Enhancing learning outcome in integral through Online teaching based during COVID-19 pandemic

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Abstract. This research aims at enhancing learning developments in Mathematics through online learning systems using multiple cycles. We conducted a classroom action research as a method with the jigsaw type within the cooperative learning model. The research samples were 36 students in the fourth semester. The finding showed that there was a considerable increase in the learning outcomes from the first cycle to the second cycle. In the third cycle, all students reached the minimum submission criteria prescribed by the faculty with a value of 70. It can be concluded that the cooperative learning model of Jigsaw type with an additional assignment of homework can maximize the results of mathematics learning in Indonesian universities.

1. Introduction
With the massive spread of the corona pandemic globally, education in Indonesia faces a new challenge in implementing learning activities. Learning that has been carried out face to face in class must be changed to an online system. This is a new challenge for both lecturers and students. Online learning is a solution to replace face-to-face learning [1]. This pandemic situation presents the implementation of education Countries around the world have changed the learning system for the continuity of education [2]. We can achieve the best student learning results at the time of Covid-19 by using the media teleconferencing facilities (e.g., Skype, Zoom, Lifesize) to deliver lessons remotely [3].

The other education system represents a tremendous contribution to the quality of pupil's knowledge; by providing various activities in learning, which are conducted under this system, there should be accounted students' achievement [4]. A high-quality math-teaching method is supposed to pique pupils' interest, to inspire them, make them active, and guide them [5]. By observing the learning activities, and the results of the learning that a lecturer has done will know the weakness of the activities he has done. From that basis, there is an action to change the learning model that should improve the learning outcomes. Learning outcomes can be measured with indicators increasing the number of 100% of students reaching the passing grade of the study.

Online learning has a hidden effect that is Online teaching and learning can take educators and students out of their comfort zones [6]. In the continuity of lifelong education, online learning becomes a learning tool for most people [7]. The change in the use of technology using computers as the media of learning has significant potential in changing the way how students study, gather information, adapt information, and so on [8].
The teacher, as a learning organizer in the classroom, should set a learning model in this study using cooperative learning models. The Cooperative learning Model is learning that prioritizes the utilization of learners groups. With the principle of grouping that each group member must have a heterogeneous level of proficiency (high, moderate, and low), and if it is necessary, they must come from races, cultures, different tribes and consider gender equality [9]. A cooperative learning strategy is a learning strategy that assists learners in developing their understanding and attitude according to real life in the community, so working together among fellow group members will increase motivation, productivity, and learning [10][11][12]. And Jigsaw type is one part of a cooperative learning model that can provide learning activities to students [13]. Some previous studies have shown that the results of learning research using conventional teaching that students had difficulty in understanding the mathematics material explained by the teacher and feel worried about the test [14]. Learning outcomes using traditional learning models are lower than learning outcomes using technology [15][16]. Other research results stated that learning outcomes by using media are better than conventional learning models [17]. Understanding the concept of learning materials in learning experiment research by using Jigsaw-type cooperative learning is better than traditional models [13]. The correlation between the Jigsaw type learning model and the pupil's academic work is very significant [18].

This research focuses on the following problem: how are the learning outcomes using conventional learning models? Can the jigsaw learning model improve student's learning outcomes? And what is the effect size of the jigsaw learning model on mathematics learning outcomes?

Learning outcomes are the results of the learning process that actively achieved by students through the involvement of cognitive, affective, and psychomotor aspects. Learning outcomes are the results achieved after students go through a learning process that is realized by learning achievement [19]. Socioeconomics factors are another external factor that can affect students' learning achievements [20]. Learning achievement is the result that students have achieved after doing a learning activity, which is a number or value[21][22][23]. Assessment of the learning outcomes of a student to understand how far has achieved this learning goal is called learning achievement [24].

In the Jigsaw Cooperative learning model, of which students are divided into small groups called beginning groups, each group of which consists of four members. The four members are given different material assignments; then, they form a new group called a group of experts, i.e., group members have the same task (material) and discuss the material with the achievement of all members of the group to understand the assigned material. Afterward, they returned to the original group to explain the material alternately in the original group. Jigsaw Cooperative learning allows interaction between students, so they are involved. Therefore, cooperative learning is very close to the social interaction between students who intangible social skills [25]. In the application of the Jigsaw technique, students separate from their groups and form new groups [26]. The "Mosaic" method (Jigsaw technique) has been used in the educational process in many countries on all continents, both in the study of specific curriculum subjects and in various social activities. This method can improve the performance of pupils and students in all subjects by using the collaborative learning method [27].

Class action research is a study with the process of reviewing a cycle of various learning activities. The cycle is intended through the planning stage, action execution, observation, and self-reflection. These stages consist of multiple cycles in one simulation until things you want to fix have been achieved. This study was conducted up to three cycles [11]. In addition, the purpose of this study is to describe the improvement of learning outcomes of students using the Jigsaw method during Covid-19.

**2. Methods**

This research is a classroom action research on integral mathematics learning, with a random sampling technique obtained as much as 35 students in their 4th semester at a private university in South Jakarta. The study was conducted at the beginning of the even semester 2019/2020. The design of this study consisted of four stages, namely: planning, acting, observing, and reflecting. That stages can be elaborated which are: 1) planning: making a plan of the learning process, learning media, and choosing an instrument of observation on student activities; 2) acting: carrying out the
learning activities following the planning; 3) observing: carrying out observation activities by lecturers as researchers or by collaborative lecturers while learning activity is taking place; 4) reflecting: Implemented at the end of the learning process to evaluate the learning. The results of the reflection in cycle 1 are a reference for lecturers to take action in cycle 2. Thus, in cycle 3, the action changes in the teaching and learning process as an improvement step from the previous cycle (cycle 2) so that learning outcomes are expected to be better. If it has not been successful, we proceed with the third cycle activity. Furthermore, learning material can be seen in table 1.

Table 1. The Mapping of learning activities.

| Cycle   | Learning materials | Activity        | explanation                                      |
|--------|--------------------|-----------------|--------------------------------------------------|
| Cycle 1|                    | conventional    | - The lecturer teaches using zoom.us application |
|        |                    | learning        | - The assistance observes                        |
|        | a. Indeterminate Integral |                | - A formative test is given                       |
|        | b. Definition      |                 |                                                 |
|        | c. Integral as an anti-derivative      |                 |                                                 |
|        | d. indeterminate integral properties  |                 |                                                 |
| Cycle 2|                    | Cooperative      | - The activity of 4 expert groups and observations via WhatsApp group and video call |
|        |                    | learning of Jigsaw type | - The lecturer is a member of the initial WhatsApp group and the expert WhatsApp group |
|        | a. Determinate integral |                | - The lecturer sets up the time for the learning |
|        | b. The basic theory of calculus |            | - The assistance makes the observation            |
|        | c. Determinate integral properties |         |                                                 |
| Cycle 3| a. Integral with substitution | Cooperative | - The lesson begins with the discussion of homework via zoom.us |
|        | b. Integral Partial | learning of Jigsaw type with additional homework | - The lesson continued as in cycle 2 |

2.1. Conventional learning activities (cycle 1)

At this stage, learning activities were conducted by using the zoom.us application, WhatsApp group, and video calls. There is no special preparation except for routine activities, such as praying before learning, preparing for taking notes, and all students must focus on the lecturer's explanation with the discussion material: indeterminate integral, integral as anti-derivative, and indeterminate integral properties. At the end of the lesson, all students completed the exercises, and they were given a formative test.

2.2. Cooperative Learning Jigsaw type activities (cycle 2)

Learning activities with Cooperative Learning Jigsaw type discusses the learning materials as in Table 1. After the lecturer distributes the material to each initial group member, then the expert group discusses in WhatsApp group and video calls, the lecturer sets the time for starting the discussion and for the students returning to the group. After the students return from the expert group, they were back into the initial group and are already experts in their fields. Then each member was asked to teach each other as peer tutors to the members of the initial group (cooperative group), then they had to report the results to the lecturer.
2.3. Cooperative learning Jigsaw type with additional home works (cycle 3)

Learning activities at this stage were basically the same as in cycle 2 activities, but students were given the task of reading and answering simple questions that are done at home.

3. Result and discussion

Based on the design of this study consisted of four stages. It has been implemented, such as planning: already prepared a plan of the learning process about Integral, material, cooperative model learning, Group Division, zoom user name & password, and WhatsApp group. Acting: Implemented by the scenario of a plan of the learning that has been made before. Observing: This stage is carried out simultaneously at the time of acting. Notes during an activity can be recorded through an observation sheet, such as student activity, student reactions, and other things that may occur in the learning process that may be useful at the time of reflection. And reflecting: Implemented at the end of the learning process to evaluate the learning. If there is a problem in the process of acting, the process of re-examination starts from planning, acting, are, and reflecting.

Based on the results of the activity that the minimum completeness criteria for mathematics set by the head of the study program are 70. Based on these criteria, students who have reached the minimum completeness criteria can be seen as in table 2.

Table 2. Learning achievement results based on cycles.

| Cycle   | Average test results | Students with achievements≥ 70 |
|---------|----------------------|--------------------------------|
| Cycle I | 57.71                | 11.43 %                        |
| Cycle II| 71.53                | 77.14 %                        |
| Cycle III| 81.25               | 100.00%                        |

Calculation based on SPSS 24 can be seen in table 3 as follows.

Table 3. Descriptive Statistics.

|          | N  | Minimum | Maximum | Mean | Std. Deviation |
|----------|----|---------|---------|------|----------------|
| Cycle I  | 35 | 45      | 70      | 57.71| 7.891          |
| Cycle I  | 35 | 60      | 90      | 72.43| 6.792          |
| Cycle II | 35 | 75      | 100     | 82.71| 7.702          |
| Valid N (listwise) | 35 |         |         |      |                |

Student learning achievement in cycle 1: The lowest value was 45, and the highest value was 70 (range of 25 points) with a mean value of 57.71, and 4 students have achieved a minimum completeness score. Student learning achievements in cycle 2: The lowest value was 60, and the highest value was 90 (range of 30 points) with a mean value of 72.43, and 27 students have achieved a minimum completeness score. Student learning achievement in cycle 3: The lowest value was 75, and the highest value was 100 (range of 25 points) with a mean value of 82.71, and 35 (100%) students have achieved a minimum completeness score. It shows that the Jigsaw cooperative learning model is very suitable for the subject integral.

The novelty of the research is how the effect size of the Jigsaw cooperative learning model compared with conventional learning. Effect size is an indicator of the magnitude of the influence of two learning models used in teaching and learning activities. Based on calculation of effect size =2.03. It was bigger than 1.45 means a very high effect [28]. It said that cooperative learning Jigsaw type, when compared with conventional learning, has very high effectiveness. Therefore cooperative learning Jigsaw type is very good used in math learning. Moreover, cooperative learning of jigsaw type is effective in terms of reasoning abilities and students' mathematics learning attitudes [29]. The learning results of student
mathematics by the Jigsaw type of cooperative learning model is more effective than conventional study on relation and function subject [30].

Actually, in Cycle 2, learning is quite successful with a high learning effect once. Still, the researcher is less satisfied with the results achieved, so it is taken off by continuing on cycle 3 with the intervention of the Jigsaw-defected model coupled with additional tasks read the material to be taught as well as the assignment of problems. If we compare cycle 2 and cycle 3, with the calculation of effect size \(= 1.37\). Based on the calculation above, learning with a cooperative model Jigsaw with additional assignments has very high effectiveness, and all students achieve grades above the minimum completeness criteria of 100% when compared to the results of the conventional learning model. If the pre-cycle learning model with cycle II learning outcomes is compared, the results will be even more significant. The results of this action research are following the results of some previous research. They stated that students who learn using Jigsaw Learning cooperative model with concept maps produce better mathematics learning achievement than students who learned with jigsaw learning models without concept maps and direct learning models [31].

4. Conclusion
Classroom action research is one of the choices for lecturers to improve learning quality so that students can gain optimal learning achievement. This study concludes that the learning outcome on cycle 1 has not yet achieved good results, on cycle 1 nevertheless is a process as the basis for the next action then we proceeded with learning cycle 2 with a cooperative learning model of jigsaw type. The learning activities in the second cycle have achieved a significant increase in learning outcomes. Nevertheless, the lecturer decided to continue on the 3rd cycle. There was an increase in learning outcomes with the achievements of all students above the passing grade (70). A high-quality math-teaching method is supposed to pique pupils' interest, to inspire them, make them active, and guide them [5]. However, this research needs to be followed up by other studies to obtain more accurate research results with a larger sample and wider scope of the research area.

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