ISBN 979-979-99232-4-0

PROCEEDINGS

5th International Seminar on Science Education

"Strengthening Science Education through Continuing Teacher Professional Development"

Bandung, November 12th 2011

Editors:
Kusnadi - Yanti Herlanti - Wiji
Jayus Riyadi Sholihin -Ismail Fikri N - Husni - Sudirman - Siti Mutiara N.A - Renia Debi Lestari

Published by:
Science Education Program
School of Post Graduate Studies
Indonesia University of Education

Development and Validation Physics Concept Understanding Assessments of Biology Education and Chemistry Education Students

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ABSTRACT

A study about development and validation of test items in Physics concept for non physics student was conducted to describe the results of assessment to measure physics concept understanding of biology education and chemistry education students in context and non-contextual versions assessments. The "contextual" assessments was developed based on "non contextual" assessments. Content validation involved expert judgment. First try out and revision obtained 20 mutiple choice items with 4 options for each version. This assessments were tried out toward a number of students' of biology education (n=315) and students of chemistry education (n=302) from "LPTKs" in Bandung, Yogyakarta, Solo and Palembang as research subjects. The data was analyzed with two different software programs: anatest and iteman. The result showed that 20 items for each version fulfill good requirement of instruments.

Keywords *: "non contextual" and "contextual"assessment, understanding of physics concepts, biology education and chemistry education students'.*

INTRODUCTION

Science education has high potency and strategic role in preparing qualified human resource development towards era of industrialization and globalization. This potency can be achieved when science education can result in smart students in their field and can develop their logical thinking, their creative thinking, their ability in problem solving, critical attitude, and can master technology as well as have the adaptability towards global changing and development. It is very important if the Educational Institutions can always improve their quality of education in general, especially the quality of science education. Nevertheles, some Educational Institutions have not optimally play their role. Some studies indicated that the quality of science education was not very good. According to Sidi (in Hinduan, 2007) it was the teachers who should act as the main actors in education in order to come to qualified and efficient educational system.

Standards for Science Teacher Preparation (NSTA, 2003: 11-13) stated that recommendation about content standard thats should be mastered by Biology teachers and Chemistry teachers consisted of *core competencies*, *advanced competencies*, and *supporting competencies*. For this supporting competencies, we have to prepare biology teachers effectively in applying mathematics and other science concepts for their biology instruction. In detail they should master fundamental concepts of: chemistry (general chemistry and biochemistry with basic laboratory technique); fundamental concepts of Physics (light, sound, optic, electricity, energy, magnetism, and thermodynamics); fundamental concepts of Earth and Space Science (energy and geochemistry cycles, climate, oceanografi, weather, natural resources, and the changes on earth); fundamental concepts of mathematics (probability and statistics).

Meanwhile Chemistry teachers should prepare themselves effectively implement mathematics and other science concepts in their chemistry instructions. They have to master fiundamental concepts of Biology (molecullar Biology, bioenergetics, and ecology); fundamental concepts of Earth Science (geochemistry, cycles of substance, and nergetics of geosystem); fundamental concepts of Physics (energy, evolution of the stars, characteristics and function of wave, movement and force, electricity and magnetism); mathematical and statistical skills and concepts (statistics and the uses of differential equition and claculus).

Toto (2008: 1) stated that based on interview and preliminary study to prospective biology teachers from Biology Education in one private LPTK in West Java the findings showed that prospective biology teachers could not understand why they had to take Physics course. Usually most of them was not interested in Physics course, sothat they were not interested in learning and considered it as difficult course. According to Giancoli (2001: ix) mathematics could be constraint to understand in learning Physics, whereas according to Cromer (1994: vii) approach by giving real examples with biology phenomena that illustrate every single physical principle did improve students' interest who in general do not interest to learn physics.

Research findings and NSTA recommendation showed that: 1) the use of complex mathematics in Fundamental Physics lecture especially for biology education and chemistry education study programs, that the students had difficulty in understanding the course; 2) contextually biology teachers and

chemistry teachers should be able to implement physics concepts in biology and chemistry instructions; 3) Relevan assessment was focused more on solving problem conceptually was very important and a must. Therefor, lecturers should select the right strategic instructions in order Fundamental Physics Teacher became more meaningful for the science education students.

One of instructional strategy, among others was the assessment forms to be used to solve problem with the help of using contextual approach. Contextual approach (contextual teaching and learning, CTL) was the right learning concept that enable students to help the teachers connect between the content that the student learned and the real students' condition and pushed them to make connection between their knowledge and the implementation in daily life as members of family, and members of society (Nurhadi, 2004).

In this study for each same Physics concepts two versions of assessment were constructed, those are non contextual version and contextual version. Non contextual assessment instrument was the assessment instrument on Physics understanding as implemented to students of Physics Education. Meanwhile contextual assessment instrument was the assessment instrument on Physics concept which are relevant to biology content and Chemistry content. Both two version instruments were aimed to give experience to prospective biology teachers and prospective chemistry teachers about the close relationships between physics and Biology, and between Physics and Chemistry. Based on the illustration mentioned above, in this paper it will be presented the results of development and validation of noncontextual and contextual physics concept mastery assessment in Fundamental Physics course for study programs of Biology Education and Chemistry Education.

RESEARCH METHOD

This study used Educational Research and Development method with some stages: designing assessment instrument based on field study and literature study, validation, conducting limited try out, analyzing result of limited try out, revising the assessment instrument based on try out result, conducting main and broader/larger try out. The main try out involved 315 students of biology education and 302 students of chemistry education from five "LPTKs" in Bandung, Yogyakarta, Solo and Palembang as research subjects. There were two types or versions of assessment for each study program: contextual version,

and non-contextual version. Each version consisted of 20 multiple choice test items assessment with four options. Examples of assessment about Physics concept mastery were presented in Table 3 and Table 4 in the Annex.

RESULT AND DISCUSSION

Based on field study and literature study, it had been chosen topics and assessment model that would be used as the basis to construct the instrument. Topics and subtopics was determined as tha basis to construct research instrument including: Fluid, Temperature and Kinetic Theory of Gases, Heat, Electricity.

Instrument was then developed based on the test item indicators which had been prepared previously, in accordance with selected topics and subtopics. Each indicator was then derived one test item on physics concept understanding with non contextual version, and then one test item for contextual version for biology education and chemistry education. Instrument with contextual version was actually instrument on Physics concept mastery related to biology and chemistry phenomena. These two version assessment instruments had the same cognitive aspects.

Table 5, Table 6, Table 7, Table 8 and Table 9 in Annex presented results of main try out from 20 multiple choice test items of assessment results with four options for each version and each study program. The criteria for selecting multiple choice test items was presented in Table 1 as follows.

Table 1. The Criteria for Selecting Multiple Choice Test Items

Criteria	coefisient	interpretation
item difficulty index	0,30 s.d 0,70	accepted
	0,10 s.d 0,29 0,70 s.d 0,90	revised
	< 0,10 dan > 0,90	rejected
discrimination index	> 0,30	accepted
	0,10 s.d 0,29	revised
	< 0,10	rejected
proportion distractor	> 0.05	

(Surapranata, 2006 : 47)

Assessment validity on concept mastery was tested its internal validity approach using point biserial formula: r_{pbi} (*point biserial correlation*). For the reliability, Ornstein (1990) gave criteria to interpret reliability degree of instrument as follows.

Table 2 . The Criteria to Interpret Reliability Degree

Reliability Coeficient	Interpretation
0,80 ≤ r	High reliability
0,40 ≤ r < 0,80	Medium reliability
r < 0,40	Low reliability

Based on research result presented in Table 5 up to Table 9 in the Annex, it seemed that all of the 20 multiple test items for each version was valid and fulfil! the requirement of good test items.

CONCLUSION

The result showed that physics concept understanding assessment for study programs biology education and study programs chemistry education students was valid and fulfill the requirement of good test items. There were two types or versions of assessment for each study program: contextual version, and non-contextual version. Each version consisted of 20 multiple choice test items assessment with four options.

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