Greener Journal of Educational Research
Vol. 4 (2), pp. 030-035, April 2014
ISSN: 2276-7789; ICV: 6.05

DOI Link: http://doi.org/10.15580/GJER.2014.2.021914117
http://gjournals.org/GJER

Developing Module of Practical Chemistry Physics SETS Vision Activity to Increase Science Process Skills of Student Teacher

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ARTICLE INFO

Article No.: *021914117*
Type: *Research*
DOI: 10.15580/GJER.2014.2.021914117

Submitted: *19/02/2014*
Accepted: *15/04/2014*
Published: *22/04/2014*

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Keywords:
Development, Activity Guidelines, SETS, Science processing skills, electrochemistry

ABSTRACT

Competencies required for prospective chemistry teachers include enhancer chemistry learning in the laboratory and field, designing experiment for learning or research, and carrying out experiments in the right method. For the time being, the implementation of Physical Chemistry lab work in Chemical Education Departmen of IAIN Walisongo was conducted through recipes models. Practical guidance and instrument have been provided by laboratory. The model therefore fosters less spirit in searching knowledge. To achieve competency of prospective chemistry teachers, the researcher has developed laboratorium guideline that feature SETS vision. The purpose of this study was to obtain a valid and effective guideline that feature SETS vision, which can be used as a reference in the laboratory work through R & D study. The learning materials which are practiced in the studies were electro-chemistry which includes: Nernst equation; electrolysis; electroplating. Based on the final analysis, the guidelines has an average score of 4 (Very Valid) from expert validators. 16 out of 21 students scored ≥ 70. It indicates that SETS can improve students' Science processing skills with N-gain of 0.6 (medium). The performances, preparation of reports, SETS discussions, and classroom presentation have high criteria. The developed guideline received high positive responses from students.

INTRODUCTION

Teacher education institution is an institution that plays an important role in improving the Human Resources (HR) in chemistry education sector. Workforce Education Institutions (LPTK) as the producer of chemistry teacher candidates must train them according to Teacher Competency Standards (SKG) which includes mastery in the application of the laws of chemistry related to chemical technology in daily life, using measuring tools, props, count tools to enhance learning in the chemistry laboratory and the field, designing experiments for chemistry teaching or research purposes, carrying out chemical experiments in the right way (Hamalik, 2009).

An approach that can be used to achieve the Teacher Competency Standards in applying the law - the laws of chemistry with technology in daily life is SETS (Science, Environment, Technology, and Society). SETS approach is expected to facilitate students in understanding the subject matter, so that the student can achieve a competent understanding, helping students to have the ability to look at something integratively to the four elements of SETS (Binadja, 2002b). The role of the student in learning SETS including: trying to always have SETS conception in learning, thinking and acting; participating actively in the activities that based on SETS conception; thinking about how to use knowledge gained through SETS; always have alternative thoughts, productive and have a SETS conception; willing to accept positive input to improve the quality of teaching and coaching career related to the field being studied. Research conducted by Yoruk (2009) concluded that "SETS visionary chemistry approach will direct the students to choose a future career field and give effect to the learning results of students". In addition, visionary SETS approach use learning evaluation instruments such as writing papers, articles, science proposal, experiments and concept development activities in simple technology. The aassessment according to Binadja (2006c) is based on the clear linkages between the information on each SETS elements developed by students.

Binadja (1999a) states that teaching SETS (Science, Environment, Technology, and Society) could encourage students to make investigations to gain knowledge related to science, environment, technology, and integrated society. Laboratory activities can arouse interest in learning and provide evidence for the theory or concepts that students learned, so that the theory or concept becoming something meaningful to the students' cognitive structures. In addition, the laboratory activity is a tool to develop and apply science- processing skills.

Science processing skills are skills in science learning including: observing, interpreting, predicting, using tools and materials, applying the concept, planning experiments and communicating the results of the experiment (Wartono, 1999; Akinbobola and Folashade, 2010). Science processing skills and knowledge are prominent and necessary to teach science milestone. Students need the processing skills to conduct scientific research and also during their learning process (Taconis et al., 2000 in Karsli, 2009).

Science processing skills are tool to understand and master the science knowledge, they are considered to have the primary goal for science education and laboratory settings. Pre-lab activity is essential to prepare the student's ability to understand the concepts of science and practice science-processing skills for the advancement of science education (Rezba et al., 2002 in El-Sabagh, 2011).

Accordingly, Physical Chemistry Laboratory activities are expected to improve students' understanding of the concepts of Chemical Physics and mastery of Science processing skills that can be a provision for students during the implementation of laboratory for research purposes. In this course, students are given the opportunity to perform their own experiments in the laboratory so that it would be associated with psychomotor aspects. According to Dahniar (2006), motor skills are associated with limb or actions that require coordination between nerves and muscles so they could improve Science processing skills.

Based on the result of field study during September-October 2012 to students majoring in Chemistry of Tadris IAIN Walisongo, practical guide which are used is a kind of food recipes. Students conducted lab work without good preparation, in the form of knowledge of theory or concepts. Lab results were made in a report but not discussed, this does not give the opportunity to students to communicate and discuss what is gained through practicum. Each experiment begins with a pretest and reporting activities, but students did not know the practical truth that had been implemented since there is no evaluation after the practicum. In addition, the practical guide used did not contain scientific concepts associated with problems in the environment using the technology created to give benefit to the community.

One of the strategies used to improve Science processing skills is the SETS visionary experimental method. SETS visionary activities guidelines in practicum courses in the Department of Chemical Physics Chemistry Tadris IAIN Walisongo can help students carry out practical work by involving students directly in formulating the problem, making a hypothesis, designing experiments, collecting and analyzing data and integrating the science, the environment, technology, and society. One of the efforts to increase student competence can be done with the consummation of Chemical Physics practical implementation, which uses SETS-based activities by measuring Science processing skills and science products.

The objective of this study is to obtain a valid and effective guideline that feature SETS vision, which can be used as a reference in the laboratory work through R & D study. While the benefits from this study are (1) provide information about: the validity and effectiveness of SETS visionary activity guidelines, effect of SETS visionary activity guidelines on Science processing skills of students and high student response to them, (2) SETS visionary activity

guidelines activities can associate or connect between science, environment, technology and society, so that students will achieve active thought patterns, integrated, critical, creative and caring attitude towards the environment, (3) contribute to the experimental model and college student.

RESEARCH METHODS

The method used is the research and development. The development of SETS visionary activity guidelines were developed using a model of Borg and Gall which includes several stages: research and data collection; planning; development; trials; limited trial; extensive trials; revision extensive trials. The study design used is one-group pretest-post-test design, where research results seen from the difference of pretest and post-test.

The subjects of the test were students of fourth semester practicum courses in the Department of Chemical Physics Chemistry Tadris IAIN Walisongo. Instruments used include a test of mastery of concepts about integrated science processing skills and non-test instruments such as quality assessment of activity guidelines questionnaire, validation of guidelines for activity sheets, sheet of validation problem, sheet of student performance observation, student presentation observation sheets, observation sheets discussion SETS expansion, assessment form and report writing student questionnaire responses.

RESULTS AND DISCUSSION

Research Result

Research is divided into 3 stages, namely initial data collection phase, the planning phase, development phase. Data collection phase, carried out literature studies and field studies. Field studies include direct observation, interviews with lecturers of chemical physics course, the analysis of existing guidebooks or have been used in the learning process, analysis of the material.

Direct observations are expected to directly discover the lab activities undertaken by the students. Direct observations carried out with the observation sheets and questionnaires. Based on the results of preliminary observations, concluded that students Science processing skills is very poor (the use of tools and materials , lab design, data interpretation, and understanding of the concept). According to the analysis of the questionnaire, the ability of students in connecting science concepts with elements of the environment, technology, people and applications in everyday life is also very poor. The ability of students to apply the concepts in solving problems in electrochemical daily life is also very poor.

The analysis of chemistry learning process is carried out through interviews with the lecturer of Physical Chemistry subject. Based on the results of the interviews, the physical chemistry lab learning has not SETS vision and invited students to apply the concepts taught to solve problems in everyday life, practical methods used are only verificative methods, and the activity guidelines used are still food recipes that do not encourage students to apply the concepts in a real context.

The planning stage aims to prepare and produce a prototype SETS-based activity guideline as an effort to improve student Science processing skills. SETS-based lab module characteristic developed include title and purpose, the concept of exposure, exposure to practical benefits to the environment, the introduction of tools and materials, materials science discussion and analysis of SETS. The design guidelines are not like the sequence of activities in the lab guide normally. In addition to the essential materials, the guidelines equipped with material activities related to daily life with pictures that support and emphasize material. Practicum conducted is an electrochemistry concept application in daily life to grow the science processing skills of students.

The initial design made subsequently validated by experts. Validation was an early stage of development. The third experts assessment of the quality of SETS visionary activity guidelines produced an average score of 4 (very valid) and validation of integrated Science processing skills produced an average score of 3 (valid) with a recommendation that it could be used with minor revisions.

In addition to validation by a team of experts, trials also conducted to test the mastery of the concept of integrated Science processing skills in 8 students of Tadris chemistry faculty of Tarbiyah IAIN Walisongo. The trial results were analyzed which included validity test, difficulty index question, power difference question, and reliability question. Based on the results of the validation team of experts and analysis about the trials, the researcher gained 20 questions of 25 questions which are proper to be used as post-test questions.

SETS-based activity guidelines which had been improved based on feedback from faculty experts, was then applied to the learning activities of electrochemical materials. At the end of the learning process using SETS-based activity guidelines, the final evaluation was conducted to determine the achievement of learning objectives, including significance test, N–gain test, and science processing skills test.

Psychomotor aspects of assessment used to measure the Science processing skills were the skills of direct observation. Affective assessment was conducted to determine the activities of students when learning was taking place. Summary results of students' psychomotor and affective aspects were presented in Table 1.

Table 1: Summary Results of the Students' Psychomotor and Affective Aspects

Students' Psychomotor and Affective Aspects	Score	Category
Students' activity during experiments	24/35; 28/30; 20/20	Very High
Presentation and discussion capability	3	High
SETS analysis discussion capability	4	High
Report writing capability	3	High

Students' questionnaire responses were given after the students had received learning materials using electrochemical SETS-based activity guidelines.

DISCUSSION

Validity of SETS-Based Activity Guidelines

The results of the validity of SETS-Based Activity Guidelines met the criteria of BSNP (2007). To get decent activity guidelines in the learning process, validity assessment of SETS-Based Activity Guidelines must meet criteria in the four components, which are the feasibility components of the content, language, presentation and graphic.

The validity result of SETS-Based Activity Guidelines by students included three aspects of quality assessment activity guidelines which are presentation aspect, linguistic, and appropriateness of the content. The average score of the three aspects has a validity response to the very high criteria. According to Trisnaningsih (2009), development of teaching materials said to be good and high if the average of all indicators is at least in the high category.

In this study, electrochemical materials lab activities using SETS-Based Activity Guidelines was implemented through inquiry approaches with the lower portion of mentoring, SETS analysis discussion, and a problem-solving discussion was implemented as well to improve Science processing skills. In addition, the learning activities were always conditioned to motivate students' active thinking, emphasize on student - centered learning activities during the development of science processing skills and individual and group assignments to improve student's science processing skills.

Another characteristic of the SETS-based guidelines is that experiments seen in any lab experiments which are being developed have always been associated with its application in real life and SETS elements. Experiments were designed to improve science processing skills (introduction of tools and materials, the determination of hypothesis, the determination of the variables, the application of the concept, as well as the experimental design) developed for students. Each learning activity always has evaluation report writing, discussion and analysis of SETS extension, and exercises to design lab experiments which improve students' science processing skills.

The differences between "traditional" experiment guidelines from activity guidelines were: a) Experiment guidelines in this study included experimental purposes. However, the purpose of this experiment was adjusted solely by the student based on the problems posed. b) Experiment instruction in this study did not include the procedure. The procedure was compiled by the students based on the principle of trial and introduction of experimental tools. c) Experiment guidelines in this study required students to define variables, create hypothesis, as well as making a series of experiments and test it through an experiment.

In the lab activities using SETS guidelines, students were given the opportunity to design a lab procedure, determine the tools and materials as well as a series of tools. According to Roestiyah (1985), the experimental method trained students to experience for themselves, follow a process, observe an object, analyze, and draw conclusions. In the experimental method, student could actively take part in doing for himself. Thus, students are able to acquire the necessary skills needed and steps of scientific thinking.

SETS-Based Activity Guidelines contained several applications or electrochemical material benefits in everyday life. Students were encouraged to seek further information about the application and issues of the existing problems related to the material in the electrochemical environment. Thus, students should be more active in gathering information and were required to think how to design or utilize technology to solve the problems that exist in the environment. In addition, students were asked to elaborate, describe, identify capabilities, and have the ability to infer the relationship of science, technology, society and the environment.

Effectiveness of SETS-Based Activity Guideline

Effectiveness Indicator of SETS-Based Activity Guidelines was seen from student responses to learning activities and SETS-Based Activity Guidelines. It was also seen from the mastery of concepts integrated with science processing skills on learning outcomes established, which 15 of the 21 students got Science processing skills scores of ≥ 70.

In general, students respond very well to guidelines and learning activities using SETS-Based Activity Guidelines. By looking at the results of the questionnaire, it was discovered that the students met the target response study which catagorized as a high positive response. Students gave positive response both to the learning process by using SETS-Based Activity Guidelines.

Participation of students in the group was also improved compared to the conventional learning. It was because the learning activities using SETS-Based Activity Guidelines implemented through lower guiding portion inquiry approach, as well as applicative discussions and practical activities undertaken by the

students in groups. In the portion of low guided inquiry activities, students were set to be independent to seek information from outside and then approved by the lecturer. This independence made a strong solidarity with each division of assignments respectively, which were a series of tools, and bill of materials and tools. In the discussion of analytical approaches SETS, students were trained to share tasks with other group members in completing the task group, helped other students' difficulties in the completion of assignments, presented the results of the discussion, and responded to questions submitted by students from other groups.

The results of the students' performance in carrying out practical work were in very high category. It was because the learning activities using SETS-Based Activity Guidelines trained students in the planning of research to obtain evidence in responding to questions, conduct experiments, communicate scientific procedures and explanations, make the relationship between variables, explain the causes of phenomenon, link the incident around the student with the concept which has been accepted in the learning process, and make the experiment results as a learning materials. This way, students became more accustomed in carrying out activities that train the skills so that their science processing skills would be improved, and indirectly, the students learning outcomes would be better.

Students are expected to like chemical physics by learning more, so the assumption that the chemical physics was difficult and only related to formula could be erased. It was also consistent with Haryadi (2003) who stated that SETS vision learning could improve achievement, interest and motivation to learn than in conventional learning. According to Indihartati (2008) and Baiti (2010), the application of SETS vision student activity sheet was shown to increase physical students' activity and learning outcomes than that of the students taught with conventional worksheet.

The Effect of Visionary Activity Guideline – SETS Learning on Students Science processing skills

This study aimed to develop SETS-Based Activity Guidelines to improve students' science processing skills. SETS-Based Activity Guidelines integrated with aspects of science processing skills were designed to allow students to work on independent experiment of the material being taught. Learning activities were directed to the analysis of activities, synthesis, and evaluation, as well as to improve the ability of students to apply knowledge to solve problems of everyday life (Dahniar, 2006). Significance test showed that the significance of learning (*Asymp Sig*) is 0.0. Since the level of significance < 0.05 then H_0 was rejected. So it could be concluded that there were differences in the ability of Science processing skills improvement between before and after the learning activities using SETS-Based Activity Guidelines. Based on the average (mean) it could be seen that the average achievement scores after learning Science processing skills are higher. This might imply that SETS-Based Activity Guidelines enhanced the ability of Science processing skills.

In a learning activity using SETS-Based Activity Guidelines, students were familiarized to work collaboratively and actively. Authentic assessment was done, and learning resources could be greatly expanded. It was in contrast with conventional lab experiment procedural which was familiar with procedural experiment situation, assessment results was more dominant to result than process, and learning resources tend to stagnate. The application of SETS-Based Activity Guidelines had shown that the approach was able to make the students experience significant learning process. Learning was developed based on the constructivism. Students were given the opportunity to explore their own reading material and information through the internet from various sources and to design and carry out scientific experiments independently, make presentations to others, communicate the results of the activity, work in groups, and provide ideas for others (Nurohman, 2008). As a result, students' learning outcomes were improved.

Science processing skills developed in this research were skills to design tool or experiment, direct observation, interpret observations, use tools and materials, and to communicate. These skills were needed to be developed since experimental design science processing skills and direct observations supported by the ability interpreted the observations and presented a good observation, which made the students be able to accurately observe the changes of natural phenomena and chemical reactions that occur, analyze, and draw conclusions on the electrochemical phenomena. Application of the concept took a role in the birth of some laws of science. The results of N-gain analysis showed that the concept mastery test integrated with science processing skills resulted in an average of 0.6 which is categorized as medium. This result suggested that there was an increasing rate in student's science processing skills after learning by using SETS-Based Activity Guidelines. In addition, the results of descriptive analysis aspects of psychomotor and affective aspects indicated that the average value of the psychomotor and affective for the four categories of research activities achieved category.

Practical activities and discussion of applied science in the surrounding environment was an effort to bring students on contextual learning, so that students could learn to live in the real world, and at the end were able to produce a strong understanding of the concept. It was consistent with Morrison and Estes (2007) who stated that the real-world application scenario was an effective strategy for teaching chemical science as a process. Wright (2001) also revealed that the students would easily understand the material when they are doing an activity to learn it. It would make the students enjoy the learning process and ultimately would produce good science processing skills for the students.

Good science processing skills meant that the students had formed their own experiences through activities to discover themselves (discovery learning) which was in accordance with the theory of Jerome Bruner. Through the use of SETS-based activity guidelines that have the characteristics as proposed by Adisendjaja (2009) which were the nature of how

students learn and the nature of the material being taught, as well as chemistry as product characteristics and process according to Nurohman (2008) could also be realized. It was because learning was started from the formation of chemical understanding through solving real problems.

CONCLUSION AND RECOMMENDATIONS

Based on the results of this study, it can be concluded that; (1) SETS-Based Activity Guidelines has an average validity score of 4 (very valid), (2) The use of SETS-Based Activity Guidelines was effective because 16 of the 21 students acquired Science processing skills score ≥ 70, (3) Visionary activity guidelines – SETS could improve Science processing skills with the average N-gain 0.6 (medium), whereas the performance, preparation of reports and presentations, discussions and analysis in classical SETS got high criteria, (4) SETS-Based Activity Guidelines activities received high positive response from the students.

Advice that could be given in this study are: (1) The use of SETS-Based Activity Guidelines should be applied to other chemistry labs; (2) Application of psychomotor and affective aspects of the assessment should be carried out in the discussion, presentation, and report writing; (3) The selection of material should be more applicative and connected to SETS elements to make it more meaningful and efficient; (4) The description of the image in visionary activity guidelines SETS impacted in different interpretations. It was because the students had their own thoughts on these drawings.

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Cite this Article: Susilogati S, Binadja A, Hidayah FF (2014). Developing Module of Practical Chemistry Physics SETS Vision Activity to Increase Science Process Skills of Student Teacher**.** Greener Journal of Educational Research, 4(2): 030-035, http://doi.org/10.15580/GJER.2014.2.021914117**.**