Improvement of Understanding Physics Concept Using Cooperative Model of STAD Type and Mapping Concept Model

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Abstract. Understanding the concept of physics can be influenced by methods used in the learning process. With the cooperative method of type STAD and mapping concept can be seen the level of understanding of physics concept. Both methods are applied to the physics learning process in SMA Negeri 2 Padangsidimpuan class XI semester 2. This test was conducted on two classes with a total of 64 students. This class is divided into control classes and experimental classes. Samples were taken using purposive sampling. From sampling it can be seen that the average pretest on the experimental class is 71.9 and postests 77.8. So that the average understanding of students who are given an inkuri treatment method is 28.38%. While the average pretests on the control class 65.8 and postests 72.19. The average increase in the learning outcomes of students given an expository method is 15.02%. Based on test calculation result of $t_{count} > t_{table}$ or $> 1.677$. This means $H_0$ is acceptable, that is, there is a cooperative influence of the STAD type to understand the physics concept of students.

1. Introduction

Education is an essential necessity for every human being. Without a person's education will be difficult to do social interaction. Education can be interpreted as a process of transforming a student’s behavior in order to become an adult man who is able to live independently and as a community member in the natural environment where the individual is located.

In Indonesia, schools have a lot of subjects that students must master. One is a physics lesson. Physical subjects are often regarded as difficult and boring subjects. This is because often the physics are considered to have many formulas that should be memorized. This situation makes the students lazy and bored to deepen the concept of physics. To address the situation, a new learning atmosphere is needed that engages the students and confronts it in cooperative learning.

Cooperative learning refers to a variety of learning methods. Where students work in groups to help one another in learning the lesson material. So that the students can be easily understood with students who are slow to understand. This is to make it easier to improve the understanding of students who are slow to understand and make the learning atmosphere more enjoyable. From mapping the concept the teacher was able to know the extent to which students knew about the lesson.

In the process is used suitable model for the learning process. Model is the cornerstone of learning practice of the decline of education psychology theory and learning theory designed based on analysis of curriculum implementation and its implications on operational level in the class [1]. Models serve as a means to simplify communicating. The Model is also a clue that is of an effective nature to take a decision. In addition, as a guideline to develop a pencenation for management activities. The learning
model is very varied, including the cooperative model Student-Team Achievement Division (STAD), mapping the concept and others. The STAD Model increased its use in the learning process [2]. In addition there is also a learning model that is mapping concepts. Concept mapping can define the environment of learning [3]. And there are still many other learning models that are commonly used in the learning process.

There is some research that has been done in implementing learning models. The ongoing cooperative learning Model can be used as a means for teachers to train and develop students in cognitive, affective, and psychomotor aspects [4]. The implementation of the STAD type Learning model through concept mapping in ecosystem materials can improve student learning outcomes at MTsN Cot Gue Darul Imarah [5]. Another study was that there were significant differences between classes taught using the Student Team Achievement Division (STAD) learning model with Mind Mapping and classes taught using the Student Team learning model. Achievement Division (STAD) with Concept Mapping (map concept) to learning outcomes of class VII MTs Guppi Samata Gowa Regency [6].

Based on the above circumstances need to be done to increase students’ understanding of the concept of physics. Where two learning models are selected to know the most appropriate model for maximum results. This model is the type cooperative model of the Stad and concept mapping model (concept mapping). Both models were applied to XI semester 2 SMA Negeri 2 Padangsidimpuan. Of these two classes are divided into control classes and experimental classes. So that students can understand the level of understanding of the physics from the use of both models. In addition, it can be determined the most suitable model to enhance such understanding.

2. Methodology

This study was conducted in SMA Negeri 2 Padangsidimpuan with the target class XI IPA 3 and IPA 4 which are located in the Padangsidimpuan. The school was chosen because of the students’ interest in the physics lesson. In addition, low understanding of students to the concept of physics and school also has the desired criteria of researchers. The time chosen for implementation is in 2018 school year 2017-2018 even semester until completion. The stages are research planning, implementation, data analysis, and report preparation.

In this case selected lesson material (Chapters) to be converted. The material (Chapter) is a work and energy. In this chapter there are some physics concepts that students must understand. The first part that students should understand is the sense of work, the concept of work and equation of work. The basic equation that the student should understand is

$$ W = F \cdot s. $$

(1)

It presented the work concept as shown in Figure 1 [17].

**Figure 1.** The work track and its components.

So that students can change Eq.1 to

$$ W = F \cos \theta \cdot s. $$

(2)

In addition, students must understand the concept of energy, kinetic energy, potential energy, mechanical energy as well as equations. Where kinetic energy can be expressed with [18, 19]
While the potential energy is expressed with \[ E_p = mgh. \] (4)

So that students can determine the equation of mechanical energy. This equation can be written into [19]

\[ Em = \left(\frac{1}{2}mv^2\right) + (mgh). \] (5)

In addition there are several tools provided as supporters. Research tools are required as supporting materials or to facilitate the research process in accordance with the problems and objectives of research. The research tool is the textbook of teaching materials on business and energy, as well as books of physics as supporting research. A variable of research is a research object, or what it focuses on in a study.

This research design is from Quasi experimental design which is Nonequivalent Control Group Design. This design was chosen because in this design two groups were determined between the Eksperimen, and Eksperimen2 classes. In the early stages before the treatment both groups were given pre-test to know the initial state. This is done to find out there is a difference between the Eksperimen1 group and the Eksperimen2 group. Where the Eksperimen1 group uses cooperative learning model of Student Team Achievement Division (STAD), while the group Eksperimen2 use concept Map learning model (concept Mapping). This design is almost the same as pretest-posttest control group design, only on this design group Eksperimen1 and Eksperimen2 groups are not selected randomly. The design scheme of this research can be seen as shown in Table 1.

**Table 1. Research Design**

| Class     | Pretest | Treatment | Post-test |
|-----------|---------|-----------|-----------|
| Experiment| QIE     | X1        | Q2E       |
| Control   | QIK     | X2        | Q2K       |

In experimental studies classes included in experimental classes (independent variables) and control classes (variable dependent). In this study before the treatment starts for both classes the sample is given treatment, for both classes of samples in the initial test or pre test to measure the initial condition \( (t_1) \). Furthermore the experimental group was given a treatment \( (X_1) \) and the control group was not given the treatment \( (X_2) \). After the second completion of the group was given another test as the final Test or postes \( (X_2) \).

Data retrieval techniques are a way of obtaining data or also called data retrieval methods. The Data in this study was gained from the test. The ways that data retrieval is used are:

- The first way is to perform pretest on both samples in order to find out the student learning outcomes before treatment.
- The second way is to implement the teaching on both samples, in the class of experiments given the teachers using the method of cooperative learning Stad type, in the control class using the concept mapping method.
- The third way is to implement Postes. This test aims to determine how the student learning results after the teaching of the type of cooperative learning methods and concept mapping methods.
In general it can be said that the activity of data processing and analysis is the process of gathering or data collection with the aim to obtain useful information, give advice, conclusion and support decision making. After obtaining the necessary data from the results of the research, the next step of the researcher is to analyze the data to provide answers to the researched issues and also to know the comparison of the learning outcomes between Second experimental class.

3. Results and discussion
From the test results obtained some data. The data collected includes two research variable data consisting of one bound variable and one free variable. Variables are bound to the outcome of students understanding of the concept of physics gathered from the concept of the test result of the chosen Chapter. The free variable is a comparison of the STAD-type cooperative learning model with the concept mapping model.

3.1. The cooperative Model of STAD type
The result of understanding of the concept of physics is made in descriptive data. By using the cooperative model of STAD type obtained descriptive data as shown in Table 2.

| Number | Parameters             | Score |
|--------|------------------------|-------|
| 1      | Minimum score (Min)    | 65    |
| 2      | Maximum score (Max)    | 90    |
| 3      | Average score (Mean)   | 77.81 |
| 4      | Middle score (Median)  | 81.1  |
| 5      | Most score (Mode)      | 81.5  |
| 6      | Standard deviation score | 7.92  |

From the data above the use of the cooperative learning model of the STAD type is better because the average value achieved by the student is 77.81. It demonstrates the mastery of the material performed by researchers to each group including either.

Furthermore, based on the analysis of student learning score data, the following is shown a frequency distribution of students’ learning outcomes by using the cooperative model of STAD type in the class XI SMA Negeri 2 Padangsidimpuan as in Table 3.

| Number | Score Interval | \(F_{abs}\) | \(F_{rel(\%)}\) |
|--------|----------------|-------------|-----------------|
| 1      | 65 – 69        | 4           | 12.500          |
| 2      | 70 – 74        | 5           | 15.625          |
| 3      | 75 - 79        | 6           | 18.750          |
| 4      | 80 – 84        | 7           | 21.870          |
| 5      | 85 – 89        | 6           | 18.750          |
| 6      | 90 – 94        | 4           | 12.500          |

Amount 32 100
From the frequency distribution table of students learning outcomes in the experimental class implementing the cooperative model of the STAD type, it can be seen that the most scores gained in Group 4 (21.87%). While the acquisition of the least value of learning outcomes are groups 1 and 6 (4.55%). To see in detail the improved learning outcomes in the experimental class using the cooperative model of the STAD type can be seen in Figure 2.

![Histogram frequency distribution level understanding of physics concept using cooperative model of STAD type in students of class XI SMA Negeri 2 Padangsidimpuan.](image)

**Figure 2.** Histogram frequency distribution level understanding of physics concept using cooperative model of STAD type in students of class XI SMA Negeri 2 Padangsidimpuan.

### 3.2. Concept mapping Model

After conducting experiments obtained descriptive data. This Data demonstrates the level of student understanding of the physics concept. Descriptive Data of student learning results using the draft mapping shown in Table 4.

| Number | Parameters                  | Score |
|--------|-----------------------------|-------|
| 1      | Minimum score (Min)         | 60    |
| 2      | Maximum score (Max)         | 85    |
| 3      | Average score (Mean)        | 71.71 |
| 4      | Middle score (Median)       | 75    |
| 5      | Most score (Mode)           | 76.5  |
| 6      | Standard deviation score    | 7.47  |

From the data above, the average score on this concept mapping model is 71.71. This shows quite successfully overcoming the mastery of student concepts. Further based on the analysis of student learning scores data in Table 4, it can see the distribution of students learning outcomes score by using concept mapping model in class XI SMA Negeri 2 Padangsidimpuan as in Table 5.
Table 5. Score frequency distribution of physics learning results using concept mapping model in students of class XI SMA Negeri 2 Padangsidimpuan.

| Number | Score Interval | $F_{abs}$ | $F_{rel}$(%) |
|--------|----------------|-----------|--------------|
| 1      | 60 – 64        | 4         | 12.50        |
| 2      | 65 – 69        | 6         | 18.75        |
| 3      | 70 – 74        | 7         | 21.87        |
| 4      | 75 – 79        | 8         | 25.00        |
| 5      | 80 – 84        | 4         | 12.50        |
| 6      | 85 – 89        | 3         | 9.375        |
| **Amount** |                | **32**    | **100**      |

From the frequency distribution table students learning outcomes in the control class implementing the concept mapping model, it can be seen that the most scores gained in Group 4 (25%). While the acquisition of the least value of learning outcomes is a group of 6 (9.375%). To see in detail the improved learning outcomes in the control class that implements the concept mapping model, it can be seen in Figure 3.

![Histogram frequency distribution level understanding of physics concept using concept mapping model in students of class XI SMA Negeri 2 Padangsidimpuan.](image)

**Figure 3.** Histogram frequency distribution level understanding of physics concept using concept mapping model in students of class XI SMA Negeri 2 Padangsidimpuan.

The posttest values in both classes were obtained with an experimental class of 77.8 with a standard deviation of 7.9 and the average value of the control class of 72.19 with a standard deviation of 7.92. After getting the average grade in the experiment class and the control, then a test of hypotheses using $t$ test. The criteria of the $t$ test is $t_{hitung} > t_{table}$. Once done test $t$ with the average value obtained, it is obtained $t_{hitung} = 2.46$ and $t_{table} = 1.677$. Because the posttest data of both classes in accordance with the criteria $t$ ($t_{hitung} > t_{table}$) or ($> 1.677$), it can be concluded there is a significant difference between the model of cooperative learning and the concept mapping model of students learning outcomes.

Based on the results of the data is seen that the cooperative model of the STAD type is better than the concept mapping model. This is seen from the above data, where the average value obtained by students by using the cooperative model of the STAD type is 77.81. While the value of students using the concept mapping model is 71.71. In other words, the score or value students get using the cooperative model of the STAD type is higher than the value that the student obtained using the
concept mapping. So it can be known students more easily understand the concept of physics using the cooperative model of the STAD type compared to the concept mapping model.

4. Conclusion
From the results of experiments in the classroom using the cooperative model of the STAD type and model mapping concept obtained some data. From these data can be inferred from the use of both models. From the use of both models there are differences in the results of physics study in grade XI students SMA Negeri 2 Padangsidipimpin. Where the cooperative model of the STAD type is more helpful to students to solve problems and understand the concept of physics. This is due to cooperation in the group so as to improve student learning outcomes. This can be seen from the test $t$, where the average value of the posttest experiment is 77.81. The value is higher than the value of the control class that has an average value of 72.19. This is due to the control class of concept mapping models that rely on the individual's own capabilities. In addition, the difference can also be seen from the results of pretest students in the experimental class is with an average of 71.9 and the control class with an average of 65.8. Thus, it can be saved that the cooperative model of the STAD type is more effective in increasing students understanding of the concept of physics than using the concept mapping model.

References
[1] Agus S 2011 Cooperative Learning Teori dan Aplikasi PAIKEM (Yogyakarta: Pustaka Pelajar)
[2] Van Wyk M.M 2012 The Effects of the STAD-Cooperative Learning Method on Student Achievement, Attitude and Motivation in Economics Education 33 261-70
[3] Stoyanov S and Kirschner P 2004 Expert Concept Mapping Method for Defining the Characteristics of Adaptive E-Learning: ALFANET Project Case 52 41-56
[4] Harmoko 2013 Penerapan Pembelajaran Kooperatif Model Student Teams-Achievement Divisions (STAD) Ditinjau dari Keaktifan Siswa dan Hasil Belajar Siswa Mata Pelajaran Menggunakan Alat Ukur Kelas X Jurusan Teknik Pemesinan di SMK Muhammadiyah Prambanan
[5] Roslimah and Muhibbuddin 2014 Penerapan Model Pembelajaran STAD (Student Teams Achievement Divisions) untuk Meningkatkan Hasil Belajar dan Kemampuan Pemetaan Konsep Siswa pada Materi Ekosistem Jurnal EduBio Tropika. 2 187-250
[6] Firdaus A 2018 Perbandingan Model Pembelajaran Student Team Achievement Division (STAD) dengan Peta Pikiran (Mind Mapping) dan Peta Konsep (Concept Mapping) Terhadap Hasil Belajar Pemahaman Matematika Kelas VIII MTs Guppi Sanata
[7] Kemendikbud 2014 Peraturan Bersama No. 5496/C/KR/2014 Dan No 7915/D/KP/2014 Direktur Jenderal Pendidikan Dasar Dan Direktur Jendral Pendidikan Menengah (Jakarta: Kemendikbud)
[8] Afandi M, Chamalah E and Wardani O.P 2013 Model dan metode pembelajaran di sekolah (Semarang: Unissula Press)
[9] Helmiati 2012 Model Pembelajaran (Yogyakarta: Aswaja Pressindo)
[10] Slavin R.E 1980 Cooperative learning 50 315-42
[11] Tarim K and Akdeniz F 2008 The effects of cooperative learning on Turkish elementary students' mathematics achievement and attitude towards mathematics using TAI and STAD methods 67 77-91
[12] Slavin 2010 Cooperative Learning Teori, Riset dan Praktik. (Bandung : Penerbit Nusa Media)
[13] Tiantong M and Teemuangsai S 2013 Student Team Achievement Divisions (STAD) Technique through the Moodle to Enhance Learning Achievement 6 85-92
[14] Hay D, Kinchin I and Lygo-Baker S 2008 Making learning visible: the role of concept mapping in higher education 33 295-311
[15] Clayton L.H 2006 CONCEPT MAPPING: An Effective, Active Teaching-Learning Method 27 197-203
[16] Novak J.D 1990 Concept mapping: a useful tool for science education 27 937-49
[17] Giancoli D.C 2015 Physics: Principles with Applications, Global Edition (United Kingdom: Pearson Education Limited)

[18] Cavagna G.A and Franzetti P 1981 Mechanics of competition walking 315 243-51

[19] Wingrave J.M, Sribnick E.A, Wilford G.G, Matzelle D.D, Mou J.A, Ray S.K, Hogan E.L and Banik N.L 2004 Higher calpastatin levels correlate with resistance to calpain-mediated proteolysis and neuronal apoptosis in juvenile rats after spinal cord injury 21