Designing biochemistry project with local materials to increased student’s creativity

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Abstract. Creativity of students has become one of the demands that must be achieved in practicum courses. This study aims to look at the effect of Biochemistry lab-based project using local materials for the creativity of students. Implementation of research using a mixed method with embedded design. The effectiveness of the program is measured by pre-post test design. Topics implementation were done on a quantitative analysis of proteins, carbohydrates qualitative analysis, quantitative analysis of carbohydrates and enzyme kinetics. The research instrument is a matter of pre-tests and post-tests that use creative thinking skills tests in the form of a description, a section of creative products as well as the student questionnaire. Quantitative data analysis performed using SPSS 22.0 to see the significance of normality, the value of N-Gain, correlation to the correlation test the skills of creative thinking with creative products and the percentage of student responses to the lab performed. Qualitative data analysis is done through a questionnaire scale attitude. Biochemistry lab results showed the project-based local materials effective in enhancing the creativity of the students both in terms of creative thinking skills as well as creative products. Students are given the opportunity to design the lab in accordance with local materials used.

1. Introduction

Universities as the highest educational institution in Indonesia has its own demands on graduates in accordance with Law No. 12 of 2012 on higher education. To enhance the nation's competitiveness in the face of globalization in all fields, required higher education are able to develop science and technology and produce intellectuals, scientists, and/or professional cultured and creative, tolerant, democratic, a character strong, and courageous to defend the truth for the sake nation. This demand is reflected in the competency standards in Indonesia, which refers to Kerangka Kualifikasi Nasional Indonesia or abbreviated KKNI contained in the regulations of the President No. 8 in 2012.

Achievement of demands practicum students at the lecture can be obtained through appropriate learning models. Many models of learning in practical lectures that have been applied in previous studies include inquiry [1], discovery learning, problem-based learning [2] and project-based learning [3]. All the research suggests that the practicum was held basically to accommodate the process of self-discovery by the students as much as possible involve thinking and motor skills.

Among the various models of inquiry, project-based learning is one model of the course that is perfect when applied to practical lectures which require students to design their own experiments and produce products at the end of the practicum. This is indicating that this model can improve the skills of creative thinking of students. Several studies have revealed the project-based learning felt could bring creative thinking skills in students [4,5,6,7]. Hsieh, Lou, and Shih [8] revealed that the lecture-based project provides the opportunity for students to do teamwork and stimulate creativity and design ideas as well as in solving problems.
Project-based learning is an instructional model that is innovative, and more emphasis on contextual learning through activities complex. Project-based learning is a learning model that provides opportunities for educators or teachers to manage the classroom learning by involving project work. Through project-based learning, creativity and motivation will increase. Project work as a sort of open-ended activity-bases contextual learning, and is part of the learning process that gives a strong emphasis on problem-solving as a collaborative effort, which is done in the learning process in a given period.

In this study, researchers used a model of project-based learning by using local materials. The use of local materials in an attempt to overcome the limitations of the chemicals in the lab lectures. In Biochemistry lab it is possible to use the environment as a context and it has the potential to develop creative thinking skills of students to search for alternative materials during the practicum. Also according to Ashraf [9], the use of environmental concerns about the practicum will increase student awareness of the environment. Furthermore, we will see how the development of the creativity of students during the lectures Biochemistry practicum project-based local materials?

2. Methods

This research method is a mixed method research [10] with the embedded design. Stages of the research include the preparation, implementation, and interpretation. Program implementation effectiveness through increased student creativity investigated by using pretest - posttest control group design [11] and analysis rubric creative products. Subjects of the research were 40 students who attended lectures of Biochemistry practical works. These 40 students were divided into 6 groups.

2.1. Procedure study
Biochemistry laboratory project with local material used mixed method design of embedded experimental. Stages in this study, include Preparation, at this stage, field studies, literature, design development program of lectures Biochemistry lab-based projects with local materials, and a limited trial. Implementation Phase, at this stage using a quasi-experimental design that equivalent control group pretest-posttest design. All instruments and biochemistry lab lecture programs that have been arranged implementation class. The implementation stage includes; Qualitative before the intervention, during the intervention Qualitative, Quantitative and Qualitative during the intervention after intervention. Stage Interpretation, at this stage, the interpretation of data of quantitative and qualitative analysis. At this stage the obtained information about the effectiveness of the program of lectures Biochemistry lab-based projects with local materials to improve creative thinking skills, strengths and weaknesses of the program being developed.

2.2. Instrument of data collecting
Quantitative and qualitative data collected Instruments of quantitative and qualitative data were used together in this study. The tests of creativity students and product creative were conducted for the quantitative data. The instruments were 7 items of the written test in the form of descriptive items. The test was used to measure the students’ creativity before and after the lectures. Each question represented the indicators of creative thinking skills, which included fluency, flexibility, novelty, and elaboration [12] within the students. Analysis of creative products was also used as quantitative data based on indicators [13], such as originality, reflecting problem-solving and detail. The qualitative data obtained through analysis of student response to the implementation of the project based learning.

2.3. Data Analysis
The data was processed using SPSS 22.0 to find out if it was normally distributed. The test of creativity was calculated by finding out the value of N gain by the formula of Hake [14,15] of the average/mean of the pretest and posttest to see student’s creativity.
3. Result and Discussion

3.1. Design Biochemistry laboratory

Biochemistry laboratory project in this study was designed to develop student creativity, excellent creative thinking skills as well as creative products. The program includes lectures developed the syllabus and SAP for Biochemistry practicum courses, student worksheets, test evaluation tools are written in the narrative form that is used to measure mastery of concepts and creative thinking skills, creative thinking skills indicators and creative products.

Biochemistry laboratory lectures designed it has the burden of 200 minutes with the number of meetings 12 times. Topics of lectures were presented namely lipid qualitative analysis, quantitative analysis of lipids, proteins qualitative analysis, quantitative analysis of proteins, carbohydrates qualitative analysis, qualitative analysis of carbohydrates, carbohydrate quantitative analysis, and enzyme kinetics. The topic is divided into two parts, namely the three topics to do with the model verification lab and the four topics were the implementation of project-based learning using local materials.

3.2. Implementation Program of Biochemistry lab lecture

Biochemistry lab lecture programs that have been designed and then further implemented. Biochemistry lab lecture program contains seven topics do with the model verification lab and lab-based model of the project with local materials. Summary of the implementation of the program of lectures Biochemistry lab work can be seen in Table 1.

| Table 1. Implementation of Biochemistry Laboratorium |
|------------------------------------------|
| Verification Lab | Project based with local materials lab |
| Learning Model | Verification | Project-based learning with local materials |
| Lab materials | Laboratory materials from distributor | Local materials |
| Procedure used | The procedure in this guide (cookbook) | The procedure is designed students through the study of literature |
| Topics | Qualitative analyses of lipids | Quantitative analysis of protein |
| | Quantitative analysis of lipids | Qualitative analyses of carbohydrates |
| | Qualitative analyses of lipids | Quantitative analysis of carbohydrates |
| | Qualitative analyses of protein | Enzyme kinetics |

In the model verification lab, students just followed the practical guide. The title, purpose, tool materials and procedures are contained in the guidebook. Different things can be seen on the model of project-based practicum with local materials, where the title, purpose, lab materials, and procedures designed by the students. Lab materials used come from local materials around the student. At this stage has been carried out tests of creative thinking skills, assessment rubrics creative products and analysis of student feedback questionnaire. The results of the analysis of creative thinking skills tests in both models practicum can be seen in Table 2.
Table 2. The mean score pretest-posttest, products, and value \(<g>\)

| Project-based learning with local materials laboratory | Verification laboratory |
|----------------------------------------------------------|-------------------------|
| **Score** | **Score** | **<g> (%)** | **<g> (%)** |
| Pretest | Posttest | Product | Pretest | Posttest |
| N | 40 | 40 | 40 | 40 |
| X | 46.21 | 72.79 | 74.20 | 49 |
| Sd | 5.98 | 7.45 | 0.067 | 3.49 |

According to the Table 2 that the average of the pretest students with project-based models with local materials by 46.21 and the average pretest score with verification models of 37.25. The average of the final tests on model-based projects with local materials amounted to 72.79 while the verification model of the acquisition of the average of the test eventually amounted to 42.30. This shows that in general there is an increase in creative thinking skills of students. The increase in the average of the percentage of N Gain on topics that are taught by the model-based projects with local materials by 49% and a model lab verification of 8.05%. The average N Gain second study included in the category of medium and low.

This is in line with the stated Wenning [16] that lab models cookbook verification method only requires learners to the minimum capabilities that do not reach the creative and independent attitude. Different things raised by several studies that should practicum with the model-based project will involve some skill think one of them creative thinking skills [4,5,6,7].

Creative thinking skills are trained in Biochemistry lab-based project will be able to make the students create creative products. As Shi-Jer Lou, et.al. [5] in his research revealed the project-based learning can make students design products. Student creative product in the form of rubric average scores obtained for 74.20 creative products. Results of tests of creative thinking skills and creative products then normality test are presented in Table 3 below.

Table 3. Normality test

|          | Kolmogorov-Smirnov | Shapiro-Wilk |
|----------|---------------------|--------------|
| Statistic | Df | Sig     | Statistic | Df | Sig     |
| pretest  | .074 | 40 | .200* | .979 | 40 | .669 |
| Posttest | .082 | 40 | .200* | .983 | 40 | .792 |
| product  | .152 | 40 | .020 | .960 | 40 | .164 |

The normality test results showed that all of the data either test the skills of creative thinking and creative products normally distributed, then used statistical parametric. Furthermore, the analysis of the relationship between the value of creative thinking skills acquired by the student's creative products through Pearson correlation coefficient calculation. Summary correlation with test creative products can be seen in Table 4.

The results of the analysis of the correlation between creative thinking skills with creative products can be seen from the correlation coefficient of 0.648 (strong). This is in line with research by Torrance [12] who argued that creativity is on learners will make discover something new. Creativity will reflect creative thinking skills that will ultimately result in creative products. The response of students to the lecture Biochemistry lab conducted can be captured from the attitude scale questionnaire. An optimistic attitude will success in learning with the learning model used is indicated by 70.97% of the students agreed that lectures biochemistry lab-based projects with local materials to make them more creative. This is in line with research Hsieh, Lou, and Shih [8] which revealed that the lecture-based project provides the opportunity for students to do teamwork and stimulate creativity and design ideas as well as in solving problems.
Table 4. Correlation test creative thinking skills tests with the creative products

|                          | Creative products | Creative thinking skills tests |
|--------------------------|-------------------|--------------------------------|
| Creative products Person | 1.000             | .648**                        |
| Correlation Sig (2-tailed). |                 | .000                          |
| N                        | 40                | 40                            |
| Creative thinking skills tests Person | .648**          | 1.000                        |
| Correlation Sig (2-tailed). |                 | .000                          |
| N                        | 40                | 40                            |

4. Conclusion
Biochemistry lab lecture-based projects with local materials can enhance student creativity both creative thinking skills as well as creative products. Creative thinking skills will contribute positively to creative products produced by the correlation coefficient of 0.648 (strong).

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References
[1] Kurniawan & Endah. 2008. *JP2F*, 1(2).
[2] Wasonowati, R. R. T., Redjeki, T. & Ariani, S. R. D. 2014. *Jurnal Pendidikan Kimia (JPK) Program Studi Pendidikan Kimia Universitas Sebelas Maret*. 3(3)
[3] Holubova, R. 2008. *Czech Republic*. 5(12).
[4] Yalcin, A., Turgut, U., & Büyükkasap, E. 2009. *International Online Journal of Educational Sciences*. 1 (1) p 81.
[5] Lou, S., Chung, C., Dzan, W. & Shih, R. 2012. *Creative Education*. 3(7) 1281.
[6] Robinson, J.K. 2013. *Anal Bioanal Chem*—Springer. 405 7.
[7] Treacy. 2011. *CBE—Life Sciences Education*. 10. 18.
[8] Hsieh, Lou, and Shih. 2013.*Journal of Science and Technology*. 41(5) 341.
[9] Creswell, J.W. 2009. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Third Edition. California: SAGE Publication.
[10] Fraenkel & Wallen. 1993. *How To Design and Evaluate Reaserch In Education*: McGRAW HILL. Singapore.
[11] Archambault, J. 2008. *The Effect of Developing Kinematics Concepts Graphically Prior to Introducing Algebraic Problem Solving Techniques*. Action Research Reguared for the Master of Natural Science Degree with Concentration in Physics. Arizona State University
[12] Wenning, C., J. 2004. *Levels of Inquiry: Hierarchies of Pedagogical Practices and Inquiry Processes*, Department of Physics Illionis State University Normal