



THE DEVELOPMENT OF ALTERNATIVE ASSESSMENT ON GENERAL CHEMISTRY PRACTICUM THROUGH CONSERVATION-BASED CHEMISTRY FAIR PROJECT (CFP) USING DAILY CHEMICAL

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ABSTRACT

This study aimed to (1) develop an alternative assessment on the 2nd General Chemistry Experiment through conservation-based chemistry fair project by utilizing the daily chemical (2) Determine the level of validity, practicality and effectiveness. This research was the development (Research Development) model applied Dick and Carey (1985). The subject of limited testing and field trials was subject lecturers and students of Science Education UNNES. Determined by purposive sample, the lecturers and the students who take the course 2nd General Chemistry Experiment. The data obtained from this trial were: (1) input from experts, to determine the content and construct validity of the assessment feature; (2) input from a limited sample testing, to determine the practicality of chemistry clue fair project (CFP) based conservation by utilizing chemical daily; Instrument data collectors in the form of a questionnaire legibility chemistry making instructions fair project (CFP) based conservation by utilizing daily chemical, scoring guidelines. (3) student learning outcomes data to determine the effectiveness of the assessment. Input from experts student questionnaire, and the value of chemistry fair project (CFP) limited test samples were analyzed qualitatively and quantitatively. Assessment of 2nd General Chemistry Experiment alternative developed was successfully well-developed assessment if valid, practical, and effective.

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INTRODUCTION

In fact, practical implementation in the laboratory plays an important role in science learning. In general, the purpose of the practicum is to improve the skills need of students in terms of using the equipment, linking the relation of theoryconcept with practice, processing and interpreting the data, formulating and testing the hypotheses, developing the problem-solving techniques, and increasing the motivation of learningas well as to correlate the results with daily life problems (Abdullah et al., 2014)

Preliminary observations of the general chemistry lab lecture II in Semarang State University suppose that the lectures are not vary enough. The students do practical work based on

the book dictates of practical guidance that has been provided by the lecturers. Lecture begins with a pretest, then it continues by practicing the experiments based on practical guidance. The evaluation of practicum are based on the student work and student lab report, finally, the results are presentatedby student group. The use of basic theory in lab has not been developed from a reference source to another, the student use the only reference source from dictates. This issue is critical when the student ability to explore other sources is limited. In addition, students are not given the task of comprehensively to gain knowledge and ability in dealing with everyday problems associated with chemical materials. Lack of instilling the strong concept when faced with basic chemistry learning theory promotes the student difficulty in answering questions and solving the problems.

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This phenomena also occurred in other practical learning as studied by Sudrajat et al. (2011), in the practical implementation, lecturers conducting the assessment which focused on the results of practical reports made by students. Other assessments are done at mid-term and end of the semester which is the measurement of cognitive course and tested in writing relating to the materials lab that had been completed. As a result of the assessment process is not yet complete, there is no authentic evidence of the lab and evidence of student learning progress. If this assessment system continues, the student's competence level can not be measured; therefore it will decrease the student skills in carrying out practical work.

According to Gulikers et al. (2004) there are four dimensions that determine the authenticity, i.e. the task, physical context, form and result/criteria. Under these circumstances, the lecturer should do a variety of innovations on practical activities to be an interesting challenge and motivating the students. The evaluation of practical issues results are also highlighted by an important practical assessment. The practical assessment must not violate the purpose of the lab itself which is only the cognitive aspects that are scalable, therefore, it becomes a challenge for researchers to design an authentic and fair evaluation model.

Bell (2010) conducted a research on project-based learning for the 21st century, a learning model was suggested to overcome the problem of evaluation of the practicum, i.e. student skills through problem based learning (PBL) that support them to produce a productive society. Project-based learning requires a specialized evaluation tools, as proposed by Abdullah et al. (2014). The assessment in probaslab is an integral part of learning. Lecturer as project planner should spell out how to measure the student's achievement in learning and the final outcome after completed project. A lecturer must develop a formative and a summative assessment. It is necessary to collect information and see what the students have done. This assessment activities help the students to develop learning process, and also the student needs to measure the achievement of has learned in its entirety.

Assessment is done on an individual and group work and it is advised to use multiple formats grading papers to assess the activities of individuals and groups through observation, presentation, discussion, questions and answers, and the final product. Assessment process allows faculty, students and even the community to

provide feedback on what have been achieved. Assessment must be conducted by covering all learning outcomes of students such as cognitive abilities, psychomotor, and affective. The assessment in every aspect are different according to the characteristics of the material that being measured. Alternative assessment in probaslab is recommended to use the performance assessment. The probaslab is an objective and reliable tool of performance appraisal system by using the rubric and task.

In addition, a research on the development of project-based learning evaluation model was proposed by Saputra et al. (2014), which stated that the results of developed rubrics was a portfolio that consists of practical processes, independent tasks and an assessment report of lab practicum. While the project assessment rubric was used to assess the process of planning, development and the end result of the product and the presentation rubric can be used as a platform reflection of student's project assignment. Rubrics can guide and facilitate the teachers in assessment activities and also to improve the quality of student work. With the assessment rubric, it can explain the expectations and encourage students responsibility on the work they have created.

Based on several studies on learning models and assessment, it requires an instrument of evaluation which can measure the skill level of the students in the experimental process. According to Hatfield et al. (2003), the characteristics of assessment alternatives are (1) the appearance, the creative process and the product of students, (2) the task problem solving/skills to think critically, (3) contextual problem, (4) the long time task, (5) rubric or scoring guide.

In order to meet the demand of alternative assessment, it requires a final practicum at the end of meeting as an evaluation tool by using conservation-based chemistry fair project (CFP) utilizing daily chemical at the end of the evaluation of general chemistry lab. CFP is an exhibition of chemical products. Chemistry lab is identical to the chemicals that are dangerous in the laboratory. CFP utilizes household chemicals to create a project based on chemistry lab. Implementation of lab course by making products using household chemicals proposes both green chemistry and conservation spirit. Students will be expected to have a wider knowledge and have a contextual learning. CFP is a final evaluation tool of general chemistry lab II that are scalable from basic chemistry lab courses. It emphasizes not only in terms of cognitive but also in terms of psychomotor and affective aspects. According to

this background, the objectives of the study were:

1. to develop an alternative assessment on the general chemistry practicum II through the conservation-based chemistry fair project (CFP) by utilizing daily chemicals,
2. to measure the feasibility level of alternative assessment on general chemistry practicum II through a conservation-based CFP by utilizing daily chemicals obtained from experts, and
3. to know the effectiveness of alternative assessment in general chemistry lab II through the CFP by utilizing daily chemicals that were developed for learning in general chemistry practicum II.

METHOD

Research and development (R&D) study was conducted to develop alternative assessment of general chemistry practicum II through conservation-based chemistry fair project (CFP) by utilizing daily chemicals. The conceptual model, analytical model that provide product components and its linkage were applied in this study.

The development of alternative assessment in general chemistry practicum II include the following steps: (1) analysis of needs, (2) the determination of the purpose and design, (3) development of instrument, (4) the study of experts, limited test, (5) analysis of test results and (6) the end product (Rusilowati et al., 2011).

After the alternative assessment drafts of general chemistry practicum II, which include the instruction of conservation-based CFP by utilizing daily chemical, the scoring guidelines and the instruction of how to translate the assessment results was constructed. These drafts were then analyzed by the experts to review it. After review, the draft was tested on a limited sample of lecturer and student. Input from limited test sample was used for revising and for constructing second and third drafts.

The subject of limited testing and field trials are lecturers and students majoring in Integrated Science Education Study Program, Semarang State University, Indonesia. The sample was determined by purposive sampling technique, i.e. lecturers of general chemistry practicum II, and students who take that course.

The data obtained from this test were: (1) suggestion from expertise to determine the content and construct validity of the assessment feature; (2) suggestion from limited testing sample, to determine the instructions of conservation-based CFP by utilizing daily chemicals; instrument of data collectors in the form of a question-

naire-based legibility instructions, and scoring guidelines; (3) student learning outcomes data to determine the effectiveness of the assessment.

Analysis of the data in this study were:

1. Expertise validation formula:

$$\bullet = \frac{\sum x}{n} = \frac{\sum x}{n}$$

Explanation:

X = Average value

$\sum x$ = Summary of validator's answering value

n = total of validator

by criteria of the value as follows:

Average	Validation criteria
$3,5 \leq \bar{x} \leq 4$	Extremely valid/ can be used without revision
$2,50 \leq \bar{x} \leq 3$	Valid/ can be used without revision
$2,0 \leq \bar{x} \leq 2,5$	Quite valid/ can be used with minor revision
$1,5 \leq \bar{x} \leq 2$	Less valid/ can be used with major revision
$1 \leq \bar{x} \leq 1,5$	Invalid/ whole revision is needed, can not be used

2. Data analysis of student's questionnaire

$$s = \frac{\text{skor}}{\text{skor total}} \times 100\%$$

3. Data analysis of *chemistry fair project*

$$N = \frac{\text{skor}}{\text{skor total}} \times 100$$

The alternative assessment of general chemistry practicum II is well developed if it shows a valid, practical, and effective results. It is said to be valid when the scores of expertise is $2.50 \leq x \leq 3$. In other words, practically if > 75% of students agree to use alternative assessments and the CFP will be effective if the score is > 75. Suggestion from the expertise and limited test samples were analyzed qualitatively and quantitatively.

RESULTS AND DISCUSSION

The product of this study was the alternative assessment of conservation-based CFP on general chemistry practicum II by utilizing daily chemicals and scoring guidelines.

1. Analysis of the result of validation score from expertise evaluation and alternative assessment of general chemistry practicum II

In this study, early stage after assessment of product design was a validity assessment of product design assessment by expertises. Some aspects that were assessed in this study such as language, materials, construction, evaluation, and conservation. Each of these aspects were obtained an average score of 4, which means the product of the alternative assessment was extremely valid.

The expertises had established some suggestions on the assessment indicators as follows:

- a. The ability of the student in designing a project with original idea with criteria (3) was different from the others, the indicator (3) was replaced by the project as a modified version of another product.
- b. Students' ability to carry out activities (project) effectively and efficiently with the following criteria (1) project conducted in collaboration; the indicator (1) was replaced by the project team performance.
- c. The ability of students to write their conclusions in the experiment with the criteria (3) The conclusion can answer the purpose of the experiment; the indicator (3) was replaced by answering the problems.
- d. Presents a bulletin board (display board) criteria (2) was an abstract containing objectives, procedures, results and conclusion; the indicator (2) were replaced by an abstract containing the background, problem formulation, procedures, results and conclusion.
- e. Presenting the project by way of a presentation by the criteria (1) showing kindness and smiles; the indicator (1) was replaced by being friendly.

Based on the results of expertise validation, some suggestions for improvement of the alternative assessment were given. Therefore, improvement based on the advice was made before the application of limited test. It has been obtained a valid and feasible product of alternative assessment.

2. Summary of the questionnaire readability from the alternative assessment on general chemistry practicum II

Based on Table 1, a total of 78.57% of students were strongly agree (SA) and 19.64% were agree (A) that the alternative assessment of general chemistry practicum is being taught by lecturers. While 1.79% of the students were disagree (DA) with the alternative assessment. Students mentioned that practicum should be given more time and guidance in order to minimize the deviation potential.

Moreover, there were 48.21% students who strongly agree and 41.07% agreed that conservation-based project instructions for the use of daily chemicals is understandable, 8.93% students were disagree and 1.79% were strongly disagree (SDA). The reason is because of some terms of the practicum instructions use a foreign language/ English. The student felt that they need to understand the meaning and there is a possibility of misinterpretation.

As many as 75% of students were strongly agree and 25% were agree that the assessment process using alternative assessments was able to hone all aspects of a good assessment of cognitive, affective and psychomotor. These results were consistent with the research of Pantiwati (2013) that authentic assessment could improve the cognitive abilities, scientific thinking, and creative thinking with regard to the character of the

Table 1. Questionnaire results summary

Indicators of questionnaire	Percentage			
	SA	A	DA	SDA
Conformity of assessment to the material of study	78.57	19.64	1.79	
Readability of instructions	48.21	41.07	8.93	1.79
The assessment process	75	25		
Interest	87.5	12.5		
Understanding of the material	59.38	40.62		
Paradigm of practicum change	70.83	29.17		
The average score	69.92	28.00	1.79	0.30
Total score SA and A	97.92			

students. Since the authentic assessment encourages students to use scientific knowledge in a real context. Students are not encouraged to create something new which are not well known by the students.

Students were also interested in this kind of assessment because they had never met, other than the usual. The new assessment models usually make students enthusiastic to accomplish these tasks as stated by Ramlawati et al. (2012). However, it challenged the students to create something new that was considered difficult to be simple. Beside, this assessment obliged them to aware of indicators which were assessed by lecturer. 87.5% students were strongly agreed and 12.5% were agreed that they were interested in this alternative assessment project since they could use daily chemicals. Daily chemicals utilization urged the students doing chemistry lab enthusiastically. Some students think that doing chemistry lab can only be done in the laboratory, and always related to harmful chemicals. Students could explore the daily chemicals for practical work. This result was in accordance to previous study conducted by Wusqo (2014). The study stated that students were interested in using daily meals as one of the ingredients for the project, in addition to the student that also encouraged to study chemistry lab using household chemicals. By this project, they claimed that the material was more easily to be accepted, remembered and understand than when conducting experiments in a laboratory with chemicals. This was consistent with the findings which stated 59.38% and 40.62% students were strongly agree and agree on daily chemicals utilization for study was understandable, respectively.

A total of 70.83% students were strongly agree and 29.17% were agree to change the existing paradigm of practicum in their minds. Previously, students' thought stated that the lab work could be done only in the laboratory, it also utilizes hazardous chemicals. However, after performing conservation-based projects using daily chemicals and household household wastes, they assumed that general chemistry lab has developed to be more attractive.

Based on the scores recapitulation, the legibility of alternative assessment questionnaire was 97.92%. Thus, it used as one of the alternative evaluation tool, effectively. The result was in accordance to the study of Wusqo and Khusniati (2014) which stated that Biochemistry Project Inquiry could be used as an alternative assessment in the course biochemistry lab project.

3. Analysis of student learning outcomes on small scale trial

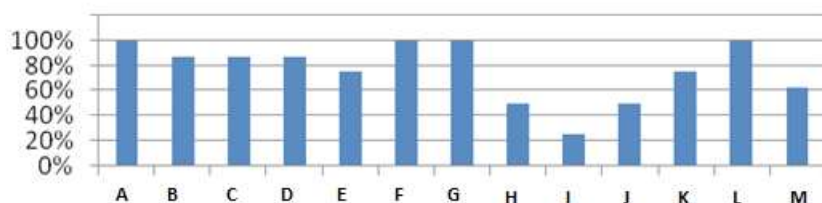
Furthermore, the initial testing phase of the alternative assessment in general chemistry practicum II was conducted on 8 students who were ready to take the course. It was an early stage trial results using alternative assessment.

All students could carry out the conservation-based chemistry fair project using daily chemicals (Table 2). Based on Figure 1, all students were able to design a project with an original idea, more than three quarter students were able to develop a theoretical basis and were able to use the tools and materials needed in the experiment according to the principles of conservation (using daily chemical). Moreover, 87.5% students were able to do experiment, and exactly eight in ten students were capable of carrying out the activities (projects) effectively and efficiently. All students were also able to do activities that pay attention to the elements of safety performance of students. Moreover, they were skilled in observing the results of the experiment. Half of students were able to write the results of the experiment and a quarter of the students were able to write a conclusion in the trial. Furthermore, five in ten students were able to present the project results and three quarter of them were able to present the bulletin board (display board). In addition, all students presented their projects by way of presentation, and more than a half of the students were able to write a bibliography. Research of Wijayanti (2014) showed that the project-based authentic assessment in scientific approach could increase the scientific thinking skills effectively.

Some students' ability need to be improved such as writing the results of experiments, the results of the experiment were written in accordance with the experiments performed. Students were still confused to define a qualitative experiment. Students also could not write the conclusions from the experiment results. Only a quarter of them were proved to be able to conclude the experiment results. Students were not capable enough to answer the problems based on the experiment data obtained. Only half of them were able to present their Project results. They had low ability to create a bulletin board which includes abstracts, summaries, questions and hypotheses, data, discussion and conclusions. Students wrote incomplete things on their display board, suppose there were no abstract and summary. Their misperceptions can not differentiate the abstract and summary, therefore, they wrote only one of them.

Table 2. Results of early stage trials on general chemistry practicum II using the alternative assessment

Scores							
1	2	3	4	5	6	7	8
86.84	94.23	98.07	96.15	96.15	96.15	88.46	92.30

**Figure 1.** Students' capability profile in general chemistry practicum II using alternative assessment

Indicator Information:

- A : Original idea
- B : Determine theoretical background
- C : Using instrument and materials based on conservation principal using daily chemical
- D : Execute practicum
- E : Execute project
- F : Pay attention to safety activity
- G : Skills to observe practicum results
- H : Capture practicum results
- I : Write conclusion
- J : Display project
- K : Display board
- L : Project presentation
- M : Ability to write references

The ability of students that have not been reached well was to write a bibliography. This was evidenced by the achievement of this capability which was only 62.5%. Students' ability to find primary source of reference was weak. They used references from no-scientific blog and Wikipedia.

CONCLUSION

Based on data analysis and discussion in this study it can be concluded that it has been produced a alternative assessment of general chemistry practicum II through the conservation-based chemistry fair project (CFP) by utilizing daily chemicals with the development process, adapted from Dick and Carey to step needs analysis, goal setting and design, instrument development, research experts, limited test, analysis of test results and the final product. Moreover, the alternative assessment of general chemistry practicum II through conservation-based CFP was an evaluation tool with the distribution of the

following criteria: aspects of language, material aspects, construction aspects, evaluation aspects, and conservation aspects. The average score of these criteria was 4 (very good). Also, the alternative assessment could be used as a practical and effective evaluation tool. It proved by almost all students were agree to use alternative assessment. Some suggestions as a follow-up assessment will be the application of alternative assessment in this study can be used as an example for further application. However, further study on programming the better scoring system that could be used for other subjects should be conducted. Also, practical guidance book related to daily chemicals utilization for general chemistry practicum learning should be developed.

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