The effect of structured individual responsibility on students’ achievement increase in cooperative learning science class

F Nugraha*, P Siahaan and D T Chandra
Departemen Pendidikan Fisika, Universitas Pendidikan Indonesia, Jl. Dr. Setia Budhi No. 229, Bandung 40154, Indonesia

*firmannugraha@student.upi.edu

Abstract Generally, student group projects can be problematic due to the lack of structured individual responsibility leading to the uprising of the social loafing phenomenon among the students. The aim of the present research was to compare types of cooperative learning models which is least structured individual responsibility (STAD type) and more structured individual responsibility (jigsaw type) within two groups of junior high school students (14-15 years old). The research design was quasi-experimental with crossover-repeated measurements design within two sessions. The sample consist of 61 students of a junior high school studying he topic of magnet in Bandung (Indonesia). The results of a pre-test and a post-test for each session were compared for the two groups. The working hypotheses were the group who has given more structured individual responsibility (jigsaw) perform better in learning the topic of magnet. With respect to Hypothesis., the results appeared to show a better improvement in students’ achievement in the more structured individual responsibility (jigsaw type) group compared to the least structured individual responsibility (STAD type) group, as it is shown both in the comparison between the n-gain value and statistical test.

1. Introduction
Although it is already known that cooperative learning model has so many benefits for student, there is still problem due to the withdrawing effort as the students start working as group, which is called social loafing [1]. Social loafing has been a usual problem when it comes to a group activity. Its reduce group performance collectively [2]. The problem of effort withdrawal within students is unfortunate since it’s leading to a positive group-learning outcome [1,2]. This effort withdrawal will lead to a decreasing student’s individual satisfaction in working [3]. Furthermore, it will cause a loss in learning motivation and result in descending student’s achievement [3].

It has been identified that the personal responsibility or accountability of every person in-group learning is essential in cooperative learning [4]. If there is high individual accountability it is can be inferred there is so much effort from each member is contributing, if redundant efforts are avoided, if every member is responsible for the final outcome, and if the group is cohesive, then the social loafing effect vanishes [4,5]. Giving the students individual structured task would result in the increasing of their individual responsibility and then increase their achievement.

In cooperative learning models, there is various type of this models that will give various ways of giving individual task to the students through the learning process. There is type of this model that give the group freedom to distribute the responsibility among their member or in this case the task for every person is not clear and other type give some specified task for every member in their group. STAD
(Students Team Achievement Division) is one of many type of cooperative learning model that give freedom to the cooperative learner to distribute the responsibility among their member since there is no specified task for members in this type. Jigsaw is another type of cooperative learning models that give every member some specified/structured task. [5]

The aim of this study is to describe the effect of structured individual task by comparing two type of cooperative learning methods. This research is comparing the effect type of the cooperative learning which is has more structured individual task (jigsaw) and less structured individual task (STAD). The working hypotheses were the group who has given more structured individual responsibility (jigsaw) perform better in learning.

2. Method
This research has utilized pre-experimental research method with crossover repeated measure design as this design reduce the potential error of subject-effect. This design also modified with two sets of pre-test and post-test on a different part of magnet theorem in science subject so it will reduce the carry-over effect in this research. 61 students of third year within two class of junior high school in Bandung who study magnetism has been chosen to become the subject of this research.

The procedure of this research start with giving first pre-test about 1) how to make magnet, 2) interaction between magnet pole, and 3) earth magnetism. After the pre-test done the Class 1 is treated with STAD while class 2 treated with jigsaw within group, consist of 5 - 6 person. Then after first session of treatment student will be held in the first post-test, as these test result will be used to measure the gain of every student. After that, second session of this research start with another pre-test with second set of topics about 1) source of magnetic field, 2) magnetic force and right hand rule, and 3) some application of magnetism in technology. After that, the treatment is switched. Class 1 now is treated with Jigsaw and Class 2 treated with STAD with same group size. As the second session, treatment done the post-test is held once again to evaluate the student’s achievement. The result from second session pre-test and post-test will be used to measure the gain of every student once again.

These data will be analyzed by calculating n-gain of every class from every session to compare which treatment has more effect on the improvement of student achievement. And then all gain scores from each model will be tested with statistics t-test, welch t' test or Mann-Whitney test depend on the result. After that it is can be determined whether the more structured type of cooperative learning (jigsaw) is significantly give more improvement in students achievement compared to the less structured type of cooperative learning (STAD).

3. Result and discussion
These part will present the result of the research. It will be presented within three section consist of 1) N-gain result, 2) statistical hypothesis test on gain result, and 3) discussion.

3.1. N-gain result
The calculation result of n-gain will be presented in table 1 as it is shown below.

|          | N-gain    |          |
|----------|-----------|----------|
|          | First session | Second Session |
| Class 1  | 0.27       | 0.42     |
| Class 2  | 0.32       | 0.26     |

Judging from the value of n-gain can be seen there is a difference between classes treated with jigsaw and STAD. Referring to Table 1, it is found that the classes that received jigsaw type cooperative learning received better result of n-gain compared to the STAD type cooperative learning class. By overall, it can be interpreted that the improvement of learning achievement of students who get jigsaw
type cooperative learning treatment is better than students who get cooperative learning treatment STAD tips.

3.2. Statistical hypothesis test on gain result
Now the analysis focused on STAD and Jigsaw gain. The result from table 1 only explain about the n-gain collectively. The difference between STAD gain and jigsaw gain mean is small which is about 0.11 as it is shown in table 2. This difference cannot really tell which one is better. Furthermore, it is necessary to test the statistical hypothesis in order to determine whether it can be concluded statistically that the jigsaw class is superior to the STAD class. First, it is need to test the normality and homogeneity of the data in order to determine the type of the test. Kolmogorov-Smirnov test has been used to determine whether the data is normally distributed or not using sample size (N) 61 and significant value (α) 0.01. The normality test will be presented in table 2.

| Table 2. Normality test between the jigsaw classroom and STAD classroom gain. |
|-----------------|-----------------|
|                 | STAD gain        | Jigsaw Gain    |
| Mean            | 0.264            | 0.374          |
| SD              | 0.203            | 0.202          |
| $|A_e - A|_{max}$ | 0.104            | 0.094          |
| Critical Value  | 0.208            | 0.208          |
| Result          | Normal           | Normal         |

It is shown that both data is normally distributed, then F-test is used for so it can be determined which statistical hypothesis test will be used. The result is shown in table 3 using degree of freedom (df) 60 and significant value (α) 0.01.

| Table 3. Homogeneity test between the jigsaw classroom and STAD classroom gain. |
|-----------------|-----------------|
|                 | Value           |
| F               | 1.013           |
| $F_r$           | 1.84            |
| Result          | Homogeneous     |

From this result, it is concluded that t-test will be performed to determine whether the type of cooperative learning with more structured individual task (jigsaw) give better improvement than the less structured individual task (STAD). The result presented in table 4 using degree of freedom (df) 60 and significant value (α) 0.01.

| Table 4. Statistical hypothesis test result on gain. |
|-----------------|-----------------|
|                 | t-value | t-critical |
|                 | 2.978    | 2.390      |

It is shown that t-value is higher than t-critical which mean the more structured type of cooperative learning (jigsaw) is significantly give more improvement in students achievement compared to the less structured type of cooperative learning (STAD).

3.3. Discussion
Students at the beginning of treatment are not accustomed and not ready to conduct learning activities with cooperative learning model. This is indicated by the findings of field observations in the form of some group discussions in some cases are charged to the group leader only even though they’ve been instructed especially in STAD class. When members given the same worksheet some member just wait
for the high achiever member to finish then their just copy the work. This is the first sign of social loafing.

According to the n-gain calculation of each class in each session it is found that students who given more structured individual task (jigsaw) is consistently superior to students who given less structured individual (STAD). From these information, can be interpreted that there was no any subject-effect underlying these results. This result correlate with some researches that suggest jigsaw classroom give positive influence to student’s achievement [6,7,8].

Although overall, there is an increase in learning achievement but improvements in student achievement results are still low. The improvement of learning achievement is still not optimal even though the level of problem used is dominated by the problem of moderate difficulty. It is stated that cooperative learning models still lack of structure [1]. Some structured evaluation technique would imply too indirectly to the perceived benefits [9]. These preceding explanations imply that Educators should put much more effort structuring cooperative learning both in terms of implementation and in terms of evaluation.

Though it is stated that STAD and jigsaw give high individual accountability [5], there is some study shows that the increase of group size would lead to the increase of social loafing [10,11]. Most cooperative learning research divided students into a 2-3 person each group [12]. Since this study has been used a bigger student groups, there is possibility that social loafing is emerge in the STAD group that would result in degrading the group performance and then affect students achievement. This reference also carry a possibility about the positive effect of giving structured individual task to students who work in a bigger group since the jigsaw classroom has shown better performance in this study. There is a finding support the mentioned possibility, which tell, that structured individual task mentioned in other research as differentiated role would lead to better individual responsibility and accountability [13]. This individual responsibility and accountability will reduce the social loafing and increase overall performance for both groups and individuals.

4. Conclusion

By analysing n-gain values from each class it is concluded that students who given more structured individual task (jigsaw) is consistently superior to students who given less structured individual (STAD) even though the treatment is switched between two sessions of treatment. Having known that the gain of each cooperative learning type is normal and homogeneous distributed, it is done by right tail t-test to find out whether there is a significant difference between improvement of student achievement through cooperative learning type jigsaw and STAD. Obtained t-value 2.97 and with significance level 0.01 and degree of freedom 60 obtained the value of t-critical is of 2.39 so t-value> t-critical. From these results, it can be concluded that the improvement of student achievement through more structured individual task cooperative learning (jigsaw) is significantly greater than the increase in learning achievement compared to less structure individual task cooperative learning (STAD). Task both from n-gain value and statistical test infer that promoting more structured individual task will give better result in improvement of student’s achievement than giving less structured individual.

Acknowledgements

The author really appreciates the assistance from earth and space laboratory staff of Universitas Pendidikan Indonesia. This work was supported by earth and space laboratory in terms of internet service and place to stay so the author can search for literature without worry.

References

[1] Voyles E C, Sarah F B and Amanda M D 2015 New pieces of the jigsaw classroom: increasing accountability to reduce Social Loafing in Student Group Projects The new school psychology bulletin 13 11
[2] Teng C C and Luo Y P 2015 Effects of perceived social loafing, social interdependence, and group affective tone on students’ group learning performance *The Asia-pacific education researcher* 24 p 259
[3] Aggarwal P and O Brien C L 2008 Social loafing on group projects structural antecedents and effect on student satisfaction *Journal of marketing education* 30 p 255
[4] Johnson D W and Johnson R T 2009 An educational psychology success story: social interdependence theory and cooperative learning *Educational researcher* 38 365
[5] Slavin R E 1980 Cooperative learning *Review of educational research* 50 p 315
[6] Azmin N H 2016 Effect of the jigsaw-based cooperative learning method on student performance in the general certificate of education advanced-level psychology: an exploratory brunei case study *International education studies* 9 p 91
[7] Kim Y and Lee Y 2015 The effects of science lessons using jigsaw cooperative learning on academic achievement and creative personality *Journal of the Korean society of earth science education* 8 p 218
[8] Honeychurch S and Draper S 2012 Taking forward the jigsaw classroom: the development and implementation of a method of collaborative learning for first year philosophy tutorials *Discourse* 11 p 40
[9] Bailey S, Barber L K and Ferguson A J 2015 Promoting perceived benefits of group projects the role of instructor contributions and intragroup processes *Teaching of Psychology* 42 p 179
[10] North A C, Linley P A and Hargreaves D J 2000 Social loafing in a co-operative classroom task *Educational Psychology* 20 p 389
[11] Simms A and Nichols T 2014 Social loafing: a review of the literature *Journal of Management Policy and Practice* 15 p 58
[12] Pai H H, Sears D A and Maeda Y 2015 effects of Small-group learning on transfer: a meta-analysis *Educational psychology review* 27 p 79
[13] Baumeister R F, Ainsworth S E and Vohs K D 2016 Are groups more or less than the sum of their members? The moderating role of individual identification *Behavioral and Brain Sciences* p 39