

## LESSON STUDY: GALLERY WALK TO SUPPORT STUDENTS PARTICIPATION IN REAL ANALYSIS

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### ABSTRACT

*Problem-solving is one of the important parts of mathematics education. It requires the students to translate the problems into the language of mathematics, where facts or principles are used. This study is a descriptive qualitative research. Therefore, the aim of this paper is to describe how far the students solved the problem to find the definition of integration in Real Analysis by using Gallery Walk. The result of the study found by observers that majority of the students involved in learning process. By lesson study, the observers found that most of the students haven't connected the use of Riemann's concept of integration. It is because of their lack understanding in Sigma notation. The steps of the solving problem are reflected and observed by observers in students' discussion. It was found that lesson study is the best alternative to observe students' participation using Gallery Walk.*

**Keyword:** *problem-solving, gallery walk, lesson study, students' participation*

### INTRODUCTION

Problem-solving is one of the important parts of mathematics. Most studies have found that students have their own strategies for solving problems. The strategies which are used in solving problems are different in each student. In this study, students' activities in the solving problem and their paper work in the classroom were seen as their participation in learning process. Students are said to have a good participation if they are involved in the teaching and learning process. Various studies (e.g. (Knight & Wood, 2005)) indicate that participation of the students is the key to an engaged class and better learning. Since not all of the students can actively participate in the teaching and learning process, then a strategy of learning must accommodate students' activities in solving the problem. One of the strategies of learning which is used to improve students' participation is gallery walk.

The gallery walk is a popular exercise in classrooms that is designed to build students' proficiency in researching materials, processing and organizing the data they uncover, and presenting their findings in an

attractive and understandable format that is ultimately presented to their classmates (Schendel, Liu, Chelberg, & Franklin, 2008). The gallery walk is a cooperative learning strategy in which the instructor devises several questions/problems and posts each question/problem at a different table or at a different place on the walls. Student forms as many groups as there are questions and each group moves from question to question. After writing the group's response to the first question, the group rotates to the next position, adding to what is already there. At the last question, it is the group's responsibility to summarize and report to the class (Hosseinali, n.d.).

On the other that, real analysis is one of the learning materials that include a symbol and abstract objects. The object of real analysis which is studying the behavior and properties of functions, sequences, and sets on the real number line. Real analysis is a depth, complexity, and arguably beauty materials for college students. Since its complexity, most of the problems in real analysis is represented by proving the theorem. The proof is an essential

characteristic of mathematics and as such should be a key component in mathematics education. Translating this statement into classroom practice is not a simple matter, however, because there have been and remain differing and constantly developing views on the nature and role of proof and on the norms to which it should adhere (Ernest & Jahnke, 1996). One of the learning material that is discussed is proving the definition of integration using Riemann's sum.

As the researcher's experience in real analysis course. It is difficult to observe the students' participation individually. By lesson study, the observers spend their attention to a specific group of students in learning. Consequently, the observation in learning activities can be seen individually. There is two observation that can be implemented in the classroom. First, direct observation can be seen by the interaction between students, teacher, and learning materials in the classroom. Second, indirect observation is seen by students' paper work. By observation in the classroom, lecturers find an information or learning materials which are appropriate to students' need.

In this study, researcher implement lesson study by using gallery walk strategies to improve students' participation in problem-solving activities. The paper explores the benefits of using gallery walk strategies in lesson study, challenges associated with students' participation in problem-solving activities, and assessment of students understanding of integration using Riemann's sum.

## RESEARCH METHOD

The study is taking place in the 3<sup>rd</sup> Campus of Universitas Ahmad Dahlan. This is a descriptive qualitative research. It describes the benefits of using Gallery walk strategies which are used in learning while doing lesson study. There are 6 observers whom they are involved in three cycles of lesson study. The explanation about each cycle in the learning process is described as follows.

### Plan

Lecturer prepares the materials related to the definite integral by using Riemann's sum approximation. Lecturer divides students in the group that consists of 4-5 students. There are 7 groups who discuss the same problems related to the definition of integral. Each student proof the definition of integral using Riemann's sum, Darboux's approximation, and Theorem Fundamental of Calculus 1 and 2. Students' participation is observed by using Abuid's (2014) Questionnaire. Observers fill the questionnaire using yes or no answers.

### Do

By using gallery walk, lecturer gives problems related to the definition of integral by using Riemann's sum approximation. Students solve the problem in the group. One of the groups presents their discussion in front of the class. Each student must contribute in finding the definition of integral by Riemann's sum approximation, Darboux's approximation, and The Fundamental Theorem of Calculus 1 and 2.

### See

After teaching and learning process, lecturers evaluate the strategies of learning that have been used. Teachers plan the appropriate gallery walk strategies in the next session. Teachers reflect students' participation and paper works.

Each stage has been reflected both the teaching and learning process and the learning materials. Based on reflection paper, lecturer plan the next learning material with the observers. Each material is discussed for the mathematics education students.

## RESULT AND DISCUSSION

Several positive outcomes were observed. The majority of both female and male students reported that they had greatly enjoyed the activity and wished to repeat gallery walk in the future. Students were particularly excited at the chance to view their own work. Students also reported great satisfaction with several other capabilities of the problem-solving activities. The feedback from observers related to the participation of

the students in the classroom is shown in Table 1.

Based on table 1 it is shown that most of the observer gives a positive response related to students' participation in teaching and learning process. Most lecturers thought that most students involve in group discussion. While solving the problem, each student discusses the strategies then find the definition of integral and theorem fundamental of calculus. When one of the students in a group was giving an opinion, the other was giving feedback to find the best way to solving the problem. It is relevant with Abdullah, *et al* (2012) who said that while there are students who actively participate in classroom and yet there are much more who hesitate to participate. Since most studies said that gallery walk stimulates students' participation in the classroom, it was found that gallery walk made the observers know whom students do not understand the material. Their lack understanding about the sigma notation inhibits them to prove the definite integral using Riemann's sum and Darboux's approximation.

In addition, based on students' paper work in figure 1, it shows that students have difficulties in the sigma notation properties. By using gallery walk, they have a chance to discuss it with the other group. Overall, among the active students, environmental factors such as the size of classroom and seating positions in the class, are not so clearly affect their participation (Abdullah et al., 2012). For active students, environmental elements do not significantly affect their willingness to ask questions and giving opinions. For passive students, the views expressed by this group are different from active students. For instance, the third group chooses to sit at the back claimed that this seating position will facilitate them to ask a friend if they do not understand the topic being studied. Overall, the size of a classroom and seating positions in the classroom is important to encourage passive students to be active in class. This accorded with their personality traits which are quiet, shy, fearful and less confident.

Besides, there are challenges associated with students' participation in problem-solving activities, such as time of learning. On the other hand, the observers found that most of the students haven't connected the use of Riemann's concept of integration in the first meeting. It is because of their lack understanding in Sigma notation. The difficulties of a concept sigma notation inhibit students' participation in the first stages. The learning process in the first meeting is reflected and evaluated to the second and third stages. It was found that lesson study is one of the best alternatives to observe students' participation using Gallery Walk

## CONCLUSION

There are three benefits of using gallery walk strategies in real analysis while doing lesson study. First, gallery walk helped lecturers to modify the assessment sheet to suit the course and the students. Second, students kept attentive in the class with the given problems. Third, gallery walk gives more information about student learning and allowed me to identify the weak students.

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## Appendix 1

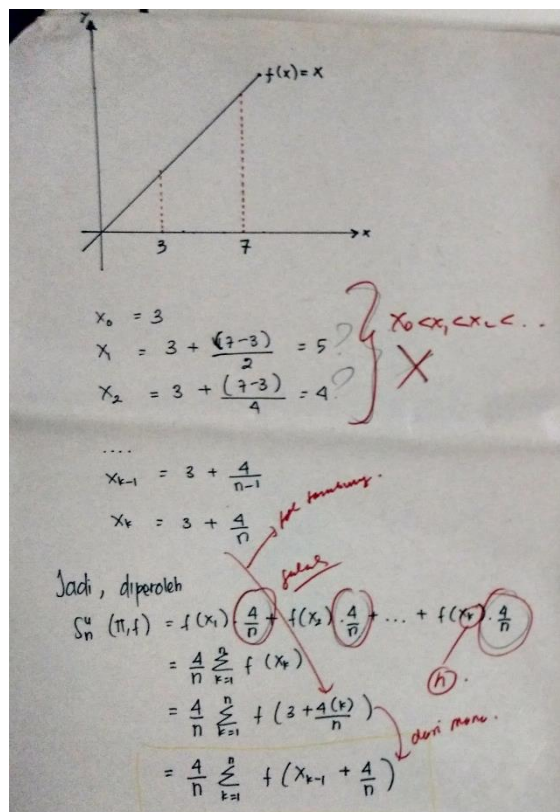


Figure 1. students' paper work

## Appendix 2

Table 1. Observers Questionnaire Result

#	Question	Frequency			% Agree
		Agree	Not agree	Invalid	
Q1	I believe in the involvement of students in teaching and learning	5	0	0	100
Q2	The process is not a waste time	3	2	0	60
Q3	The students' participation is necessary for the course	4	1	0	80
Q4	The time of the teaching and learning process is enough to accommodate the process	2	3	0	40
Q5	The process is not cumbersome and does not impose pressure on the students	4	1	0	80
Q6	The strategies is clear to design for implementation	4	1	0	80
Q7	The strategies helped me to modify the assessment sheet to the course	3	2	0	60
Q8	Students kept attentive in the class	4	1	0	80
Q9	The strategies gives more information about student learning and allowed me to identify weak students	5	0	0	100
Q10	I noticed some new and creative participation from students	3	2	0	60