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INTERNATIONAL CONFERENCE ON LESSON STUDY

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International Conference on Lesson Study

" Professional Learning Community through Lesson Study for Promoting Student Learning"

14th- 16th September 2017

Lombok, West Nusa Tenggara, Indonesia

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"Professional Learning Community Trough Lesson Study for Promoting Student Learning"

Penerbit: Universitas Hamzanwadi
Jalan TGKH. M. Zainuddin Abdul Majid No.132 Pancor-Selong Lombok Timur
Telepon: (0376) 21394, 22359
Fax: (0376) 22954
Email: universitas@hamzanwadi.ac.id

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INTERNATIONAL CONFERENCE ON LESSON STUDY

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E-mail: icls8@hamzanwadi.ac.id, website: http://icls8.hamzanwadi.ac.id

INTRODUCTION

September 11, 2017

The theme of the 8th ICLS is "Professional Learning Community through Lesson Study for promoting student learning" is appropriate to respond the current issues in education, especially the issue related to the quality improvement through teaching and learning process.

This theme is expected to assisst/contribute towards the quality improvement through the inclusivity of teaching and learning process that can be gained from many studies of researchers, practioners, workers in education professional learning, school improvement, curriiculum development and other fields that can help to promote its goals.

The ICLS is the annual meeting at Hamzanwadi University in East Lombok West Nusa Tenggara from septermber 13-16, 2017. This conference is organised by Hamzanwadi University in cooperation with Indonesian Association of Lesson Study (ICLS) and the Ministery of Research, Technology and Higher Education.

We proudly announce that we have invited some experts: Prof. Manabu Sato, Gakushuin Uni, Japa, prof. Petter Duddly (President of WALS UK), Prof. Cristin Lee (NU), Prof. Siriripaane Swanmonka - Chulalongkorn University Thailand., Carly Klein, Windesheim University of Nedherland and Prof. Sumar Hendayana, Ph.D (President of ICLS Indonesia).

We would like to say thank you to all invited speakers and participants who share their ideas to complete the agendas in this conderence, we also provide you to visit some schools as our partners in this Lesson Study.

It is a great honor for us and all commitee to be the host at the 8th ICLS 2017. Welcome to Lombok, have a nice conference and get ready to be inspired and challenged. Thank you.

Khirjan Nahdi
The vice Rector of Academic Division
Hamzanwady University

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The Implementation of Lesson Study Towards Students' Spatial Thinking Ability on Multivariable Calculus Subjects

Eko Andy Purnomo[1], HascaryoPramudibyanto[2] ,EnnyDwiLestariningsih[3]
University of Muhammadiyah Semarang
ekoandy@unimus.co.id, hascaryo@ecampus.ut.ac.id, ennydl@ecampus.ut.ac.id

Abstract

The Multivariable Calculus is an advanced course of Differential Calculus and Integral Calculus. In Multivariable Calculus material, there is Cartesian coordinate material R3. The material drawing a Cartesian coordinate graph of R3 requires a good spatial thinking ability. Based on the observations, the ability of spatial thinking students is still low. Low spatial thinking will affect the mastery of differential and integral subjects for variables. One of the learning models used to improve the ability ofspatial thinking is PjBL using inquiry approach. Based on those explanations, the researchers implemented lesson study using PjBL learning model and inquiry approach on Multivariable Calculus subjects. The purpose of this Lesson Study is to diagnose the students' ability of spatial thinking in the Multivariable Calculus subjects. The method of the research was qualitative approach using descriptive analysis. In addition, the instruments used Student's Activity Sheets, and spatial thinking ability as the evaluation sheet. The result obtained that the students had mastered the concept of drawing R3, determining the distance and applying the concept in drawing solid objects on linear and quadratic equations. Through the implementation of Lesson study, it can be concluded that the ability of students'spatial thinking is good through the PjBL using inquiry approach.

***Keywords**: Multivariable calculus, Lesson Study, PjBL, Spatial Thinking*

A. Introduction

The current education system has not been able to make people have the ability and independence,resulting in weak competitiveness (Pramudibyanto&Purnomo, 2017).It needs to improve the Indonesian competitiveness to be able to be equalized with other countries. One of the keys of success in performance as well as professional work and learning is the spatial thinking ability (Prieto & Velasco, 2010) and the success of learning (Sorby, 2009). Spatial thinking is the ability to imagine forms and movements in different positions of our mind (Strong & Smith, 2002) while Clements (1998) defines a spatial view is the ability to move two or three dimensional objects in one's mind and to be able to understand them. One of the spatial capability of thinking application on the multivariable calculus subject.

The multivariable calculus subject discusses about the Cartesian coordinate material in R3, functions, derivatives, and integral n variables. Cartesian coordinate material in R3 is the first introduction of Cartesian coordinates, points, and distances on R3, drawing graphs of linear equations, and drawing graphs of quadratic equations. Based on the observations, students have mastered the introduction of Cartesian coordinates, dots, and spots in R3. Whereas, for drawing graphs of linear equations and squares, still much mastered. The ability of students in drawing R3 chart is determined by the spatial ability of thinking. Low spatial thinking ability on

quiz score and semester test score. Spatial thinking ability can be improved through practice but not directly (Nemeth, 2007). These skills can be trained and improved by applying the learning that has been designed.

One of the alternative ways to improve spatial thinking skills by applying the learning model of Project Based Learning (PjBL). PjBL learning is an innovative learning model, which emphasizescontextual learning through complex activities (Purnomo, Rohman&Budiharto, 2015) and ultimately results in (Thomas, 2000). Through PjBL students are required to complete projects that have been designed by lecturers. This project is designed in order to the students are more active in learning and have responsibility for completing the task. Student has responsibilities not only complete the assignment, but also make all members in the group to master the material provided. In addition, by applying PjBL can improve the students'ability to solve mathematical problems (Purnomo&Mawarsari, 2014).

In the lecture of differential calculus, integral calculus, and basic geometry the students have been introduced with Cartesian coordinate R2. Based on this, learning is made with an inquiry approach. The advantages of inquiry learning can significantly decrease the misconception of matter (Yunita et al, 2013), develop the ability of mathematical concepts (Chapman, 2011), and develop professionalism (Maab&Artique, 2013). Through the concepts and application of Cartesian coordinates in R2, students are expected to find the concepts and patterns in drawing on Cartesian coordinates in R3. In principle the material is almost identical, which distinguishes the addition of variables so that the drawings are made with three dimensions.

The application of PjBL and inquiry learning models are included in Lesson Study (LS) activities. Besides, to improve the quality of learning LS , it aims to prepare the future of children for a better life too (Supriatna, 2014). LS activities collaborate between the PjBL and the inquiry learning models applied to the Multivariable Calculus subjects. Through the application of PjBL and inquiry, it can improve Spatial Thinking ability,so it will improve the students'achievement and achievement of science, technology, engineering and mathematics (Wai, Lubinski&Benbow, 2009) and (Shea, Lubinski&Benbow, 2001).

B. Method

This research uses qualitative approach. It applies descriptive analysis. Creswell (2010) defines that the descriptive method analysis as a method that attempts to describe and interpret objects directly. LS consists of three stages, such as plan, do, see through application of learning model PJBL using inquiry approach. The focus of this LS is to determine the ability of students' spatial thinking. The instrument of this research used Students' Activity Sheet (LKM) and spatial thinking ability evaluation. The results obtained was described the implementation of LS activities and students' spatial thinking ability.

C. Findings and Discussion

Findings

In the implementation of lesson study, lecturers apply the learning model of PjBL, inquiry approach. The project given to students is in the form of Student Worksheet which contains Cartesian coordinate material in R3. Student Worksheet

are designed with the application of inquiry approach, from the beginning to the end of the student materials are given the opportunity to explore the capabilities they have to complete the Student Worksheet. Implementation of Lesson Study, lecturers divide the group by taking into account the ability of students and gender. Students are given the task to be able to complete the project given and each group is given responsibility for mastery of the material of the group members.

In the LS activity, the material is divided into introduces the R3 coordinate of Cartesians, determines the point and distance, draws a linear equation, and draws a quadratic equation. Cartesian coordinate recognition materials are applied to determine the point and distance in R3 students which do not have difficulties. The students do the MFIs quickly and all groups are correct when answering the questions. There are some students who have difficulties at stage of drawing linear equations in R3. The differences in drawing linear equations in R2 and R3 are not understood correctly. One linear equation in R3 becomes a plane or space, not a straight line. In the early stages, the students are asked to draw a simple equation with the problem 2x + 3y + 4z = 12 which the result can be seen on this figure below.

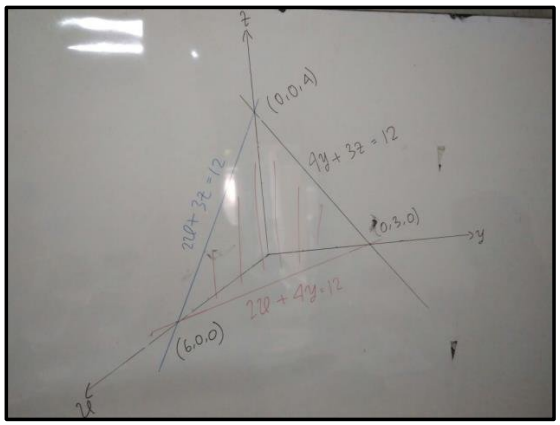

Figure 1. The graphic result of 2x + 3y + 4z = 12

The results of drawing 2x + 3y + 4z = 12 charts are well done by the students, in fact they can do it without having difficulties. The students draw according to the appropriate stages and steps. Doing this problem, there are three stages which are divided the equations into 3 sections such as; thexy plane, z = 0 equations being 2x + 3y = 12, the yz plane, x = 0 equations being 3y + 4z = 12, the xz plane, y = 0, the equation becomes 2x + 4z = 12. The next step draws the desired graph.

This understanding is quickly comprehended by the students, so there is no difficulty in drawing the equation. Furthermore, students are given a more complex problem that students are given the problem to draw the equation of solid objects that are limited some equations. Drawing solid objects on the surface in the first octane bounded by the surface of the fields: 2x + 2y + z = 12, y = x, z = 0 and x = 0! The result is as follows;

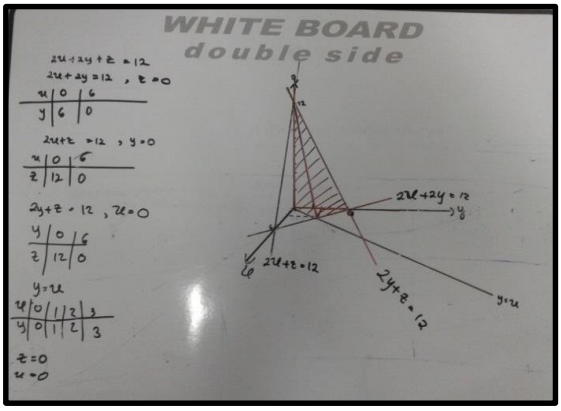

Figure 2. The figure of graphic result of2x + 2y + z = 12, y = x, z = 0 and x = 0

In drawing the graph, the student has gone through the desired stages with the equation 2x + 2y + z = 12 made into three stages, such as; the field xy, z = 0 equation becomes 2x + 2y = 12, the yz plane, x = 0 equation becomes 2y + z = 12, the plane xz, y = 0, the equation becomes 2x + z = 12. The next step draws the line y = x. Next, determining the solid region when through the intersection of regions 2x + 2y + z = 12 and y = x, z = 0 and x = 0. The stages have been done well, and the result of solid body is also true. Furthermore, the students are given a more complex problem of drawing solid objects with limits y + z = 4, x + y = 2, y = x, z = 0, and x = 0. The results can be seen in the picture below.

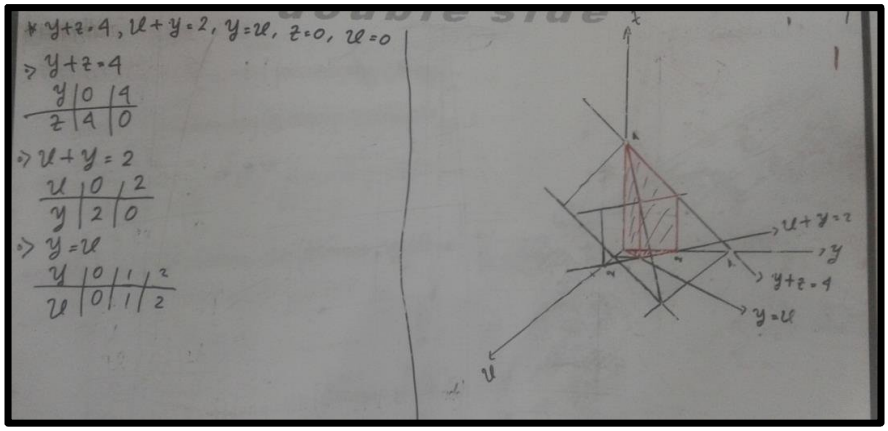

Figure 3. The graphic drawing result :y + z = 4, x + y = 2, y = x, z = 0, and x = 0

Drawing the graphic above, in describing each equation is no difficulty. First stage by drawing the equation y + z = 4, then proceed x + y = 2 and y = x. Students have no difficulty in this stage, but to determine the area of intersection there are some students who have not been able to. The assumption of the solid objects in question is not in accordance with the desired that is the limit z = 0, and x = 0.

Knowing the depth of student's ability is given in the following project: draw the first solid octane object bounded by the surface of the parabolic cylinder x = y^2, and x = 2– y^2, and the plane surface y + z = 4, by the xy plane and yz. The results are shown in the picture below.

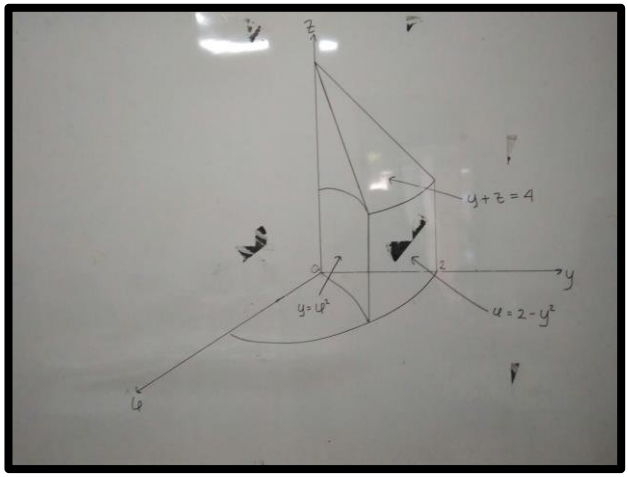

Figure 4. Paraboloida x = y^2, and x = 2– y^2, and the plane surface y + z = 4, by the xy plane, (z = 0) and yz (x = 0)

The matter of drawing the graph of this quadratic equation which becomes student has difficulties. Drawing a quadratic equation, there are some students get difficulties. Drawing the equation $x = y^2$ and $x = 2 - y^2$ students have difficulty. Many students have not been able to determine the graph's arch and its intersection. Drawing the surface of field $y + z = 4$ there is no difficulty for the student. The student has difficulty again when drawing the intersection area between the cylindrical surface of paraboloid$x = y^2$and $x = 2 - y^2$, and the plane surface $y + z = 4$. All groups have not been able to independently complete the assignment. Through the guidance of lecturers, students can determine the expected solid objects.

Discussion

Based on the learning process and evaluation, most students have good spatial thinking skills. This ability is reflected in drawing with equations more than 2 have been mastered well. The ability to determine the intersection of fields on linear equations, as well as determining solid objects has been comprehended by student well. Students' ability of spatial thinking well developed because the application of learning model PjBL requires students in completing the project provided (Purnomo, Rohman&Budiharto, 2015). When there is a group discussion, it can make the discussion more interesting and there are some creative ideas emerge from each member of the group. The member of the group is from the different gender, background and ability to make group performance better (Esmonde's, 2009). The competence demands to draw three equations by determining the intersection and the desired area of solid body makes the student challenged. This raises the motivation for students to complete the assigned task (Purnomo, Rohman&Budiharto, 2015).

Based on the group activities, the presentation and analysis of student work results have mastered the definition concept, determining the point and distance in R3. The students can also explain the stages in drawing at the coordinates of Cartesian R3. The mastery of student's concepts is well absorbed because of the inquiry application. Through the inquiry approach, students can recall the previously taught material and can construct a new concept that forms mathematical argumentation, this result is in harmony with Walshaw& Anthony's (2008) research. Derived from drawing concepts in R2, students inquiry find concept, pattern and gradually develop knowledge (Gee & Clinton, 2000).

Through the application of inquiry-minded PjBL, the project was completed well and the results were near perfect. Through group activities and responsibilities among members can improve their performance (Gresalfi, Martin, Hand &Greeno, 2009) Through mathematical modeling and student's worksheet can improve spatial capability of thinking (Keskin, 2008) & (Toptaş, 2008). The successful completion of the task is due to the application PjBL learning model of inquiry approaches well. Through the learning model can improve student's performance, it is in line with Gresalfi, Martin, Hand &Greeno (2009).

D. Conclusions and Suggestions

Based on the implementation of lesson study through the application of PjBL learning model using inquiry approach, it can be concluded that:

1. Through the application of PjBL learning model using inquiry approach can improve spatial thinking ability in Multivariable Calculus subject.
2. The ability of to draw a quadratic equation is the spatial ability of thinking which need to be improved in multivariable calculus.
3. The application of the PjBL learning model using inquiry approach can be applied to other subjects.
4. There is a need for further research on PjBL learning model using inquiry approach and spatial thinking ability.

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