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Students' Knowledge of Solubility Topics through The Cooperative Learning STAD Type

Ismi Nurlatifah [a,1,*], Wawan Wahyu [b,2], Wahyu Sopandi [b,3]

[a] Universitas Islam Syekh Yusuf, Jl. Maulana Yusuf No. 10 Babakan, Tangerang 15118, Indonesia
[b] Universitas Pendidikan Indonesia, Jl. Dr. Setiabudhi No. 229, Bandung 40154, Indonesia
[1] isminurlatifah@unis.ac.id*; [2] wawan_wahyu@upi.edu; [3] wsopandi@upi.edu
* corresponding author

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Abstract

The topic of solubility is included in the chemistry subject matter that is considered difficult by students. This study aims to identify differences in knowledge improvement between the experimental class using the cooperative learning model STAD (Student Teams Achievement Divisions) type and the control class using the conventional learning model. The research method and design used is a quasi-experimental with nonequivalent control group design. The participants that involved in this study were students of class XI MIPA with 33 students for the experimental class and 32 students for the control class. A written test that has been validated is used as an instrument in this study. From the student scores that obtained, the N-Gain score is calculated, and hypothesis testing is done through SPSS. The results showed that there was a significant difference in increasing knowledge ($p<0.05$) between the experimental class ($<g>=0.71$) and the control class ($<g>=0.54$). The cooperative learning model STAD type is suitable to be applied for solubility topic learning. It can also be used for the others topic.

1. INTRODUCTION

The students are the figure of the nation's next generation. There are so many who have high hopes for today's young generation in order to bring the better changes for the future. One of the ways to produce the quality young people is through the educational process. Education is designed in such a way in order to facilitate students to be able to develop their potential, good personality, noble character, intelligent, skilled, and also able to find the solutions when

they faced various problems (Peraturan Pemerintah Republik Indonesia Nomor 57 Tahun 2021 Tentang Standar Nasional Pendidikan, 2021)

educational goals can be achieved or not is depends on the learning design. It's includes the stages of the learning process, which contains of learning objectives, materials, strategies, and also learning evaluation (Mitarlis & Yonata, 2018). In formulating strategies, it is necessary to plan learning instructions so that they remain on track to achieve the goals that have been set (Jin, 2021). In addition to developing student knowledge, learning design can also be a provision for students in living their future (Sarkadi et al., 2020).

There are three aspects that are developed simultaneously in the learning process, namely aspects of knowledge, attitudes, and skills. Aspects of knowledge are important to be managed optimally by students. By knowing and mastering their knowledge, these students can apply their knowledge in everyday life. Especially if it is applied in everyday life, besides being able to educate the society, it can also provide benefits to society. Optimal knowledge shows optimal mastery of concepts as well. Mastery of this concept reflects the ability of students to understand the meaning both theoretically and practically (practiced) (Dahar, 2003). Besides to the knowledge aspect, the attitude aspect is no less important (Khan & Ali, 2012)

It is not uncommon to find students who find it difficult to mastering a concept. One of them is the concept on the topic of solubility and solubility product. In the high school students (Senior High School), students often feel confused when studying this topic. Besides being required to memorize, they are also required to understand the concept well because it discusses solubility which depends on the addition of temperature and pressure (Singh et al., 2020), equilibrium, and Le Chatelier's principle (Fadilah & Anwar, 2018). This solubility topic is also related to the previous topic, namely acids-bases and it is one of the prerequisite materials for the solubility topic (Sudiana et al., 2019). This acid-base topic is also often considered difficult for students (Damanhuri et al., 2016).

The topic of solubility and solubility product is a topic that contained in the chemistry subjects. This subject is essentially studying nature and whatever it contains, so that teachers are required to be able to use the most effective learning methods (Otor & Achor, 2013). The learning methods and models are within the scope of the learning strategies designed by the teacher.

To anticipate the difficulties experienced by students, it requires the learning model that can facilitate these students in understanding the concepts in it. Cooperative learning model can help to improve students' academic achievement (Warsono & Hariyanto, 2012). Learning activities that use the cooperative learning model have a positive effect on academic achievement (Gull & Shehzad, 2015). In addition to academic achievement, the cooperative learning model can also increase student learning motivation (Tran, 2019).

One type of cooperative learning model is STAD (Student Teams Achievement Divisions). Students will be mobilized to work together in a group in this learning model activities, solving problems to understand concepts in groups which in the end each individual has a positive responsibility. When students that has applied the cooperative learning model STAD type participating in the post test, they had a better score if its compared to the conventional learning (Tran, 2014). It means, by applying the cooperative learning model STAD type, it can help improve cognitive aspect (knowledge) for students . Not only on students' knowledge, the cooperative learning model STAD type can also increase students' self-efficacy (Nurlatifah et al., 2018).

This cooperative learning model STAD type can be combined with a guided inquiry approach, its effect in improving student learning outcomes on the topic of chemical equilibrium is 87% (Zam & K, 2017). With the use of the learning model STAD type which is assisted by the use of modules, it can improve student learning outcomes on chemical equilibrium material (Danggus, 2020). Not only on the topic of chemical equilibrium, but also on the topic of chemical bonds by applying the cooperative learning model STAD type to get higher learning outcomes (Nurhijrah et al., 2020). Based on this, this research will be implemented the cooperative learning model STAD type on the topic of solubility. This study was conducted with the aim of identifying the differences in students' knowledge improvement between the class that applied the cooperative learning model STAD type (experimental class) and the class that applied the conventional learning model, namely lecture (control class).

2. METHOD

The research method that used is quasi-experimental (Sugiyono, 2017). This study involved two classes, namely the experimental class using the cooperative learning model STAD type and the control class using the conventional learning model. The research design chosen was the nonequivalent control group design which can be seen in Figure 1. In both classes, it started with giving pretest and ended with giving post test. The question items in the pretest and post test are the same. Before the post test, the two classes received different treatment, but the time allocation, teachers, and teaching materials were the same for both classes. Therefore, the only difference between the two classes is the learning model.

G_1	**O**	**X_1**	**O**
G_2	**O**	**X_2**	**O**

Figure 1. Research Design
Source : (Wiersma & Jurs, 2009)

Description :
G_1 = Experiment Class
G_2 = Control Class
O = *Pretest dan Post test*
X_1 = Cooperativef Learning type STAD
X_2 = Conventional Learning

The Place and Subject of Research

The research conducted in one of high schools in West Bandung Regency in the even semester. The research subjects were students of class XI Natural Science (IPA). By coordinating with the teachers, 33 students was selected as a sample for the experimental class and 32 students for the control class with the same learning outcomes.

Instrument

The instrument that used in this study was a written test. The written test was chosen because it is one of the instruments that used to assess the aspects of knowledge (Rusman, 2017). The form of the written test that used is the multiple choice form of 15 questions that have been prepared by Farina (Farina, 2014). The questions are arranged based on 12 indicators of knowledge achievement, which are then validated. The CVR (Content Validity Ratio) value in each question is one, and the reliability value is 0.79 (Farina, 2014). Therefore, the questions

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that used have been validated and reliable. Each question answered correctly gets a score of one.

Research Procedure

The procedure that carried out includes two stages, the preparation stage and the implementation stage. In the preparation stage, the Lesson Plan (RPP) is carried out. The Lesson Plan (RPP) that was initially prepared as a draft then it validated and revised until a final and validated Lesson Plan (RPP) obtained. The implementation stage is carried out by giving a pretest for two classes before the implementation of a different learning model. After the learning was completed, a post test carried out in both classes.

Data Analysis Technique

The student score data that obtained from both the pretest and post test are still raw data so they didn't show any meaning. For this reason, analysis of raw data is carried out so that an overview could be obtained of how the differences in knowledge improvement between the two classes. The analytical steps used are:

a. Calculate students score

$$\text{students score} = \frac{\text{number of correct answers}}{\text{total score}} \text{ x } 100 \qquad (1)$$

b. Calculate student's *N-Gain*

N-Gain (<g>) calculated to determine whether there is a difference in the increase in student knowledge.

The formula that used is

$$N - Gain = \frac{post\ test\ score - pretest\ score}{maksikum\ score - pretest\ score} \qquad (2)$$

Tabel 1 shows the interpretation of the obtained N-Gain.

Tabel 1. *N-Gain Score Classification*

Skor *N-Gain*	Interpretation
N-Gain > 0,70	High
0,30 < *N-Gain* ≤ 0,70	Medium
N-Gain < 0,30	Low

Hypothesis Test

The hypothesis being tested is :

Ho : There is no significant difference in knowledge improvement between experimental class students who use the cooperative learning model STAD type and control class students who use conventional learning models

Ha : There is a significant difference in knowledge improvement between the experimental class students using the cooperative learning model STAD type and the control class students using the conventional learning model.

Through SPSS the hypothesis is tested with the following criteria :

If the significance value > 0.05 (p> 0.05) then Ho is accepted

If the significance value <0.05 (p<0.05) then Ho is rejected

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3. RESULTS AND DISCUSSION

One of the activities that experienced by students during learning with the cooperative learning model STAD type is formulate their own problems in their groups to find their own answers after discussing with their groups. Group discussions provide space for each student to communicate based on their knowledge. Students who are facilitated to formulate their own problems until they try to find their own problems and there is communication in it is an effective teaching and learning process (Mahdi, 2014). By learning through the STAD model, students can improve academic achievement through collaborative activities with their group friends (Lantajo & Tipolo, 2018).

Many people say that learning by applying the cooperative learning model is called learning in groups. For this STAD model, even though the problem is solved together, but in the end, each individual has an equally important role for the success of the group. For this reason, in a group, it is emphasized that each individual really understands the concept or topic they studied. Therefore, each individual will be more motivated to understand the material because of the positive responsibility. Of course, you need a self confidence in your abilities which is called self-efficacy. Knowledge mastery and self-efficacy have a relationship (Hasheminasab et al., 2014). Not only at the high school level, but also in the college level it shows a relationship between self-efficacy and academic achievement (Kocakaya & Gonen, 2013). At the elementary school level, the implementation of the cooperative learning model STAD type can improve student learning outcomes (Patimah et al., 2018). Students who study using the cooperative learning model STAD type have high self-efficacy (Wichadee & Orawiwatnakul, 2012). Someone who believes in his abilities or has good self-efficacy tends to have good knowledge as well.

To find out the difference in increasing students' knowledge between the experimental class used the STAD type learning model and the control class used the lecture method, a pretest and posttest were conducted. The items in the posttest and pretest are the same. The questions that has given to students referred to 12 indicators of knowledge achievement. These items are an evaluation tool. This evaluation tool must be adjusted to the indicators of kbowledge achievement (Mauliandri et al., 2021).

The pretest and post test scores from the experimental and control classes are shown in Table 2. The table shows the average pretest score between the two classes is not much different. The pretest itself is given before the learning takes place, so it can be seen that the level of students' cognitive abilities between the two classes before the treatment is not much different.

Tabel 2. *Pretest* dan *Post test Score for* Experimental Class and Control Class

Data	*Pretest Score*		*Post test Score*	
	Experimental Class	Control Class	Experimental Class	Control Class
N	33	32	33	32
Average	27,07	26,04	79,09	66,67

Figure 2 shows a graph of the average pretest score for each indicator of knowledge achievement. From Figure 2, it can not be seen that the experimental class was superior to the control class at the time of the pretest. In some indicators of knowledge achievement, the average score of the experimental class is higher than the control class, but for several other indicators of knowledge achievement, it show the opposite result.

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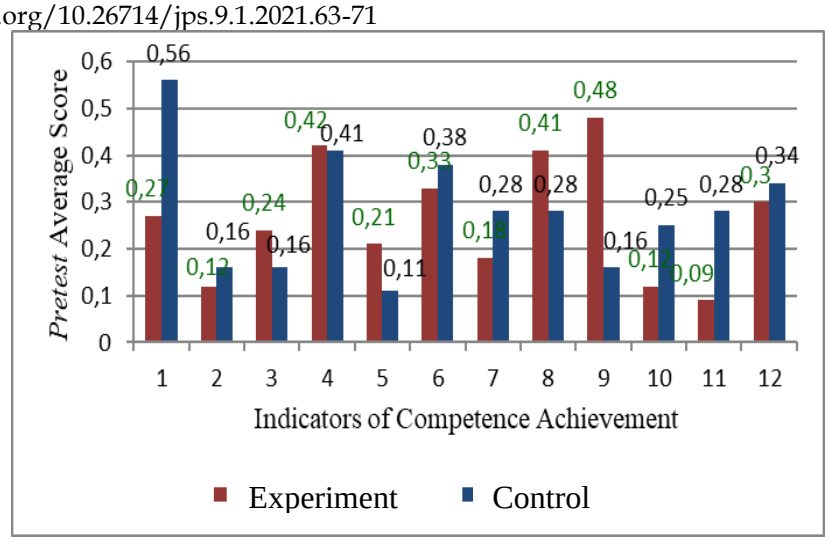

Figure 2. Graph of The Average *Pretes Score*

It's different for the post test. The average post test score of the experimental class was higher than the control class. Post test average score results for each knowledge achievement indicator can be seen in Figure 3.

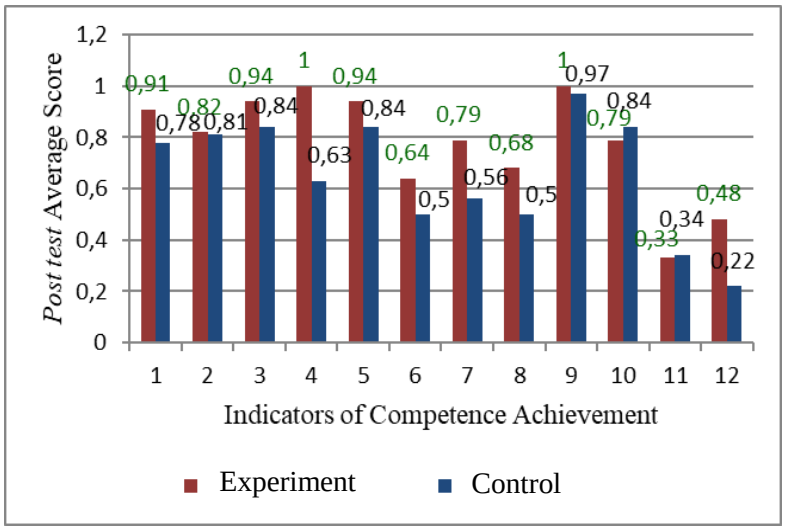

Figure 3. Graph of Average *Post test Score*

Generally, the experimental class in each indicator of knowledge achievement obtained a higher average score than the control class. Therefore, it can be said that learning that used the cooperative learning model STAD type produces a better level of knowledge than the conventional learning model. The application of the cooperative learning model STAD type can improve students' academic achievement (Joshi & Bhatnagar, 2015). Not only academic achievement, learning through the STAD model can also improve student's social skills, attitudes, and independence (Islami et al., 2021)

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Based on previous data, it shows that students in the experimental class have a higher knowledge achievement than the control class. But to see whether the knowledge improvement is significantly different or not, it can be seen based on the data contained in Table 3.

Tabel 3. *N-Gain Score*

Data	Experimental Class	Control Class
N	33	32
N-Gain Average	0,71	0,54
t- Test(*Sig.*)	0,000	

The N-Gain value that obtained by the experimental class is in the high category whereas the control class is in the medium category. The t-test that obtained is less than 0.05, so the result is Ho is rejected for hypothesis testing, which indicates that there is a significant difference in the student knowledge improvement between the experimental class using the cooperative learning model STAD type and the control class using the conventional learning model.

4. CONCLUSION

Based on the research conducted, the student knowledge improvement of experimental class students (<g>=0.71) who applied the cooperative learning model STAD type was significantly different (p<0.05) with control class students (<g>=0.54) who applied the conventional learning models. By applying the cooperative learning model STAD type, it is possible for students to get optimal knowledge achievement even though it was considered difficult before on this solubility topic. There are many other topics that students find difficult to master. For this reason, the implementation of the cooperative learning model STAD type can be used as a solution in the practice of the learning process. This cooperative learning model STAD type can also be collaborated with other learning models and approaches.

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