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Research Article

Implementing Jigsaw technique as an effective way for promoting ocean literacy among prospective geography teacher: An action research

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Abstract

This study was aimed to examine the effectiveness of JIGSAW type cooperative learning models in enhancing student learning outcomes of prospective teachers in Oceanography in the Geography Education Department, Faculty of Teacher Training and Education University of Lampung, Indonesia. This learning model is expected to help students to reduce their cognitive constraints by actively training themselves to collaborate in groups with others in understanding Oceanographic concepts. The number of students involved was 35 people (21 female and 14 male). This study was a classroom action research (CAR) carried out in 2 cycles. Each cycle is a series of activities that include planning, implementing, observing, and reflecting. Data collection techniques are carried out through observation, documentation, and tests. Data analysis was performed using descriptive-quantitative techniques using the principle of normalized gain and paired sample t-test. Each cycle is a series of activities that include planning, implementing, observing, and reflecting. Data collection techniques are carried out through observation, documentation, and tests. Data analysis was performed using descriptive-quantitative techniques using the principle of normalized gain and paired sample t-test. Each cycle is a series of activities that include planning, implementing, observing, and reflecting. Data collection techniques are carried out through observation, documentation, and tests. Data analysis was performed using descriptive-quantitative techniques using the principle of normalized gain and paired sample t-test. The results show that the use of JIGSAW type cooperative learning effectively increased student involvement in learning Oceanography courses that have an impact on growing mastery for Oceanographic concepts. By focusing on giving scaffolding appropriately by lecturers through the participation of peers as "experts" it had been able to encourage students' motivation and active participation in ocean literacy.

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Introduction

Indonesia is an archipelago nation that has a coastline of more than 81,000 km, therefore Indonesia needs to develop education oriented to empowering coastal and marine areas in a reliable, competent, creative and innovative manner (Rositasari, 2001). In addition, two-thirds of the total area of Indonesia is an ocean that has natural resource potential which is very important for the life of the nation. This potential needs to be managed appropriately so that it can be optimally and sustainably utilized for the welfare of the community (Yusron, 2005). Therefore, ocean literacy (oceanography) becomes an integral part of the development of the national curriculum in Indonesia, not least in universities that prepare prospective teachers who will educate young people about the importance of ocean literacy

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(Ajie, Ramalis & Liliawati, 2012; Fauville, 2017; Hilda & Elly, 2019). However, learning oceanographic concepts in prospective teacher students in Indonesia is still unable to produce optimal learning outcomes, so there are still a number of learning innovations needed that are able to optimize their learning potential, including the quality of assessment treatment and students engagement in the classroom (Strang, 2008; Guest, Lotze & Wallace, 2015; Noviana, Abdurrahman, Rosidin, & Herlina, 2019).

Despite, the one main factor of the quality of the learning process is the involvement of students in the learning process. Most of the learning process in prospective teachers' classrooms tend to still focus on lecturers as the only source of learning. This condition had an impact on the ability of students to become independent learners and critical thinkers (Fuller & France, 2019; Aparicio-Ting, Slater & Kurz, 2019). Thus a learning strategy was needed to activate their thinking and physical power in acquiring learned concepts. This class action research attempted to investigate the effect of implementing a jigsaw cooperative learning model on oceanography classes for prospective students of geography teachers.

JIGSAW is the type of cooperative learning model that could help students develop their cognitive abilities through effective collaboration activities in the classroom (Johnson & Johnson, 1989; Vygotsky, 2019; Kamaruddin & Yusoff, 2019; Hakim & Sakti, 2019). Indeed, collaboration skills had been identified by many as key skills of the 21st century (OECD, 2005; Tan, 2020) which were included in most of the current education learning models in almost all countries in the world (Hager, Lee & Reich, 2012).

JIGSAW type of cooperative learning is one of learning that consists of the original group and the expert group. Group members consist of several students with a high level of heterogeneity in both academic and gender abilities. Students who had the same topic met with the expert group, the expert group learned one topic. Then, the topic was thoroughly discussed, students from the expert group returned to the original group and shared knowledge with friends in the original group (Suyatna, 2011). Furthermore, JIGSAW is designed to increase students' sense of responsibility towards their own learning and also the learning of others. Students not only learn the material given, but they must also be prepared to give and teach the material to other group members. Thus, students are interdependent with each other and must cooperate cooperatively to learn the material assigned (Lie, 2007). Jigsaw learning required groups of origin and expert. The homegroup was a combination of several experts. Expert groups were student groups consisting of members of different origin groups who were assigned to study and explore a particular topic and complete tasks related to the topic to then be explained to members of the homegroup (Suyatna, 2011).

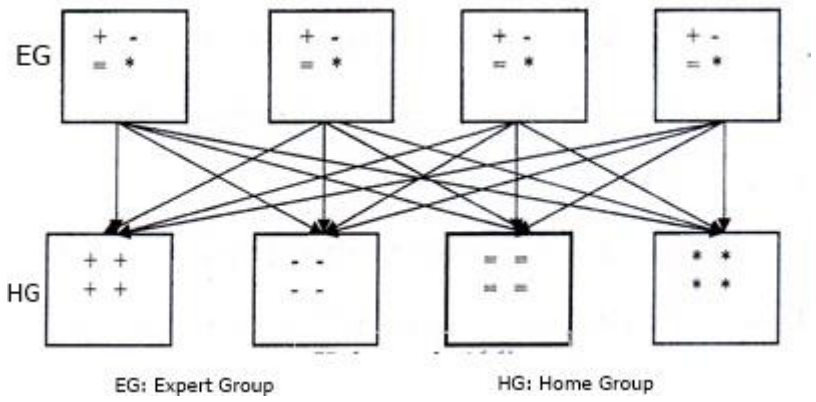

Figure 1.

Students Classroom Management of JIGSAW (Suyatna, 2011)

Problem of Study

As a formulation of the problem statement in this study is expressed in the form of the following questions:

- How effective is the JIGSAW cooperative learning model in increasing the mastery of oceanographic concepts in second-year geography education students?

The consequence of this question is the formulation of the following research questions:

- How is the implementation of the JIGSAW technique learning program suggested in oceanography learning in geography pre-service teachers?
- How effective is the JIGSAW technique learning program recommended in oceanography learning in second-year geography pre-service teachers?

Method

Research Model

This research is a classroom action research (CAR) in which the first author reflects on formative assessment in oceanography classes and improves the learning process. CAR, which is implemented in the form of technical action research (Kemmis, 2009), focuses on strategies, methods, or techniques to find out what is best for improving student learning performance. This research position occupies a continuum from personal reflection at one end to formal empirical education research on the other, which is more informal and private than formal educational research such as experimental research (Mettetal, 2001).

Participants

This research was conducted in the odd semester of the academic year 2019/2020, carried out in two cycles. This study involved 35 students (21 female and 14 male) aged range 20-22 years old of the Geography Education Undergraduate Program at the Department of Social Sciences Education at a State University in Lampung Province, Indonesia.

Data Collection Tool

This classroom action research includes two main instruments developed by researchers, namely the learning observation sheet (LOS) and the oceanographic conceptual understanding survey (OCUS). The LOS instrument contains 36 items arranged by five components. The components include: (a) Perception and motivation, (b) Exploration, (c) Elaboration, (d) Exploration, and (e) conclusion. The number of indicators under each component varies. Each indicator is evaluated on a scale ranging from 1 (low) to 4 (very good) with the observer confirming each score assigned to each item.

The OCUS instrument consists of 10 items. Five items administrated at the end of the first cycle about basic oceanography concepts. Whereas five items are given at the end of the second cycle about the concept of physical oceanography. The reliability of the concept mastery instrument is checked by calculating r. Both cycles had consistent measurements of r (Cycle 1, $r = 0.317$; Cycle 2, $r = 0.341$). Internal consistency was also checked by calculating the Cronbach Alpha ($\alpha = 0.781$).

Data Analysis

In this study, a formative assessment of student performance has been carried out to examine the effectiveness of the treatment. An analysis of variance of repeated measures with scores on pre-measurement, post-test 01, and post-test O2 were used. Normalized-gain analysis of the second pre-measurement score formative post-test was used. Likewise, the paired sample t-test on the two formative post-tests was carried out.

Procedure

This study adopted a spiral model of Kemmis's classroom action research (2007). In general, the spiral model of classroom action research (CAR) describes a continuous process that includes two iterations where each cycle goes through the process of gathering information, planning, implementing actions, observing and reflecting actions and then designing actions in the next cycle, which were based on facts and findings from the previous cycle (Figure 2). The first cycle investigated the effectiveness of expert groups in stimulating target group members in exploring and explaining the basic concepts of oceanography through group discussion as a deep and meaningful learning activity. In this cycle, students were expected to increase their scientific communication skills in an in-depth discussion of the subject matter of fundamental oceanography. The second cycle evaluates the effectiveness of expert-researcher group interventions in elaborating on the essential concepts of marine natural resources as reinforcement of group investigations in the first cycle.

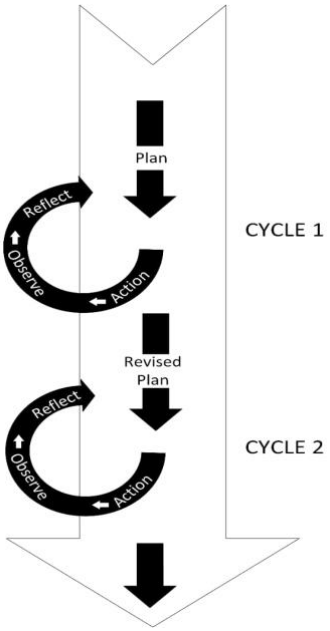

Figure 2.
The Two-Cycles Kemmis Classroom Action Research Spiral Model (Kemmis, 2007)

Research Setting

This research was conducted in the odd semester of the academic year 2019/2020, carried out in two cycles. This study involved 35 students (21 female and 14 male) aged range 20-22 years old (20.83 ± 0.79) of the Geography Education Undergraduate Program at the Department of Social Sciences Education at a State University in Lampung Province, Indonesia.

Procedure Stages

Cycle 1

a. Planning Stage

At the planning stage the steps conducted were:

1) Prepared a lesson plan;
2) Prepared materials needed for JIGSAW type cooperative learning, namely:
    a. Prepared pretest and posttest material which was used as evaluation in the first cycle;
    b. Preparing lecture material presented, namely the Standard of Competence in understanding Fundamental of Oceanography and the History of Oceanographic Development in Indonesia;
    c. Prepared group discussion materials with the subject matter;

b. Action Implementation Stage

At the implementation stage the steps conducted were:

1) Provided motivation and apperception in the opening;
2) Carried out a pretest to find out the initial abilities of students;
3) Delivered the subject matter to be presented, namely the standard of competence to analyze the assistive sciences of Oceanography;
4) Divided students into groups of 4-5 students each.

c. Observation

Observations carried out during the learning process. In order to make the observation more directed, we used the observation scale.

d. Reflection

In the end of the learning process, the reflection was carried out to find out the deficiencies in the implementation of learning in the second cycle and redesign the lesson plan based on the first cycle realization.

Cycle 2

The second cycle of CAR conducted after a special lecture on raising issues that stimulate thinking and focus on the impact of a jigsaw cooperative intervention model. During this cycle, all groups were challenged on how to manage marine resources intelligently without creating exploitative elements and each group had to present the team work investigations in turn.

After a special discussion and presentations, the lecturer-researcher observed and tested how much increased mastery of concepts about marine resource management by conducting a post-test. The evaluation step required students to develop their reasoning capability in elaborating sources of information from various learning materials when getting an explanation from a team of experts and intensive discussions in their respective groups. The questions posed have high-level thinking skills, requiring students to synthesize, analyze, compare, and evaluate situations related to oceanographic content and contexts.

Results

The students' average score and grade of Oceanography course mastery on the three stages of learning were presented in Table 1.

Table 1.

Student Grade Attainment for Each JIGSAW Cycle

Grade	Before Treatment (N = 35)	Treatment of Cycle I (N = 35)	Treatment of Cycle II (N = 35)
A	0	15	29
B +	1	12	5
B	8	8	1
C +	10	0	0
C	16	0	0
D	0	0	0
F	0	0	0

Table 1 showed that the number of student grades after JIGSAW type cooperative learning had increased. Result revealed that 4 students (11.42%) got an A grade criteria before JIGSAW type cooperative learning treatment conducted. Then, in cycle 1, there was an increased that was showed by 15 students (42.85 %) got an A grade criteria, and in cycle II there was an A grade of 29 students (82.85 %). In cycle I and cycle II there was no grade of C. Furthermore, the average score of student learning outcomes in Oceanography courses before the JIGSAW type cooperative learning treatment, cycle 1 and cycle II had increased. For more details, the results could be seen in Figure 3.

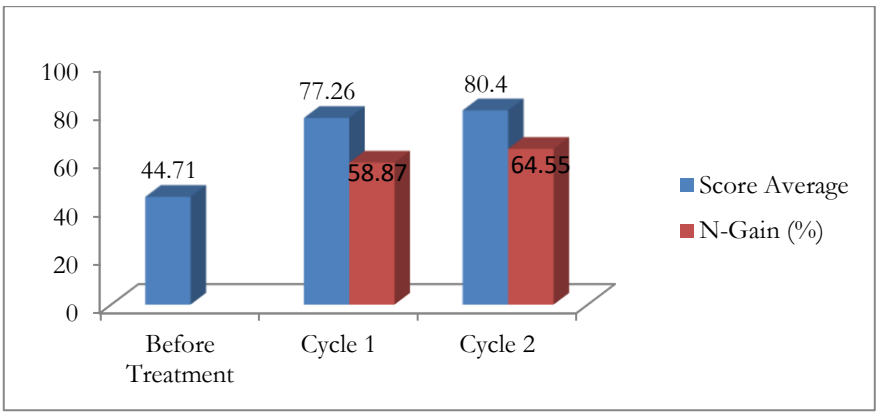

Figure 3.

The Average Score and Normalized-Gain in Cycle 1 and 2

Figure 3 showed that the average score of students in Oceanography courses learning using JIGSAW type cooperative learning from cycle I and II had significantly increased with normalized-gain in medium categories (Hake, 2002). It means that the implementation of JIGSAW type cooperative learning in the Oceanography class effective in enhancing students' understanding of Oceanographics.

Table 1.
t-Test of Paired Two Sample for Means of Pre-Cycle and Cycle 1

	Pre-Cycle	*Cycle 1*
Mean	44,714	77,264
Variance	35,563	31,457
Observations	35	35
Pearson Correlation	0,830	
Hypothesized Mean Difference	0,000	
df	34	
t Stat	-56,916	
P(T<=t) one-tail	0,000	
t Critical one-tail	1,691	
P(T<=t) two-tail	0,000	
t Critical two-tail	2,032	

Furthermore, the results of the t-paired samples test showed that the conceptual understanding of students before and after treatment until cycle 1 changed significantly ($p = 0,000$) as shown in Table 1. Likewise, the student learning outcomes in cycle 2 significantly demonstrated very good performance ($p = 0,000$) at mastering oceanographic material (see Table 2)

Table 2.
t-Test of Paired Two Sample for Means of Pre-Cycle and Cycle-2

	Pre-Cycle	*Cycle 2*
Mean	44,714	80,429
Variance	35,563	29,782
Observations	35	35
Pearson Correlation	0,841	
Hypothesized Mean Difference	0,000	
df	34	
t Stat	-64,830	
P(T<=t) one-tail	0,000	
t Critical one-tail	1,691	
P(T<=t) two-tail	0,000	
t Critical two-tail	2,032	

Discussions and Conclusions

This study had shown that one of JIGSAW's strengths in the Oceanography class in CAR that was combined with collaborative learning (CL) and inquiry-based learning (IBL). This applied combination had been agreed by a number of researchers as a promising teaching and learning strategy in modern universities (Bell, Urhahne, Schanze & Ploetzner, 2010). The high achievement of N-gain in both cycle 1 and cycle 2 shown by prospective teacher students on oceanographic concepts was made possible by the factor in the number of students working as group members actively and collaboratively to investigate their inquiry questions. Research had shown that the combination of CL and IBL in the JIGSAW context had a positive influence on student learning outcomes in science classrooms (Kolloffel, Eysink & de Jong, 2011; Tabiolo, 2019).

Furthermore, JIGSAW activities also provided opportunities for students to work on and answer their inquiry questions collaboratively in ways that were not available to one student. With the support of lecturers and expert group members, students could complete learning tasks related to the basic concepts of oceanography and the utilization of marine resources in the zone of proximal development through a positive scaffolding process (van de Pol, Volman & Beishuizen, 2012; Nurulsari, Abdurrahman, & Suyatna, 2017). In addition, JIGSAW also allows students to acquire oceanographic knowledge with their inquiry questions with the help of appropriate learning media (Khoiriah, Jalmo & Abdurrahman, 2016) and provides many opportunities for students to develop and practice their 21st-century skills, especially collaboration skills with support from group members, so the lecturer will facilitate and

provide group balance only when needed. The lecturer had a role in monitoring the progress of each JIGSAW group and providing guidance if necessary, motivating the inactive groups, and providing feedback after completing the treatment stage for each particular JIGSAW cycle (Williams, Nguyen & Mangan, 2017).

Overall, this research showed that we could present a coherent innovative learning climate that had the opportunity to improve the conceptual understanding of student-teacher candidates for the course. Although this study was conducted in the classroom of prospective Geography teachers, the philosophy and pedagogical insight into the process of internalizing curriculum development for prospective teachers can be applied to other fields of study. The way to facilitate student-teacher candidates in developing their creative, independent learning abilities, classroom action by actively involving students in collaborative activities required an emphasis on any anticipative and contemplative treatment process. This collaborative action research study could serve as a catalyst for retesting the importance of building peer initiation learning power that refocuses on the development of conceptual learning of teacher candidates and further development of a more coherent understanding of the role of lecturer scaffolding in building student collaboration skills in each phase of the learning process.

Recommendations

For Further Studies

The cooperative learning model not only has the potential to develop students 'collaboration skills but also has great opportunities in building students' thinking skills. Therefore, instructors can elaborate on various types of learning techniques based on cooperative learning in the context of formal research. Besides, instructors need to consistently carry out holistic reflections in every effort to improve the quality of education at the classroom level, especially in the oceanography course.

For Applicants

The ability to build-own their knowledge for students in the cooperative learning process is the goal of modern education. The JIGSAW technique is one of the most appropriate alternatives for the development of collaborative and communicative skills that are needed by students in the era of the industrial revolution 4.0. The JIGSAW technique also has the potential to spur student cognitive development with the help of peers who have a more in-depth ability to comprehend material content comprehensively. In addition, teaching materials and instructional media in the JIGSAW technique will significantly help improve students' overall cognitive performance.

Limitations of Research

This classroom action research is limited to only two cycles. To get a complete picture of student learning performance and the treatment innovations that were tried out, it is better if the number of cycles needs to be considered proportionally. Furthermore, the application of the JIGSAW technique should be supported by a number of ICT-based learning tools to help improve students' elaboration skills in mastering the essential concepts of oceanography lecture materials. Likewise, the assessment methods and instruments provide a means of reflective thinking for students to have more imaginative thinking skills.

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