Original Article

The effectiveness of Jigsaw and STAD (student teams achievement division) cooperative learning model on pharmaceutical mathematics

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ABSTRACT

Introduction: In Pharmacy Diploma Program, mathematics is known as pharmaceutical mathematics. This research is to describe about mathematics lecture by using the Cooperative Learning Model of Jigsaw and STAD-type Method and to know the activity and result of student learning at the Pharmaceutical Academy of Dwi Farma. **Method:** This research design's approach is quantitative approach, the research method is the research Experiment using The Static Group Pre-test-Post-test Design. The instruments used are student activity observation sheets and students' cognitive achievement tests. The techniques used for data analysis are descriptive statistical analysis and inferential statistical analysis. **Result:** Based on the results of descriptive analysis, the average of the two groups, the first experimental class before using Jigsaw-type (Pre-test) type of Cooperative Learning Model is 61.09 and after using Jigsaw-type Cooperative Learning Model (postest) of 79.15; while the average experimental class II (Pre-test) is 66.48 and the average (postes) is 75.91. Samples from both groups were normally distributed, the variance homogeneous. Data analysis using t-test, the result of calculation data of average difference of N-gain of both groups obtained t value counted 2.14; while t table at 5% significant level with degrees of freedom (dk) = 70 that is 2.00, means the alternative hypothesis (Ha) is accepted and the null hypothesis (Ho) is rejected. **Conclusion:** Student activity during pharmaceutical mathematics lecture with Jigsaw-type and STAD-type Cooperative Learning Model did not differ significantly and learning outcomes during pharmaceutical mathematics learning using of Jigsaw-type and STAD-type Cooperative Learning Model differed significantly. Jigsaw-type is more effective than STAD-type during pharmaceutical mathematics learning.

Keywords: Pharmaceutical Mathematics, Jigsaw, STAD, Cooperative Learning Model.

Introduction

Education in Indonesia continues to be cultivated to be more advanced and qualified, especially in the world of D-III pharmacy education. Diploma-III of Pharmacy is an educational program that educates students to become skilled and proficient pharmacists who can carry out their duties optimally, both independently and collaboratively. Diploma-III of Pharmacy is oriented to the procurement and improvement of Associate Pharmacy Specialists' quality. The attempt to increase the quality of D-III pharmacy education is carried out, i.e. by seeking improvements in the teaching and learning process in math pharmacy lectures[1]. In Pharmacy D-III education, mathematics is better known as pharmaceutical mathematics studied in the semester I [2-6].

The teaching and learning process that occurs during the lecture includes all activities related to the provision of materials students to obtain competence and knowledge. Improvement of quality and refinement of the teaching and learning process during the lecture aims to make students get better and

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competent, qualified, responsible, rational, critical, and creative thinking. Lecturers need to choose appropriate teaching basic models, methods, and skills in the lecturing process.

To increase the activity, learning achievement, competence, quality, responsibility, rational thinking, critical, and creative approach can use Cooperative learning as a teaching and learning strategy that emphasizes attitude or behavior together in work or help among fellow in the structure of regular cooperation in groups, consisting of two or more persons. In this model students in one class are divided into small groups, usually 4-6 people who are heterogeneous. Where the success of the group is determined by the liveliness of each group member. Some models of cooperative learning can be a choice of lecturers such as Jigsaw and STAD (Student Teams Achievement Division). In cooperative learning, each group member helps each other to succeed in learning[7].

Jigsaw-Type Model is developed by Aronson, Jigsaw is one type of cooperative learning that has learning steps that give responsibility to every student and every student should be responsible for what is their respective duties. In Jigsaw-type Cooperative Learning Model, there is an expert group and origin group[8]. An origin group is a student group whose abilities, origin and background are diverse. The expert group is a combination of several expert students. An expert group is a student group that expertise on learning assignments, exploring specific topics, and completing tasks related to the topic and explained to the original group. Each group has a heterogeneous academic ability of 4-5 students[9].

Steps of Jigsaw-type Cooperative Learning Model:

1. Lecturer prepares text or learning materials
2. Lecturers divide students into groups (origin groups) and distribute sub-groups to each group
3. Students carry out expert group discussions
4. The student returns to the original group (presenting) and performs the quiz (determination of group score)
5. Lecturer gives evaluation and award

The implementation scheme of the Jigsaw-type Cooperative Learning Model can be seen in Figure 1.

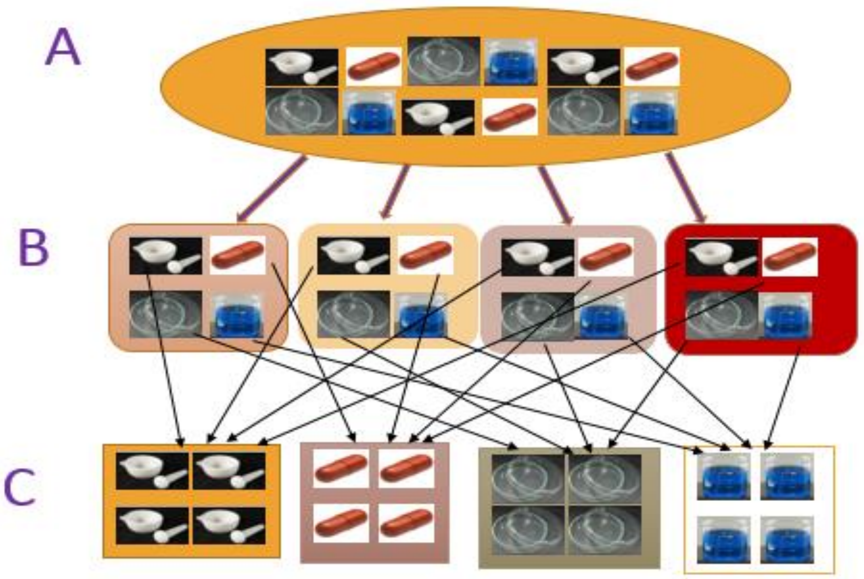

Figure 1. Implementation of The Jigsaw-type Cooperative Learning Model

Information :

A : Hetorogen Group

B : Origin Group

C : Expert Group

The second is STAD-type. STAD-type is developed by Robert Slavin at the John Hopkins University of the United States, is the simplest model of cooperative learning[10], each group has a heterogeneous academic ability of 4-5 students. The emphasis of STAD-type learning is that every student is only given responsibility in each group and does not feel having responsibility for their expert group[11]. Lecturers present materials and then students work in their teams and ensure that all team members have mastered the lesson. Students are given a test, and at the time of the test, students are not allowed to help each other.

STAD-Type Model step[12]:

1. The lecturer conveys the learning objectives and provides motivation
2. The lecturer divides the students into groups and explains the material
3. Students perform group work and continue to carry out the quiz
4. Lecturers reward the group
5. Lecturer gives evaluation

The implementation scheme of the STAD-type Cooperative Learning Model can be seen in Figure 2.

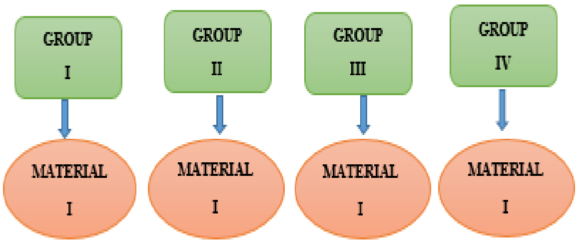

Figure 2. Implementation of The STAD-type Cooperative Learning Model

This research is generally aimed to describe the effectiveness of pharmaceutical mathematics lectures by using the Jigsaw and STAD-Type Model and to know the activity and result of student learning at the Pharmaceutical Academy of Dwi Farma. Specifically this study aims :

a. Knowing the student's activity description and outcome on pharmaceutical mathematics learning using the Jigsaw-type Cooperative Learning Model at Pharmaceutical Academy of Dwi Farma.
b. Knowing the student's activity description and outcome on pharmaceutical mathematics learning using the STAD-type Cooperative Learning Model at Pharmaceutical Academy of Dwi Farma.
c. Knowing the effectiveness of the Jigsaw and STAD Cooperative Learning Model in pharmaceutical mathematics learning at the Pharmaceutical Academy of Dwi Farma.

Methods

This research is using a quantitative method and the method is Experiment research. This research is a study by conducting experiments on the class or experimental group. Each experimental group was subjected to certain treatments under controllable conditions. This type of research uses a type of comparative research. The purpose is to describe the application of the Jigsaw-type and STAD-Type Model toward learning activity and outcome in pharmaceutical mathematics at the Pharmaceutical Academy of Dwi Farma. This study requires two classes to be studied to determine the extent to which improvements in student learning outcomes in the course of pharmaceutical mathematics using "Prescription Compounding and Calculation of Formula" Chapter on lecturing material. The two classes will be divided into the treatment class which is an experimental class I (class I A) using Jigsaw-type Cooperative Learning Model and experiment class II (IB class) using the STAD-type Cooperative Learning Model (Student Teams Achievement Division). The Independent variable (independent variable) in this research is STAD-type and Jigsaw-type, and the dependent variable (dependent variable) is student activity and student learning result. The research used static group Pre-test - Post-test design as in Table 1[13].

Table 1. Research design

Group	*Pre-test*	Control variables	*Post-test*
Experiment I	O	X_1	O
Experiment II	O	X_2	O

X_1 : Treatment in experimental class I by using Jigsaw-type Cooperative Model

X_2 : Treatment in experiment class II by using STAD-type Cooperative Model

O : Pre-test and post-test are imposed on both groups.

This design requires two observations. the first test is Pre-test, this test result is good if the experimental group I and experimental group II were not significantly different. The second one is the Post-test that was conducted after the treatment. This study uses two classes, namely experimental class I and experimental class II, where the experimental class I is a class that uses the Jigsaw Cooperative Learning Model, and the experimental class II uses the STAD-type Cooperative Learning Model.

In this study, the test used to measure the ability of students was done twice, before and after being treated. This test is given to both groups of classes, namely experimental class I and experimental class II[14]. The initial test as a Pre-test that was conducted to determine the students' initial ability before being given treatment through the Jigsaw and STAD-type model. The final test as Post-test to see the results of student achievement after getting treatment through the Jigsaw-type Cooperative Learning Model and the STAD-type model[15].

The instruments used to measure student activity variables are using observation/activity sheets in the form of a checklist, and to measure student learning outcomes using tests in essay form. Data which is the result of observation is analyzed qualitatively. While the data that is the result of student learning is analyzed quantitatively by using descriptive statistics and inferential statistics. Descriptive statistical analysis is used to describe the mathematical learning outcomes obtained by students to get a clear picture of the level of understanding of mathematical pharmacy. To calculate the increase in understanding or mastery of student concepts after the learning took place used the normal gain formula by Meltzer:

$$Gain\ (g) = \frac{Posttest\ Score - Pretest\ Score}{Max\ Score(Ideal) - Pretest\ Score}$$

Hake further categorizes the acquisition, as follows:

g- High : $gain > 0.7$
g- Medium : $0.3 < gain \leq 0.7$
g- Low : $gain \leq 0.3$

According to Hake, the normalized gain values show the level of effectiveness of the treatment rather than the value (post-test) [16].

The Syntax of the Jigsaw Cooperative Learning Model and the STAD Cooperative Learning Type in the pharmacy mathematics course can be seen in Table 2.

Table 2. Syntax of the Jigsaw-type Cooperative Learning Model and STAD-Type Cooperative Learning

Jigsaw-type Cooperative Learning Model		Phase	STAD-type Cooperative Learning Model	
Information	**Activities**		**Activities**	**Information**
The lecturer explains the learning objectives and prepares students to learn like: 1. Open the lecture with greetings 2. Motivating the students 3. Deliver the objectives of the lecture and apperception and give the pretest. 4. Lecturers can use various choices in delivering lecture material through guided discovery methods or lectures.	Delivering goals and preparing students	1	Delivering goals and motivating students	The lecturer explains the learning objectives and motivates students to learn like: 1. Open the lecture with greetings 2. Motivating students 3. Deliver the objectives of the lecture and apperception and give the pretest.
1. Lecturers divide students into groups of 4-5 people called groups of origin. 2. The lecturer determines the original group. The original group members have different academic abilities (high, medium, and low). 3. Divide students into 8 groups, each group has 4-5 members. 4. During the learning process in groups, the lecturers act as facilitators, motivators, consultants, and managers who coordinate the lecture process.	Form heterogeneous large groups	2	Material review (Delivering / Presenting material)	1. Lecturers convey the basics of the material (lecturers present/present material), activity procedures, and procedures for group work. 2. Lecturers can use various choices in delivering lecture material through guided discovery methods or lectures. 3. Share the discussion material sheet
1. Sharing different material assignments for each student in each group. 2. Determine the expert team that will be responsible for dealing with the material of each expert	Sharing material assignments, forming experts	3	Form heterogeneous groups	1. The lecturer divides students into small groups of 4-5 people (the lecturer helps each group make the transition efficiently). 2. Group members have different academic abilities (high, medium, and low).
1. Students discuss in groups based on the similarity of the material given to each student 2. Share expert group worksheets. 3. The lecturer requests the worksheet to be discussed with each group. 4. The lecturer went around monitoring student work	Expert group discussion	4	Giving assignments	The lecturer divides the task of studying group material. The lecturer distributes the worksheet to be discussed with each group. The lecturer went around monitoring student work.
1. Students discuss again in their original group (each member of the expert group after returning to the group is responsible for teaching their friends) 2. Ask students from the original group to report/present the results of their group discussions and other groups responding. 3. Lecturers act as facilitators during material presentations by each group.	Origin group discussion	5	Group discussion	Each group discusses completing the task (the lecturer guides each group when discussing material or presenting their work). During the learning process in groups, the lecturers act as facilitators, motivators, consultants, and managers who coordinate the lecture process.

1. Lecturers conduct assessments to measure students' learning abilities and results. 2. Students are not allowed to help each other in doing quizzes. 3. The lecturer directs students to conclude the material (the results of the discussion).	Providing individual quizzes for all material	6	Individual quizzes	1. Lecturers conduct assessments to measure students' abilities and learning outcomes (giving post-tests). 2. Students are not allowed to help each other in doing quizzes. 3. The lecturer directs students to conclude the material (the results of the discussion).
1. Prepare ways to recognize the group and individual efforts and achievements. 2. Give awards to outstanding groups and students (best value). 3. The most successful origin group is given an award. 4. Read the best scores in individual tests. 5. For motivation, based on the results of student quizzes and calculation of the increase in group points, forms of appreciation for groups can be given in various forms, such as gifts or praise, certificates, class reports or bulletins on display.	Awards	7	Awards	1. Prepare ways to recognize the group and individual efforts and achievements. 2. Give awards to outstanding groups and students (best value). 3. The value of each group member is added to get the group score. 4. Read the best scores in individual tests. 5. For motivation, based on the results of student quizzes and calculation of the increase in group points, forms of appreciation for groups can be given in various forms, such as gifts or praise, certificates, class reports or bulletins on display.

Students are not allowed to help each other in doing quizzes. Therefore, every student has the responsibility to understand the lecture. Individual progress scores can be achieved if they learn harder and provide better performance. Each student can contribute maximum points to his team in scoring system, but no student can do it without giving maximum effort. Each student gets an initial score, they will collect points for their team based on the escalation of their quiz score compare to the previous one. Group scores are calculated based on the escalation of member's scores. The group's success can be evaluated from the point's accumulation of each group contributed by its members. Increased points are calculated based on the quiz results. Quizzes are given to students and are done individually after they have completed group assignments. Quizzes must be provided with sufficient time allocation for students to complete. The most successful original group was awarded as motivation, based on the results of student quizzes and calculation about the increase in group points. The form of awards for groups can be given in various forms, such as gifts or compliments, certificates, or displayed class reports or bulletins. The contents of the awards describe the group's achievements. These achievements can be seen from the results of the group increase score based on the previous quiz.

Results and Discussion

Results

Implementation of the research conducted as many as 5 meetings for each class i.e meeting I conducted pre-test, meetings (II, III, IV, and V) filled with lecture activities, and VI meetings conducted post-test. This research uses two classes of experimental class I and experiment II class, where experiment class I is a class using the Jigsaw-Type Model, and experiment class II using the STAD-type model. The observed aspects during the pharmaceutical mathematics lecture in the experimental class I can be seen in Table 3 and class II in Table4.

Table 3. Student Activity Observation Result at Each Meeting in Experiment Class I

No	Student activity	Meeting to… Figures and%				Average (%)
		II	III	IV	V	
1	Active (in collaboration) in group discussions	(18) 55%	(22) 67%	(25) 76%	(25) 76%	69%
2	Pay attention to friends who are presenting the material	(15) 45%	(19) 58%	(21) 64%	(28) 85%	63%
3	Helping friends who have difficulty in learning	(18) 55%	(20) 61%	(23) 70%	(27) 82%	67%
4	Dare to ask questions	(17) 52%	(21) 64%	(20) 61%	(24) 73%	63 %
5	Dare to express opinions in group discussions	(17)	(21)	(24)	(27)	68 %

		52%	64%	73%	82%	
6	Be indifferent and self-taught	(8) 24%	(6) 18%	(3) 9%	(1) 3%	14 %
	Number of students present	33 Students				

Table 4. Student Activity Observation Result at Each Meeting in Experiment Class II

No	Student activity	Meeting to... Figures and%				Average (%)
		II	III	IV	V	
1	Active (in collaboration) in group discussions	(16) 48%	(19) 58%	(22) 67%	(26) 79%	63%
2	Pay attention to friends who are presenting the material	(14) 42%	(18) 55%	(23) 70%	(25) 76%	61%
3	Helping friends who have difficulty in learning	(15) 45%	(21) 64%	(22) 67%	(23) 70%	62%
4	Dare to ask questions	(13) 39%	(19) 58%	(21) 64%	(25) 76%	60%
5	Dare to express opinions in group discussions	(11) 33%	(13) 39%	(14) 42%	(17) 52%	60%
6	Be indifferent and self-taught	(9) 27%	(8) 24%	(5) 15%	(3) 9%	19%
	Number of students present	33 Students				

Based on the data that has been collected, the data includes pre-test scores and post-test scores on 66 students consisting of experimental class I, namely the class that uses as many as the Jigsaw model as the number of students, and experimental class II uses 33 students, STAD-type model. In pharmaceutical mathematics lectures, both classes were given a pre-test and carried out the implementation of the Jigsaw and STAD-type model. This Pre-test was given to measure students' initial knowledge. Then giving the post-test is done after each class during the pharmacy lecture process gets a different treatment and also aims to measure the extent to which student learning outcomes increase.

The student learning results in pharmacy mathematics courses can be seen in Table 5. The Normality test and Homogeneity test are carried out before conducting the t-test. The Normality test and homogeneity test results can be seen in Table 6 and Table 7.

Table 5. Results of Student Learning in Pharmaceutical Mathematics Lecture

Descriptive statistics	Experiment Class I Jigsaw-type Cooperative Learning		Experiment Class II STAD-type Cooperative Learning	
	Pre-test	Post-test	Pre-test	Post-test
Mean $\overline{X}$	61.09	79.15	66.48	75.91
Median ($\widehat{X}$)	59	83	67	77
Modus ($\widetilde{X}$)	48	90	48	83
The lowest value (x_{min})	37	53	48	37
The highest (x_{max})	95	98	92	96
Variance (S^2)	281.335	200.633	194.758	207.835
Standard deviation (S)	16.77	14.16	13.96	14.42
Amount (n)	33			
(N)	33 Students			

Table 6. Normality Test Result Calculation

Experiment Class	Test of Normality Kolmogorov- Smirnov			
	Pre-test (significance*)	Conclusion	*Post-test* (significance*)	Conclusion
Jigsaw-type Cooperative Learning	0.082	Normal	0.072	Normal
STAD-type Cooperative Learning	0.093		0.113	

Table 7. Homogeneous Test Result Calculation

Experiment Class	Value	*Varians*	F_{count}	F_{table}	Conclusion	Value	*Varians*	F_{count}	F_{table}	Conclusion
Jigsaw-type Cooperative Learning	Pre-test	242.42	1.44	1.79	Ho accepted : Second data homogeneous	Post-test	178.89	1.08	1.79	Ho accepted : Second data homogeneous
STAD-type Cooperative Learning	Pre-test	168.67				Post-test	193.56			

From the data analysis prerequisites can be concluded that the two samples are normally distributed and homogeneous, therefore the calculation of data analysis can be done using the t-test formula that can be seen on Table 8.

Table 8 . Test results Hypothesis N-gain value with "t-test"

Experiment Class	Value	$(\bar{x})$ N - gain	Amount (n)	t_{count}	T_{table}	Conclusion
Jigsaw-type Cooperative Learning	*Post-test*	0.37	33 Students	2.14	2.00	H_a accepted or Ho rejected
STAD-type Cooperative Learning	*Post-test*	0.32				

Discussion

1. Description of Learning Activities and Outcome in Pharmaceutical mathematics Courses at Pharmaceutical Academy of Dwi Farma Using Jigsaw-type Cooperative Learning Model (Experiment Class I)

The experimental class I (class IA) uses a Jigsaw-Type Model. The first meeting held pre-test activities of students' cognitive learning outcomes. The meetings (II, III, IV, and V) are filled with lecturing data of the experimental class I, and VI meetings to post-test students' cognitive learning outcomes.

a. Description of Student Activitiy on Pharmaceutical mathematics Courses Using Jigsaw-type Cooperative Learning Model (Experiment Class I)

Student activity on pharmaceutical mathematics lecture The experimental class I was assessed using student activity observation sheet. Before the lecture begins, provide direction and discuss with student activity observer to equalize opinion about aspects observed. From the data on Table 3 shows that the observed results for Active activities (cooperate) in the group discussion, Noting friends who are presenting the material, Helping friends who difficulty in learning, Dare to ask questions, Dare to express opinions in group discussions during the process of math pharmacy lectures in the experimental class I (class IA) showed improvement at each meeting. While the activity of students Being indifferent and self-study shows decreased activity at each meeting[17]. Changes in the form of an increase or decrease for each activity (Figure 3).

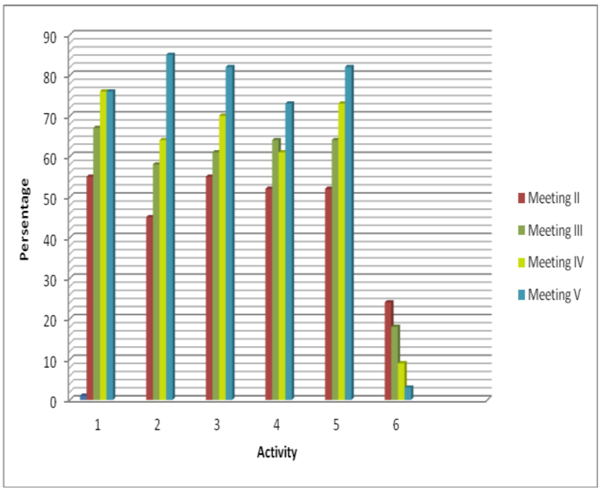

Figure 3. Student Activity Diagram of Each Meeting in Experiment Class I

Table 3 and chart in Figure 3 shows the student activity during the pharmaceutical mathematics course Good, it means that aspects of the activities undertaken by the students in the lecture process have been implemented well, following the observation sheet of the student activity assessed although only some of the students play an active role. In other words, students play an active role during the pharmaceutical mathematics lecture.

b. Description of Student Learning Outcomes in Pharmaceutical mathematics Courses by Using Jigsaw-type Cooperative Learning Model (Experiment Class I)

From the data on Table 5 shows that data of 33 students obtained through the initial test, the pre-test value of experimental class I has a range or distribution of 58 with the highest value of 95 and the lowest value of 37, with the number of class 6 and length of class 10 so that obtained mean 61.09; median 59; mode 48; the first quartile/quartile below 47.5; which means that 75% of students have scores > 47.5; the third quartile/quartile above 75.5; which means 25% of students have grades > 75.5; variance 281.335 and standard deviation of 16.77. The largest frequency is in the interval class 47-56 that is 9 students or 27.27%. The lowest frequency is in the interval classes 87-96 which is as many as 3 students or 9.09%.

From the data on Table 5 shows that data of 33 students obtained through the final test, the experimental class I post-test score has a range or distribution of 45 with the highest value of 98 and the lowest value of 53, with the number of class 6 and length of class 8 to obtain the mean of 79.15; median 83; mode 90; the first quartile/quartile under 68.50 which means 75% of students have grades > 68.50; the third quartile/quartile above 90.50, which means 25% of students have grades > 90.50; variance 200.633 and standard deviation 14.16. The largest frequency is in the interval class of 85-92 as many as 8 students or 38.10%. The lowest frequency is in the 61-68 interval class of 3 students or 9.09%.

c. Results of N-gain Data on Pharmaceutical mathematics Courses Using Jigsaw-type Cooperative Learning Model (Experiment Class I)

The results of the existing subject picture then determined the value of the gain of each class. Based on the mean score of pre-test and concept comprehension, the comprehension level of the initial concept of the student (pre-test) is 61.09 while the comprehension level of the post-test student's final concept is 79.15. This shows an increase in student concept understanding is directly visible from the average score of the gain value of 0.37 and is included in the medium category. Each gain value is grouped into categories, ie high ($g \geq 0.70$), medium ($0.30 \leq g \leq 0.70$), and low ($g < 0.30$).

Table 9. Categorization of gain of Experiment Class I in Pharmaceutical Mathematics Lecture Using Jigsaw-type Cooperative Learning Model

Categorization	Frequency
High	5
Medium	13
Low	15
Amount	33

Table 9 shown the result of the categorization of the value of the gain in the experimental class I On Pharmaceutical Mathematics Course using the Jigsaw-Type Model which is a category of students who have grades with high categories of 5 students, 13 moderate category and 15 low students.

2. Description of Learning Activities and Outcomes in Pharmaceutical mathematics Courses at Pharmaceutical Academy of Dwi Farma Using STAD-type Cooperative Learning Model (Experiment Class II)

Experiment class II (IB class) using the STAD-type Cooperative Learning Model. The first meeting held pre-test activities of students' cognitive learning outcomes. The meetings (II, III, and IV) are filled with lectures as well as data collection of experimental class experimental students activity, and meeting V performs post-test of students' cognitive learning outcomes.

a. Description of Student Activity on Pharmaceutical mathematics Course Using STAD-type Cooperative Learning Model (Experiment Class II)

Student activity in the pharmaceutical mathematics experiment class II was assessed using a sheet of student activity observation. Before the lecture began, giving directions and discussing with observers of student activities to equate opinions about the aspects observed. From the data on Table 4 indicates that the observed results for Active activities (cooperate) in the group discussion, Noting friends who are presenting the material, help friends whose difficult to learn, dare to ask questions, dare to express opinions in group discussions during the process of pharmaceutical mathematics lectures in the experimental class II (IB class) showed improvement at each meeting. While the activity of students Being indifferent and self-study shows decreased activity at each meeting[18]. Changes in the form of an increase or decrease for each activity (Figure 4).

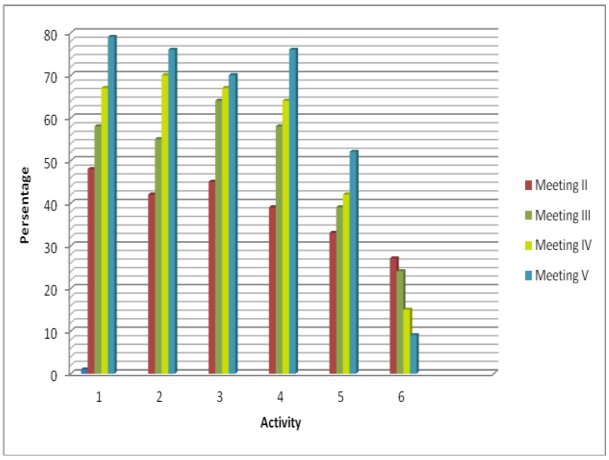

Figure 4. Student Activity Diagram of Each Meeting in Experiment Class II

Table 4 and Figure 4 show the student activity during the pharmaceutical mathematics lecture works well, it means that the aspects of the activities undertaken by the students in the lecture process have been done well following the observation sheet/observation of student activities assessed although only partially students who play an active role. So the students play an active role during the pharmaceutical mathematics lecture.

b. Description of Student Outcomes in Pharmaceutical mathematics Course Using STAD-type Cooperative Learning Model (Experiment Class II)

From the data on Table 4 shows that data of 33 students obtained through the initial test, the pre-test value of experimental class II (class I B) has a range or distribution of 44 with the highest score is 92 and the lowest score is 48, with the number of class 6 and length of class 8 to obtain the mean 66.48; median 67; mode 48; the first quartile/quartile under 51; which means 75% of students have grades > 51; the third quartile/quartile above 75.5, which means 25% of the students have values > 75.5; variance 194.758 and standard deviation of 13.96. The largest frequency is in class interval 48-55 that is as many as 10 students or 30.30%. The lowest frequency is in class interval 56-63 that is as much as 2 students or 6.06%.

From the data on Table 4 shows that data of 33 students obtained through the final test, the experimental class II post-test score (class I B) has a range or distribution of 59 with the highest score is 96 and the lowest score is 37, with the number of class 6 and length of class 10 to obtain the mean of 75.91; median 77; mode 83; the first quartile/quartile below 70.50 means that 75% of students have grades > 70.50; the third quartile/quartile above 86.50 which means 25% of students have values > 86.50; variance 207.835 and standard deviation of 14.42. The largest frequency is in class interval 67-76 that is as many as 10 students or 30.30%. The lowest frequency is in the interval class 37-46, 47-56, 57-66, that is as much as 2 students or 6.06%.

c. Result of N-gain Data in Pharmaceutical mathematics Course by Using STAD-type Cooperative Learning Model (Experiment Class II)

The existing result then determined the value of the gain of each class. Based on the mean score of pre-test and concept comprehension, the students' pre-test understanding level is 66.48 while the level of understanding of the final concept of the post-test student is 75.91. This shows an increase in student concept understanding is directly visible from the average score of the gain value of 0.32 and in the medium category is included. Each gain value is grouped into categories: i.e high ($g \geq 0.70$), medium ($0.30 \leq g \leq 0.70$), and low ($g < 0.30$).

Table 10. Categorization of gain of Experiment Class I in Pharmaceutical Mathematics Lecture Using STAD-type Cooperative Learning Model

Categorization	Frequency
High	2
Medium	13
Low	18
Amount	33

Table 10 shown The result of the categorization of the value of the gain in the experimental class I in the pharmaceutical mathematics course by using the STAD-Type Model is 2 students have high category grade, 13 students have medium category grade, and 18 students have low category grade.

3. The Difference between Student Activity and Outcome in Pharmaceutical Mathematics Lectures using the Jigsaw and STAD-type Cooperative Learning Model at Dwi Farma Academy.

The observation was conducted to determine the students' activities during the lecture using the Jigsaw-type and the STAD-type cooperative model. The observation was referred to as the observation sheets that have been made corresponding to the scenarios that have been prepared for the pharmaceutical mathematics lectures using the Jigsaw-type and the STAD-type cooperative model. Using table 3 and table 4 as input, the average students' activity during the lecture with the Jigsaw-type and STAD-type cooperative model can be seen in Table 11.

Table 11. Average Student Activity In Pharmaceutical Mathematics Lecture With Jigsaw-type and STAD-type Cooperative Learning Model (Student Teams Achievement Division)

No	Aktivitas mahasiswa	Experiment Class I (Jigsaw-type Cooperative Learning Model)	Experiment Class II (STAD-type Cooperative Learning Model)
		Rata-rata (%)	Rata-rata (%)
1	Active (in collaboration) in group discussions	69%	63%
2	Pay attention to friends who are presenting the material	63%	61%
3	Helping friends who have difficulty in learning	67%	62%
4	Dare to ask questions	63 %	60%
5	Dare to express opinions in group discussions	68 %	60%
6	Be indifferent and self-taught	14 %	19%
	Number of students present	33 Students	

Student learning activities in pharmaceutical mathematics courses with Jigsaw and STAD-Type Model have positive and negative aspects. The positive activities consists of active (collaboration) in group discussions, pay attention to friends who are presenting material, help friends whose difficult in learning, dare to ask questions, dare to express opinions in group discussions. While the negative activity of students being indifferent and self-study[19].

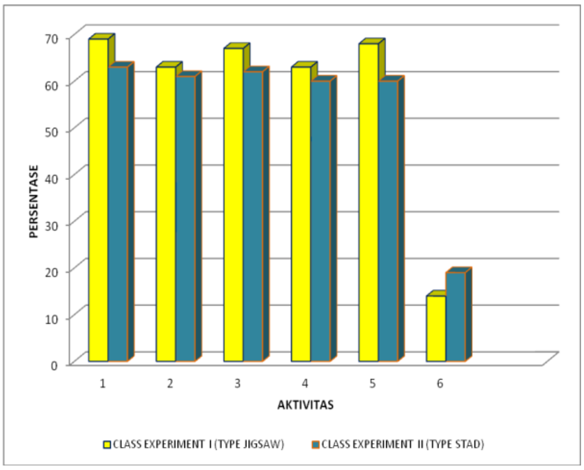

Figure 5. Diagram of Average Student Activity in Pharmaceutical Mathematics Lecture With Jigsaw-type and STAD-type Cooperative Learning Model

Based on Table 11 and Figure 5, the positive activity aspect of the pharmaceutical mathematics lecture with the Jigsaw-Type Model (experimental class I/ class IA) has a higher average than the positive activity in the pharmaceutical mathematics lecture with STAD-Type Model (class Experiment II/IB class). The negative aspect of the pharmaceutical mathematics lecture with the Jigsaw-Type Model (experimental class I/class IA) has a lower average than the negative activity in the pharmaceutical mathematics lecture with the STAD-Type Model (experimental class II/IB class). The percentage of the students' activities implementation during the lecture with the Jigsaw-type Cooperative Learning Model is greater than the STAD-type Cooperative Learning Model. The Active Aspect (in collaboration) in the group discussion had the highest average score during the pharmaceutical mathematics lecture with the Jigsaw and STAD-type model.

Student activity on the pharmaceutical mathematics lecture with Jigsaw and STAD-Type Model did not differ significantly between students who were taught using Jigsaw-type and students who were taught using the STAD-type model. This is because both learning models are equally potent to increase student activity so as not to cause differences in results in both classes that have group stages of work, quiz, and group awards. Jigsaw-type and STAD-Type Model train how students to be active (cooperate) in group discussions and express opinions in group discussions as well as presentations in front of the class[20]. Both of models can also invent a good atmosphere of teaching and learning activities, because students do not feel bored in learning quickly and increase the students' confidence because they are trained to argue actively, respect differences of opinion, and motivated to improve their performance due to competition and appreciation given.

In both of these models, students who usually study individually, without competition and awards are tried to be conditioned on the existence of competitions and awards that are the motivation for their learning success, and the learning atmosphere can become more alive and varied.

Based on table 6 by using the Kolmogorov-Smirnov test known as normally distributed data. In the pre-test and post-test data, the experimental class I (class I A) uses Jigsaw-Type Model in the pharmaceutical mathematics lecture that is significant *0.082 and significant *0.072 have significant > 0.05. It can be concluded that the pre-test and post-test data of experimental class I (class I A) using the Jigsaw-Type Model in normally distributed mathematics lecture. In the pre-test and post-test data, experimental class II (class I B) uses the STAD-Type Model in the significant mathematics lecture *0.093 and significant *0.113 have significant > 0.05. It can be concluded that the pre-test and post-test data of experimental class I (class I A) using the STAD-Type Model in normally distributed mathematics lecture.

Based on table 7 using Fisher Test it is known that the data has a homogeneous variance. In the experimental data, the experimental class I (class I A) uses the Jigsaw-Type Model and the pre-test data. The experimental class II (class I B) uses the STAD-type Cooperative Learning Model in the mathematics lectures obtained $F_{count} = 1.44$ and $F_{table} = 1.79$ (with a 5% error rate). Because the value $F_{count} \leq F_{table}$ can be stated that the data has a homogeneous variance. In the first experimental class I (class IA) data using the Jigsaw-Type Model and post-test data The experimental class II (IB class) using the STAD-Type Model in the mathematics lecture was obtained $F_{count} = 1.08$ and $F_{table} = 1.79$ (with 5% error rate). Because the value $F_{count} \leq F_{table}$ can be stated that the data has a homogeneous variance.

After performing the normality test and homogeneity test, it can be concluded that both experimental groups are normal and distributed homogeneously, hence hypothesis test using the "T" test. From table 8 "T" test was conducted to determine differences in learning outcomes in pharmaceutical mathematics lectures using the Jigsaw-Type Model and STAD-type model. "T" test is conducted by comparing the gain value in each experimental group. Based on table 8 of the gain of the Jigsaw-type experimental group and STAD-type $t_{count} = 2.14$ and $t_{table} = 2.00$ (with 5% error level). This indicates that Ho rejected and Ha accepted, since $t_{count} \geq t_{table}$, It can be stated that there is a significant difference in learning outcomes in pharmaceutical mathematics lecture taught using the Jigsaw-Type Model and STAD-type model.

Based on the learning outcomes in the pharmaceutical mathematics lecture stated that the average value of students in the experimental class I (class IA) using the Jigsaw-Type Model was higher than the average value of students in the experimental class II (class IB) using the STAD-type model. Based on table 9, it can be seen the results of the categorization of gain scores in the experimental class I during Pharmaceutical mathematics lectures using the Jigsaw-Type Model have 5 students on high category score, 13 students on medium category score, and 15 students on low category score. Based on Table 10, it can be seen the results of the categorization of gain scores in the experimental class I during the pharmaceutical mathematics course using the STAD-Type Model have 2 students on a high category score, 13 students on medium category score, and 18 students on low category score. This shows that the experimental class I that using the Jigsaw-type cooperative model tends to achieve a higher score than the experimental class II that using the STAD-type cooperative model.

Eventually, the experimental class I on the Mathematical Pharmacy Course using Jigsaw-Type Model has a higher number of students with high category score than the experimental Class II (class I B) using the STAD-type model. The high number of students in the high category in the experimental class I during the lecture of Pharmaceutical mathematics using the Jigsaw-Type Model because the teaching and learning process can stimulate the students to be more stimulated and active (working together) in the Classroom discussion, help the others in learning, dare to ask questions, and express opinion.

Pharmacy mathematics lectures using the Jigsaw-type Cooperative Learning Model are better than the STAD-type Cooperative Learning Model. This is based on the Pharmaceutical Mathematics lecture average score, where the experimental class I achieves an average score of 79.15 out of 100, higher than the experimental class II that achieves an average score of 75.91 out of 100. Based on the result of the category, N-gain average value in the Pharmaceutical Mathematics lecture using the Jigsaw-type Cooperative Learning Model is 0.37 and the N-gain average value in the Pharmaceutical Mathematics lecture using the STAD-type Cooperative Learning Model is 0.32.

Limitations of research

The implementation of this research is inseparable from weaknesses because some variables cannot be controlled and avoided which can affect the research results. Various weaknesses perceived as limitations during this research are:

1. This study describes the effectiveness of pharmaceutical mathematics lectures using the Jigsaw-type and STAD-type Cooperative Learning Models and to find out the students learning activities and results at Dwi Farma Pharmacy Academy in Bukittinggi. This study is limited to the effectiveness of pharmaceutical mathematics lectures by using the Jigsaw-type and STAD-type Cooperative Learning Models on student learning activities and results, there is no other approach or strategy.
2. This research is only applied to pharmacy mathematics subjects in Chapter “Prescription Compounding and Calculation of Formula”, so it cannot be generalized to other concepts yet. This allows different results to be obtained if applied to other lecturing material.
3. Some students are less able to adapt to the new learning model that is applied. So it takes time to familiarize students with various changes in activities during the lecture.

Although there are some limitations, it can be believed that the data obtained in this study has gone through the correct procedure and accounted for.

Conclusion

1. The Research on the effectiveness of the Jigsaw and STAD (Student Team Achievement Division) Cooperative Learning Model on pharmaceutical mathematics found that Student activity during pharmaceutical mathematics lectures did not differ significantly between students taught by the cooperative model of Jigsaw-Type Model and student taught by STAD-type model. This is due to both learning models that equally increase student activity. None can be used in classes that have group work, quiz, and group awards.
2. Learning outcomes during pharmaceutical mathematics lectures using the Jigsaw-Type Model and STAD-Type Model differ significantly. The result of the post-test average score of the experimental class I using the Jigsaw-type Cooperative Learning Model gets 79.15 out of 100 while the experimental class II (class IB) using the STAD-type Cooperative Learning Model gets 75.91 out of 100, from the hypothesis test obtained t_{count} greater than t_{table} ($t_{count} = 2.14$ and $t_{table} = 2.00$ with the level 5% error).
3. Jigsaw-Type Model is more effective than the STAD-Type Model during pharmaceutical mathematics lectures. The improvement in learning results can be seen from the N-gain value of each class where the experimental class I using the Jigsaw-type Cooperative Learning Model is higher than

the experimental class II using the STAD-type Cooperative Learning Model. So that the class that uses the Jigsaw-type Cooperative Learning Model has a higher influence on learning results than the class using the STAD-type Cooperative Learning Model.There are differences in learning outcomes during the pharmaceutical mathematics lecture between students taught using the Jigsaw-Type Model and STAD-Type Model both before and after research due to the two different treatments.

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