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The Effect of Practical-Based Jigsaw Strategy on Science Process Skills of Students

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A professional science teacher is a teacher who not only understands the basics of science but also understands the skills of the scientific process. However, the results of the tracer study show that science process skills (SSP) from Unwira Biology Education graduates is still low. Therefore, the right strategy is needed to create graduates who understand SSP, like practical jigsaw-based cooperative strategies. The purpose of this study was to determine the effect of practical-based jigsaw strategies on the science process skills of biology education students. This research is a quasi-experiment. The sample used was the fourth-semester students of class A and Class B. Class A as a control and class B as an experimental. The results showed that the average score of students' SPS in the experimental class was 90.4 while in the control class was 62.67. After being analyzed using the Independent-Sample t-Test, it showed a significant effect with a value of 0.036. This research concludes that the practical-based jigsaw strategy influences student science process skills.

1. Introduction

The teacher is someone who has the ability to manage and organize classes. Teachers can also be defined as people who consciously direct the experiences and actions of an individual so that education can occur (Grambs & Clare, 2003). So the teacher is a person who has the ability to direct and educate students. Such abilities require teachers to be professional so that they can realize schools based on knowledge (Kariman, 2002). Today's learning has to apply the concept of "learning to do" to replace the concept of teacher-centred learning. This fact demands the readiness of a teacher in designing the learning process so that the concept of "learning to do" is carried out as expected. The concept of "learning to do" in this era is learning with a scientific approach.

Learning with a scientific approach requires teachers who can apply science skills. However, the facts show that many Unwira Biology Education Study Program graduates lack knowledge of science process skills (SPS). The lack of mastery of graduates to SPS is an obstacle for them to be able to apply the concept of learning with a scientific approach in schools (KKNI Biology Education Curriculum, Unwira, 2016).

The solution to these problems is to implement learning strategies that can improve student SPS. Students must be trained from the beginning before becoming a teacher later. Literature study results show that there have been many studies that reveal the effectiveness of various strategies, models and learning methods that can improve students' science process skills. As research conducted by Soraya et al., (2016) on the effect of the team assisted individualization (TAI) cooperative model on SPS students showed that after the application of the TAI cooperative learning model the percentage of posttest scores on the science process skills increased for the experimental class at 70.5. Sidiq et al., (2012) in their research also showed that the collaboration of the STAD and inquiry models had a significant effect on student SPS. Besides, Agustini et al., (2016) reported that there was a difference in the percentage of SPS in the class using the experimental method that was 88.85% compared to the class with the other method which was only 64%.

Some of this research shows that the cooperative learning model can improve students' SPS. Similarly, the application of experimental methods can also stimulate SPS. Thus the application of cooperative learning models such as practical-based jigsaw is expected to have a significant effect on the SPS of students. Research by Pratiwi et al. (2013), Dewi (2018) that a jigsaw learning model if collaborated with an experimental method can improve students' SPS.

Jigsaw is a type of cooperative model in which each group member is responsible for one part of the subject matter and to teach it to other members in the group (Amri & Ahmadi, 2010). Jigsaw is an interesting strategy because the subject matter is divided into sections and does not require it to be studied sequentially. The advantage is that it can involve all students to learn while teaching it to other students in the group (Zaini, Munthe & Aryani, 2008). Learning strategies like these can motivate students, increase self-confidence, and form interpersonal relationships. This allows all students to understand the subject matter at an equal level. By using a practical-based jigsaw strategy it is expected to involve individual responsibility in practicum groups, team rewards and the same opportunities for success but in different ways (Slavin, 2005).

In the application of a jigsaw-based practicum, all students are divided into several groups of 4-5 heterogeneous students. Each group gets several practical topics and each member of the group is responsible for working on one topic. This group is called the home teams. Each member of the home teams forms a new group called the expert group adapted to the similarity of topics received in the home teams. In expert groups, the topic is worked on and discussed. After that, each member of the expert group returns to the home teams and explains to each member of the home teams (Suprihatin, 2017).

Furthermore, in practicum, students will get experience applying scientific methods, so they can develop student SPS. Through the practicum, students carry out scientific activities to improve the ability to find problems, find solutions to problem-solving, formulate hypotheses, design experiments, control variables, measuring, analyzing data, concluding, and communicate the results of experiments/research both verbally and in writing (Saptono, 2003).

Through the practicum, students can prove the theory, experience the practicum process and make conclusions, to support students' understanding of the subject matter. Some theories are sometimes difficult for students to understand without directly experiencing the application of the theory. Students need direct practice to get meaning from the subject matter they are learning. Students must touch, observe, measure, and do to prove a theory. This means that students construct knowledge directly using real objects to better understand the subject matter (Rusita, 2014).

Based on the description above, it is necessary to conduct a research study to determine the effect of practicum-based jigsaw on science process skills. The results of this study can be one of the reference learning models based on a scientific approach.

2. Research Method

This research was conducted at the Biology Education Study Program at Unwira. The population in this study were students of Biology Education Study Program Unwira with a total of 232 students. Samples were selected using a purposive sampling technique. From the available population, semester IV was chosen as a sample with the consideration that the semester students were programming plant anatomy courses with a total of 40 students. From a total of 40 students divided into two classes, namely class A and Class B. Class A was assigned as a control and class B was designated as an experimental class.

This research is a quasi-experimental study. The independent variable in this study is a practical-based jigsaw strategy while the dependent variable is the students' science process skills. In practice, the control class is given a conventional strategy based on practicum as has been done while the experimental class is given a practical-based jigsaw strategy.

The instrument used to measure student SPS was an observation sheet and an assessment rubric. The rubric contains several SPS indicators observed, namely (1) observing, (2) classifying, (3) communicating, (4) designing an experiment, (5) interpreting data, and (6) concluding. Data in the form of SPS values that have been obtained are analyzed descriptively and independent-sample t-Test analyzed with a significance level of 0.05 (5%).

3. Result and Discussion

Students' Science Process Skills

The results of this study are in the form of a total student SPS score and a score based on each measured SPS indicator. The average SPS score of students in both the experimental and control classes can be seen in Figure 1.

The data in Figure 1 shows that the average SPS score of students in the experimental class was also greater than in the control class. This data shows that the practicum method can improve the SPS of students. As reported by Agustini et al., (2016) that theoretically, the high SPS of students is influenced by the treatment of experimental methods. Through this method, students get the opportunity to practice science activities directly. Also, students believe more if truth or conclusions are formulated based on experiments conducted by themselves (Djamarah and Aswan, 2006). In conducting experiments/practicums, students have the opportunity to do it themselves so that students are more confident than just knowing from the teacher or book (Pratiwi et al., 2013).

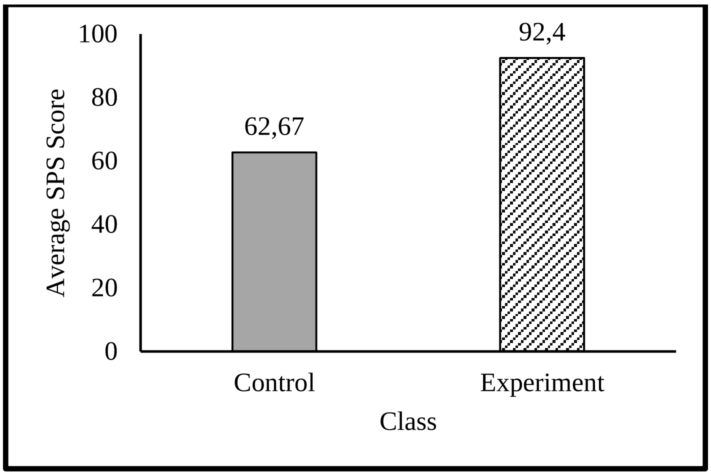

Figure 1. Average SPS score of students

However, practicum activities can be carried out if students work in small groups so that the implementation becomes more effective. Such learning is called cooperative learning. Cooperative learning provides space for students to work together and help one another to complete assignments. Cooperative learning allows students to develop their knowledge and skills in full in a democratic learning atmosphere.

Cooperative learning emphasizes teamwork. Collaboration can accelerate learning goals because a learning community will have better outcomes than only a few individuals who study individually (Hamid, 2011). With the collaboration of students can develop self-confidence, add life experiences and enhance social interaction (Rosita and Leonard, 2015).

Of the several types of cooperative learning, the jigsaw is one of the interesting cooperative learning. This is proven by the SPS value of students in the class with a cooperative jigsaw that is relatively higher than in the class with regular discussion. According to Silberman (2009) jigsaw is the same as an inter-group exchange, the difference is that each student teaches something. This method is an interesting alternative if there is material that can be segmented and each student learns the parts and then combined to form a unified knowledge.

Lie (2005) explained that several things make jigsaw different from ordinary discussion groups. Jigsaw builds students' sense of responsibility and demands positive interdependence among group members. Jigsaw also demands individual accountability which measures the mastery of the concept of each group member and is given feedback about the ability of its members so they know each other partners who need help. In contrast to ordinary discussions, accountability is often neglected so that tasks are usually done by only a few members. In a jigsaw, each student is obliged to take responsibility for the tasks they carry.

In this study, six SPS indicators were developed. These indicators are adjusted to the material of plant anatomy. The six indicators referred to include (1) observing, (2) classifying, (3) communicating, (4) designing an experiment, (5) interpreting data, and (6) concluding. The observation result per indicator is shown in Figure 2.

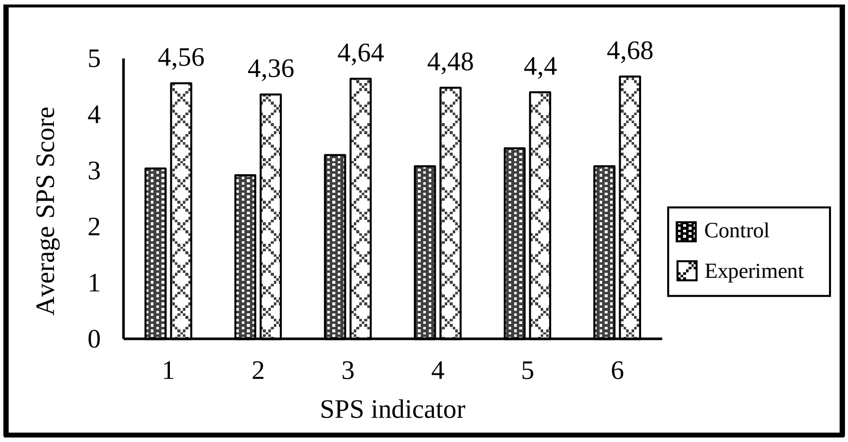

Figure 2. Average student SPS scores per indicator

The average SPS score of students per indicator in Figure 2 shows that the highest SPS indicator score in the experimental class is the deducing indicator of 4.68, while the highest SPS indicator score in the control group is the interpretation of the data of 3.4. Conversely, the lowest KPS indicator for the two classes is the SPS indicator classifying with the experimental class of 4.36 and the control class of 2.92. The overall achievement of each SPS indicator in the experimental class was higher than the control class.

When viewed from the overall SPS indicators achieved by students in the control class, it can be seen that the student SPS level is in the range of 2.92 to 3.4 and is included in the sufficient and good categories. This indicates that practicum with regular group division is good enough to develop student SPS. This is consistent with research conducted by Purwanti (2017) that practicum-based learning can influence the improvement of students' SPS. Likewise, research by Sari (2013) also reported that the application of practicum-based learning models improved SPS, scientific attitudes and students' understanding of concepts.

According to Djamarah and Aswan (1996) quoted by Purwanti (2017) practicum based learning model is a way of learning in which students conduct experiments by experiencing, following a process, observing an object, finding their answers to something learned, proving, analyzing, and make your conclusions about an object, state or process of something.

Practicum allows students to develop learning activities, obtain facts from concepts learned by students, and develop basic skills in conducting experiments such as using a microscope, solving problems with a scientific approach and increasing understanding. It also can develop skills in observing, communicating the results of observations both oral and written, and can facilitate the reconstruction of concepts (Murti et al., 2014). Thus, practicum-based learning models are proven to significantly improve science process skills (Subekti & Ariswan, 2016) which ultimately have an impact on student achievement (Murwani & Wibowo, 2013).

In the control class, the highest SPS indicator is data interpretation. This shows that students can interpret observations of plant anatomy. From the observations made by each group both on the anatomy of monocot and dicot roots, monocot and stems dicot, and leaves, each group can determine the anatomical parts of each organ. This is because each group gets only one organ so that it is easy for the group to determine the anatomical structure parts of plant organs based on references.

On the other hand, the lowest SPS indicator is to classify, which means that students, both in the control class and the experimental class, are still quite difficult to classify the type of dicot or monocot. This is because students do not know in advance the types of plants in the preparations observed.

Overall review of the SPS indicators achieved by students in the experimental class shows that the student SPS level is in the range of 4.36 to 4.68, which means that it is included in the excellent category. This shows that if each student is given the responsibility to observe a preparation in the expert group then explain back to the original group more able to develop their SPS. This is because of the six available indicators, each student in the expert group works and is directly accounted for by re-communicating his observations to other members in his home group. Instead, he gets the same explanation for the observations of preparations that are different from the other members.

Based on this, Slavin (2011) asserts that jigsaw is learning that emphasizes peer model tutorials. In other words, jigsaw facilitates social communication between students with different academic abilities through scaffolding. Social interaction between students in group discussions can construct their knowledge (Yurdakaban, 2011). Students will better understand the concept if they are in the environment of their peers who are smarter (Kilic, 2008). The communication language used by students in delivering subject matter will be better understood by their friends. Social interactions with other friends through group work stimulate the formation of ideas and enrich children's mental development.

Thus practicums combined with a jigsaw can increase students 'confidence, increase their sense of responsibility for the material they carry while simultaneously training students to conduct experiments by the steps of the scientific method that have an impact on increasing students' science process skills.

Students finally understand more and are more confident in making conclusions based on the results of real work done. This is the basis for the highest SPS indicator in the experimental class is the conclusion indicator.

The Effect of Practical-Based Jigsaw Strategies on Students' SPS

In addition to the descriptive analysis of students 'SPS scores obtained in this study, an analysis was also conducted to determine the effect of the practical-based jigsaw strategy on the students' SPS. The results of the analysis of the independent-sample t-test showed that the probability value (sig.) obtained was 0.036. This value is smaller than the determined significance level of 0.05 so that it is stated, practicum-based jigsaw strategy has a significant effect on the SPS of students.

This significant effect was due to the difference between the SPS scores in the experimental group and the control group, where the SPS scores in the experimental group were higher than the control group. The results of this study are following what was reported by Pratiwi et al. (2014) showing that practical jigsaw-based cooperative strategies can improve students' process skills with an average N-gain of 63.05 and the results of research by Dewi (2018) which also revealed that cooperative strategies practicum-based jigsaw affect science skills and student learning outcomes.

Practical activities alone, in essence, can already develop student SPS. As revealed by Gormally et al., (2009) that SPS can develop if students take an active role in laboratory activities. But the reality in a class/group is usually composed of students with varied academic abilities. The variation in academic ability can affect participation in learning/practicum. This was confirmed by Jiwanto (2017) in his observation that in conventional classes, students usually tend to compete for high ranks, so students with low academic ability always lose. This situation affects the level of SPS development.

The results of this study prove that the right method to overcome the gap between students with high academic ability and students with low academic ability is through cooperative jigsaw. Jigsaw, as well as cooperative types, generally allow for interdependence between group members. The interdependence triggers mutual assistance between smart students to students with inadequate abilities (Sanjaya, 2012).

Previous studies that have been conducted from 1990 - 2000 have also shown that cooperative models have a significant effect on the academic achievement of students who have learning difficulties (Rosyidah, 2016). Therefore, supported by the specificity of the jigsaw that requires each student to be responsible for one part of the material and trying to explain to his friends allows for equality of understanding between students. In this regard, practicums combined with a cooperative jigsaw can be applied in science learning which can develop SPS evenly at all levels of student academic ability.

4. Conclusion

Based on the results of the data analysis and discussion, it can be concluded that the practicum based jigsaw strategy influences the science process skills of students. This is seen based on the average SSC of students in the experimental class is higher than the control class and after testing the significance value obtained is smaller than the significance value specified.

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