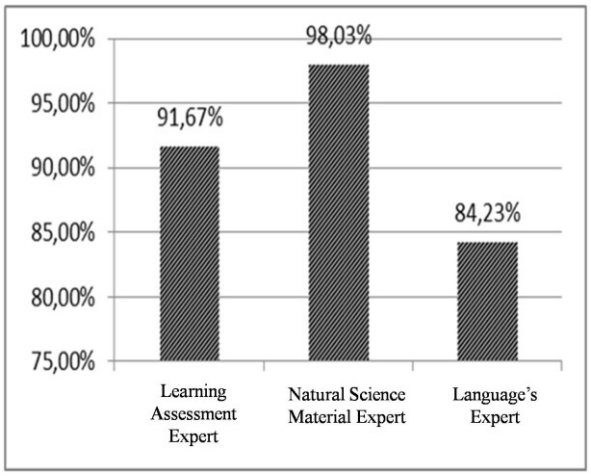

Figure 1. Recapitulation of Validation Assessment

Average score from stage II validation result by 3 material experts was 50 (98.03%). This score was included to very good criteria so that Natural Science materials of Light and Vision can be considered to be valid and without misconception, and suitable with students' development level. Stage II validation by 3 language experts came up with average score 43.8 (84.23%). This score was included to very good criteria but received revisions on 9 assessment aspects including language suitability with students' development level, communicability, accuracy of sentence structure and terminology, and suitability with correct Indonesian language rules. After the assessment was revised based on inputs and suggestions from experts, then it was tried to small scale with limited samples amount. Researcher took 10 students from grade VIII A.

Small scale trial aims to determine students' and teacher' responses toward readability of inquiry-based Natural Science assessment that is improvised. Student response result on the small scale trial is good in average (Table 2), with average percentage 78%; and score 76.67% from teacher response result and included to good criteria. All statement aspect got score 3, except on number 5 statement that is development of inquiry-based Natural Science assessment in which questions referring to inquiry and logical thinking indicators exist, get score 4. Inputs from small scale trial were then revised including figure reference revision, levelling description of answer options and explaining figures. After being revised, the assessment that was improvised is ready for large scale assessment trial.

Large scale assessment trial aims to: (1) determine student and teacher response by using questionnaire (Table 2); (2) collect data for questions' validity including validity, reliability, distinguishing capacity, and difficulty level of questions.

Table 2. Recapitulation of Student Response to Large and Small Scale Tests

Question Items	**Small Scale (10 students)**	**Large Scale (34 students)**
	%	**%**
Student's attraction to the assessment	70	88,23
Usage guidance is clear.	77.5	90,44
Materials are easy to understand.	75	80,15
Scientific terms are easy to understand.	70	77,21
Language is easy to understand.	75	89,71
Figures in the assessment ease students.	85	93,38
Students' understanding on assessment content	80	89,71
The assessmentincreases curiosityand doing investigation step or advanced inquiry.	80	86,77
Assessment appearance isinteresting.	90	91,18
Questions ability to lead students think more logically.	77.5	90,44
Average Percentage	78%	87,72%
Criteria	Good	VeryGood

Student response result (Table 2) from small scale trial to large scale trial happened to increase, because revisions had been done to the developed assessment by revising figure reference in questions, explaining figures, making percentage for answer options (A, B, C, and D) in level portion.

Table 3. Recapitulation of Teacher Response to Small and Large Scale Tests

Question Items	Small Scale Scores	Large Scale Scores
Assessment development is suitable with learning purpose.	3	4
Questions framework is clear.	3	4
Assessment is suitable with the framework, logical thinking and inquiry indicator.	3	4
Question difficulty level based on taxonomy	3	4
Questions refer to logical thinking and inquiry indicator.	4	4
General guidance is clear.	3	3
Assessment usage guidance is clear.	3	4
Language is easy to understand.	3	4
Reading texts are systematically presented.	3	4
Questions in the assessment are considered to be able to increase students' curiosityto do advanced inquiry activity.	3	4
Figures in the assessment are clear.	3	4
The assessment is able to stimulatestudents' logical thinking	3	4
Teachers are eased to measurestudents' logical thinking	3	4
Flexible if it is used by other teachers	3	4
Assessment appearance is interesting.	3	4
Total	46	59
Percentage	76,67%	98,33%
Criteria	Good	Very Good

Recapitulation result of teacher response questionnaire (Table 3) shows that the totally developed assessment: (1) is suitable with KI and KD, inquiry and logical thinking indicator, and questions framework is clear and suitable with aims and competence that will be achieved; (2) difficulty level of questions is suitable with Bloom taxonomy (C1 until C6); (3) questions don't only contain memorizing typical, but also stimulate students to analyze, think logically, based on student development level with understandable language; (4) can construct students' logical thinking skill and is able to increase students' curiosity to do investigation or advanced inquiry process for it is supported by readable knowledge; (5) has interesting appearance, flexible to be used by other teachers and ease to measure student logical thinking skill.

Second purpose of large scale trial is to collect data of questions analysis. According to Arikunto (2009) a test be said as good to be measuring instrument if it fulfills test terms; they are to have: (1) validity; (2) reliability; (3) difficulty level; (4) distinguishing questions capacity. Inquiry-based assessment instrument that had been developed then was tested to 1 class of 34 students, the result was later processed by using *Microsoft Excel*. Analysis result of question validity shows that 35 questions in the developed assessment is valid and can be used further to measure students' logical thinking skill.

Second analysis of questions is reliability. A test is considered to have high reliability if it gives relatively constant result when it is used in other moments (Arikunto, 2009). Based on calculation of question reliability, it was acquired r_{11} value as many as 0.883. r_{11} value was consulted with r_{table} with significant level 5% and n = 34 resulted r_{table} value 0.399. So, it can be concluded that questions in inquiry-based assessment instrument is considered as reliable, because value of $r_{11}>r_{table}$. Result of questions difficulty analysis in the developed assessment shows that 11 questions are difficult, 22 questions are medium, and 17 questions are easy from the total of 50 questions.

Analysis of question difficulty shows that 22 of 50 questions are good questions, because they have medium level of difficulty. Result of distinguishing question capacity analysis shows that amount of questions and question numbers with very good criteria are 4, good are 17, enough are 20, bad are 7 and negative are 2 from total of 50 questions in the developed assessment. Result of student and teacher response questionnaire shows that the developed assessment is good, because revisions was done to it after small scale trial, while result of questions analysis shows that 35 questions are valid, the difficulty

level of questions is difficult, medium and easy, then the distinguishing capacity is enough, good and very good.

As many as 35 of 50 questions in assessment were later used for usage test. Result of questions analysis and expert validation showed that assessment instrument was valid, so it could be used in assessment usage test to measure students' logical thinking skill. The usage test was conducted by providing assessment instrument containing 35 questions to 32 students of grade VIII E. Result of the usage test (Table 4) was used in analysis of assessment empirical evidence to determine whether it is able to measure students' logical thinking skill stage or not.

Table 4. Recapitulation of Students' Logical Thinking Skill Stage (Usage Test)

Logical Thinking Stage Criteria	∑	%
Concrete Thinking Stage	2	6,25%
Transitional Thinking Stage	11	34,375%
Formal Thinking Stage	19	59,375%
Number of Students	32	

Data of students' logical thinking was analyzed by using descriptive analysis recapitulated in Table 4. Result of usage test as empirical evidence on the ground shows that the developed assessment is able to measure students' logical thinking skill. According to Piaget in Valanides (1997), a person who has logical thinking skill has a development on formal operation level which is in the age of more than 12 years old. In this stage a student has had an abstract thinking skill in hypothesis and logic. Result of assessment usage test (Table 4) shows that 59.375% students of grade VIII E State Junior High School 1 Jati Kudus for academic year 2013/2014, from a total of 32 students who did inquiry-based assessment with average age of 14.5 years old, had formal thinking level in the stage of logical thinking skill. It means that every knowledge the students get is based on logical reasoning (Sukayasa, 2012).

Result of usage test is suitable with Piaget's theory of that a child or a student has been able to think abstract and logically, although there are still some students who are in the stage of concrete thinking (2 students or 6.25%) and transitional thinking (11 students or 34.375%) since the age of 10-12 years old is human's transition time from child to teenager, so it is possible that in those ages there are still some children who think concrete or even transition in order to go through the nest stage of logical thinking in formal level.

CONCLUSION

Based on the result and explanation above, it can be concluded that the process of developing inquiry-based Natural Science assessment using Research and Development (R&D) steps, and inquiry-based Natural Science assessment on Light and Vision theme, can be used to measure logical thinking skill of grade VIII students based on experts validation, questions analysis and usage test.

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