

An Experiment of Cooperative Learning Model to Teach the Students in Writing Scientific Works as Observed from their Logical Thinking Capacity

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Abstract: *The aims of this research are: (1) find the differences of the skill in writing scientific works among student groups taught with a cooperative learning model that was divided into several learning methods: Mind Mapping, Problem Based Learning, and Cooperative Integrated Reading and Composition, (2) find the differences of the skill in writing scientific works among student groups that had high and low logical thinking capacity, and (3) find the interaction of the use of those three learning methods and logical thinking capacity in affecting the students' skill in writing scientific works. The method applied in this research was experiment. The population in this research was the students of private universities in Surakarta. The sample was taken by using multi stage area random sampling technique. The data were collected with an instrument test and a standardized test. They were analyzed by using two ways analysis of variance. The results of this research showed that the skill in writing scientific works of the students who joined the learning with Mind Mapping and Cooperative Integrated Reading and Composition methods was better than with Problem Based Learning method. Meanwhile, the skill in writing scientific works of the students who joined the learning with Mind Mapping method was just as good as with Cooperative Integrated Reading and Composition method. Besides, logical thinking capacity also affected the skill of writing scientific works, in which the students with high logical thinking capacity had higher skill in writing scientific works than those with low logical thinking capacity.*

Keywords: cooperative learning, logical thinking capacity, writing skill

1. Introduction

Writing skill is an ability to express the idea, knowledge, and experience in the form of writing. The skill in writing scientific works is one of the important abilities for students in order to meet academic demands during their study, such as arranging scientific works, planning observation reports, writing books, and preparing for theses or final projects. According to Supriadi (2007: 109), the skill in writing scientific works is also important for the university students, because it can be provisions for them to meet the flow of recent information. The skill in writing scientific works is one of important abilities to fulfill that obligation. Therefore, every student needs to know the ways to write scientific work and have the skill in writing scientific works.

A phenomenon that recently happens in the universities in Surakarta is the students, in general, still have many weaknesses in writing scientific works. As stated by Cahyani (2005: 7), there are some factors causing the difficulty for the students in expressing idea in a form of writing, such as the fear of starting and making mistakes when writing a topic. In addition, the students are less capable in organizing compositions, developing paragraphs, managing language effectively, particularly making up sentences, putting appropriate vocabularies, and applying writing mechanism, that was especially writing techniques. The lack of academic culture in Indonesia can be seen from the number of scientific works produced by the academicians. According to the data published by SCImagoJR, Indonesia lies in the 61st position in the world in terms of the number of scientific publication in the international works that were indexed

by Scopus. Meanwhile, in Asian level, Indonesia is ranked 11 under Singapore, Malaysia, Thailand, and Pakistan.

The skill in learning writing is determined by selecting the learning model applied. The application of learning model must be adjusted to the students' condition, the materials that are taught, the objective of the learning to be reached, and the students' involvement in the process of learning. If the appropriate model is applied in the learning process, hence the development of the students' writing competence will be more effective.

To develop the competence of the skill in writing scientific works, the cooperative learning model can be identified. There are several methods can be selected in the cooperative learning model. The methods in the area of cooperative learning model are suitable to be applied in improving the skill in writing scientific works. Those referring methods are: 1) *Problem Based Learning* (PBL), 2) *Mind Mapping* (MM), and 3) *Cooperative Integrated Reading and Composition* (CIRC).

From another point of view, the skill in writing scientific works is basically an implementation of thinking capacity, especially in terms of logical thinking capacity. Logical thinking is to think by using logic or think with reasoning. Meanwhile, logic can be divided into two classifications; they are inductive logic and deductive logic. Therefore, logical thinking capacity can be defined as the capacity to think by using inductive logic and deductive logic.

Based on the background, it was considered important to hold a research about the application of the methods of

PBL, MM, and CIRC in developing the skill in writing scientific works as seen from the logical thinking capacity. The basic problem of this research could be formulated as follows:

- 1) Is there any difference of the influence of the skill in writing scientific works between student groups that joined the cooperative learning model with the methods of PBL, MM, and CIRC?
- 2) Is there any difference of the skill in writing scientific works between students who had high logical thinking capacity and those who have low logical thinking capacity?
- 3) Is there any interaction between the learning methods with the logical thinking capacity towards the skill in writing scientific works?

2. Theoretical Framework

The definition of writing skill according to Gie (2002: 3) is the skill in making a sign language into a writing form. Scientific work, according to Danial (2001: 4), is a variety of writing composed by a person or group by implementing scientific procedures. Each scientific work must contain scientific truth, which is the truth not only based on the ratio but also proved empirically. The result of the application of this scientific method is called as scientific work. The work is presented in accordance with the fixed principles and using certain scientific methods.

Logical thinking is the thinking activity that is in accordance with the definite pattern of reasoning and using logic (Suriasumantri, 1985: 43). Logical thinking is sorted with ordering, comparing, contrasting, evaluating, and selecting (Stevens, 1996: 6). Another variable in this research is cooperative learning model. Slavin (2005: 15) states that cooperative model in learning can increase the quality of the students' learning and raise the attitude of helping each other in the students' social behavior.

The application of the cooperative learning model contains of five elements, e.g. positive interdependence, individual responsibility, face-to-face, communication among members, and evaluation of the group process. Cooperative approach is a learning model that emphasizes the positive interdependence among students, the individual responsibility, face-to-face, intensive communication between students, and evaluation of the group process. Cooperative learning has a lot of procedural applications, including the procedure of cooperative learning model, e.g. *Mind Mapping* (MM) learning method. MM is a method of recording creativity, effectivity, and literally can "map" the mind (Buzan, 2008: 4).

Another method is *Problem Based Learning* (PBL), which is a significant strategy for solving a problem relying on the real-life situations, giving information/sources, directing or guiding, and giving direction to the learners to develop their knowledge (Mayo, Donnely, Nash and Schwartz, 1993). The last method is *Cooperative Integrated Reading and Composition* (CIRC), which is a method for teaching

reading and writing. Reading can indirectly increase vocabulary mastery, while vocabulary mastery is useful for writing skill (Nagy and Herman, 1987: 24). In general, the implementation of CIRC method is done by grouping the students into some groups to achieve learning objectives by working together (Slavin, 2005: 200).

There are three methods included in this cooperative learning area, then those methods are compared in teaching the skill of writing scientific works to the university students.

3. Methodology

- 1) This was an experiment research. The design used in this research was factorials 3 x 2, and involving two factors that each consisted of 3 and 2 level. The schema of the research design could be seen in Table 6.

Table 6. Factorial 3 x 2 Experiment Design

Learning Method (A)	Logical Thinking Capacity (B)	
	High (B1)	Low (B2)
MM (A1)	A ₁ B ₁	A ₁ B ₂
PBL (A2)	A ₂ B ₁	A ₂ B ₂
CIRC (A3)	A ₃ B ₁	A ₃ B ₂

Note:

- A₁B₁: MM learning method with high logical thinking capacity
- A₁B₂: MM learning method with low logical thinking capacity
- A₂B₁: PBL learning method with high logical thinking capacity
- A₂B₂: PBL learning method with low logical thinking capacity
- A₃B₁: CIRC learning method with high logical thinking capacity
- A₃B₂: CIRC learning method with low logical thinking capacity

The manipulative independent variables were the learning methods containing of 3 levels, i.e. (1) *Mind Mapping* (MM), *Problem Based Learning* (PBL), (2) and (3) *Cooperative Integrated Reading and Composition* (CIRC). The attributive independent variables were the logical thinking capacity including 2 levels, they are: (1) high logical thinking and (2) low logical thinking. The dependent variable was the skill of writing scientific works.

- 2) The Population and Sample of the Research

a. Population

The students of non-language study program in private universities in Surakarta that took the subject of Indonesian Language in the 2nd semester academic year 2012-2013

b. Sample

The determination of the sample in this research was done by using the sample collection technique of *multi stage probability proportional cluster random sampling*, in which the gradual probability

design was based on the area and the quota (Burhan, 2001: 67). The private universities for the sample were Widia Dharma University and Veteran University with the total sample of 638 students.

3) The Research Location

This research was carried out in the universities in Surakarta, Central Java - Indonesia. The research locations were namely Widia Dharma University in Klaten and Veteran University in Sukoharjo.

4) Data Collection Techniques

The techniques in collecting the data of the skill in writing scientific works used in this research were the writing instruments of scientific works that had been tested for their reliability and validity adopted from opinions (Suwandi, 2006). The indicators referring to the skill in writing scientific works in this research were Content, Organization, Grammar, Diction, Spelling, and Scientific Notation.

5) Data Validation

a. The instrument validation in this research was undertaken by expert judgement involving two experts. The purpose of holding this assessment was to find out the validation of the contents from the assessment guidance of scientific writing based on the assessment of expert judgement involving two experts.

b. Instrument Reliability

The assessment of the scientific was carried out by three lecturers from each university that were the Indonesian Language lecturers in Central Java, Indonesia. Final score of the scientific writing was the average score from those three lecturers. The scoring of the scientific writing scientific that involved more than a person intended to fulfil the consistency of scientific writing assessment. In accordance with the opinion from Azwar (1997: 105-109) that the assessment done by more than a person intended to fulfil the assessment reliability or the reliability test of rating among assessors, which laid stress on the consistency between the assessors/interrate reliability.

6) Data Analysis Technique

The data analysis technique used in this research was two ways analysis of variance with non-similar cell, which was to assess the mean difference of the scientific writing skills. The research design used was factorials 3 x 2. If the analysis showed the difference in learning methods and the interaction, then it continued with the analysis of *scheffe* test.

4. Research Result

The result of data analysis using two ways analysis of variance with non-similar cell could be seen in Table 1.

Table 1: The Counting Result of Analysis of Variance

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1.400 ^a	5	.280	42.888	.000	.695
Intercept	1132.684	1	1132.684	1.734E5	.000	.999
Learning Method Code	.657	2	.328	50.280	.000	.517
Logical Thinking Capacity Code	.699	1	.699	107.097	.000	.533
Learning Method Code * Logical Thinking Capacity Code	.001	2	.001	.104	.902	.002
Error	.614	94	.007			
Total	1187.783	100				
Corrected Total	2.014	99				
R Squared = .695 (Adjusted R Squared = .679)						

Based on the statistical analysis in Table 1, it was obtained the significance of $0.000 < 0.05$. This showed the differences in the skill of writing scientific works between the students taught by using MM, PBL, CIRC learning methods. The difference in the skill of writing scientific works was also influenced by the logical thinking capacity. This was shown with the obtained significance value by $0.000 < 0.05$. However, the student's skill of writing scientific works was not influenced by the implementation of MM, PBL, CIRC learning methods with logical thinking capacity. This was shown with the obtained significance value by $0.902 >$

0.05 . In other words, there was no interaction between learning methods and logical thinking capacity towards the student's skill of writing scientific works.

The next, there was a following test or double comparison between lines by using *scheffe* test to comprehend the mean difference of the student's skill of writing scientific works taught by using MM, PBL, CIRC learning methods. The result of double comparison between lines by using *scheffe* test can be seen in Table 2.

Table 2: The Result of Double Comparison Test between Lines Multiple Comparisons

The Score of Skill of Writing Scientific Works Using <i>Scheffe</i>						
(I) Learning Method Code	(J) Learning Method Code	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
MM	PBL	.1802*	.01948	.000	.1415	.2189
	CIRC	.0048	.01980	.971	-.0345	.0441
PBL	MM	-.1802*	.01948	.000	-.2189	-.1415
	CIRC	-.1754*	.02021	.000	-.2156	-.1353
CIRC	MM	-.0048	.01980	.971	-.0441	.0345
	PBL	.1754*	.02021	.000	.1353	.2156
Based on observed means. The error term is Mean Square(Error) = .007.						
*. The mean difference is significant at the .05 level.						

Based on the result of *scheffe* test in Table 2, it could be seen the significance value between MM and PBL methods was $0.000 < 0.05$. This showed that there was difference of the skill in writing scientific works between the students taught by using MM and PBL learning methods. The significance value between MM and CIRC learning methods was $0.971 > 0.05$ showing that there was no difference of the skill in writing scientific work between the students taught by using MM and CIRC learning methods. The significance value between PBL and CIRC learning methods was $0.00 < 0.05$. This showed that there was difference of the skill in writing scientific works between the students taught by using PBL and CIRC learning methods. The next was inter-cell double comparison, in which the amount of significance value can be seen in Table 3.

Table 3: Inter-cell Comparison in the Similar Columns and Lines

No	Comparison	Sig ρ	Sig α	Result
1	MM with High Logical Thinking (A_1B_1) and PBL with High Logical Thinking (A_2B_1)	0.000	0.05	H_0 Denied
2	MM with High Logical Thinking (A_1B_1) and CIRC with High Logical Thinking (A_3B_1)	0.957	0.05	H_0 Accepted
3	CIRC with High Logical Thinking (A_3B_1) and PBL with High Logical Thinking (A_2B_1)	0.000	0.05	H_0 Denied
4	MM with Low Logical Thinking (A_1B_2) and PBL with Low Logical Thinking (A_2B_2)	0.000	0.05	H_0 Denied
5	MM with Low Logical Thinking (A_1B_2) and CIRC with Low Logical Thinking (A_3B_2)	0.946	0.05	H_0 Accepted
6	CIRC with Low Logical Thinking (A_3B_2) and PBL with Low Logical Thinking (A_2B_2)	0.000	0.05	H_0 Denied
7	MM with High Logical Thinking (A_1B_1) and MM with High Logical Thinking (A_1B_2)	0.000	0.05	H_0 Denied
8	PBL with High Logical Thinking (A_2B_1) and PBL with High Logical Thinking (A_2B_2)	0.000	0.05	H_0 Denied
9	CIRC with High Logical Thinking (A_3B_1) and CIRC with High Logical Thinking (A_3B_2)	0.000	0.05	H_0 Denied

5. Discussion

Based on the results of hypotheses test on the variant analysis, it was known that the difference of the skill in writing scientific works happened between the students taught by using MM learning methods and the students taught by using PBL methods on the students who had high logical thinking capacity. Based on the descriptive analysis that had been done, the mean value of the skill in writing scientific works on the students who had high logical thinking capacity and were taught by using MM learning method (A_1B_1) was 3.5668. Meanwhile, the mean value of the skill in writing scientific works on the students who had high logical thinking capacity and were taught by using PBL learning method (A_2B_1) was 3.3974.

The result of advanced testing using *scheffe* test showed a significant difference. This indicated that the students who had high logical thinking capacity and were taught by using MM learning method (A_1B_1) had better skill in writing scientific works than the students who had low logical thinking capacity and were taught by using PBL learning method (A_2B_1).

The differences of the skill in writing scientific works happened between the students taught by using MM learning methods and the students taught by using CIRC learning methods on the students who had high logical thinking capacity. Based on the descriptive analysis that had been done, the mean value of the skill in writing scientific works on the students who had high logical thinking capacity and were taught by using MM learning method (A_1B_1) was 3.5668. Meanwhile, the mean value of the skill in writing scientific works on the students who had high logical thinking capacity and were taught by using CIRC learning method (A_3B_1) was 3.5744.

The result of advanced testing using *scheffe* test showed a significant difference. This indicated that the students who had high logical thinking capacity and were taught by using MM learning method (A_1B_1) had better skill in writing scientific works than the students who had low

logical thinking capacity and were taught by using CIRC learning method (A_3B_1).

The differences of the skill in writing scientific works happened between the students taught by using PBL learning methods and the students taught by using CIRC learning methods on the students who had high logical thinking capacity. Based on the descriptive analysis that had been done, the mean value of the skill in writing scientific works on the students who had high logical thinking capacity and were taught by using PBL learning method (A_2B_1) was 3.3974. Meanwhile, the mean value of the skill in writing scientific works on the students who had high logical thinking capacity and were taught by using CIRC learning method (A_3B_1) was 3.5744.

The result of advanced testing using *scheffe* test showed a significant difference. This indicated that the students who had high logical thinking capacity and were taught by using PBL learning method (A_2B_1) had the skill in writing scientific works that was different from the students who had high logical thinking capacity and were taught by using CIRC learning method (A_3B_1).

The differences of the skill in writing scientific works happened between the students taught by using MM learning methods and the students taught by using PBL learning methods on the students who had low logical thinking capacity. Based on the descriptive analysis that had been done, the mean value of the skill in writing scientific works on the students who had low logical thinking capacity and were taught by using MM learning method (A_1B_2) was 3.4064. Meanwhile, the mean value of the skill in writing scientific works on the students who had low logical thinking capacity and were taught by using PBL learning method (A_2B_2) was 3.2250.

The result of advanced testing using *scheffe* test showed a significant difference. This indicated that the students who had low logical thinking capacity and were taught by using MM learning method (A_1B_2) had the skill in writing scientific works that was different from or better than the students who had low logical thinking capacity and were taught by using PBL learning method (A_2B_2).

The differences of the skill in writing scientific works happened between the students taught by using MM learning methods and the students taught by using CIRC learning methods on the students who had low logical thinking capacity. Based on the descriptive analysis that had been done, the mean value of the skill in writing scientific works on the students who had low logical thinking capacity and were taught by using MM learning method (A_1B_2) was 3.4064. Meanwhile, the mean value of the skill in writing scientific works on the students who had low logical thinking capacity and were taught by using CIRC learning method (A_3B_2) was 3.3962.

The result of advanced testing using *scheffe* test showed a significant difference. This indicated that the students who had low logical thinking capacity and were taught by

using MM learning method (A_1B_2) had better skill in writing scientific works than the students who had low logical thinking capacity and were taught by using CIRC learning method (A_3B_2).

The differences of the skill in writing scientific works happened between the students taught by using PBL learning methods and the students taught by using CIRC learning methods on the students who had low logical thinking capacity. Based on the descriptive analysis that had been done, the mean value of the skill in writing scientific works on the students who had low logical thinking capacity and were taught by using PBL learning method (A_2B_2) was 3.2250. Meanwhile, the mean value of the skill in writing scientific works on the students who had low logical thinking capacity and were taught by using CIRC learning method (A_3B_2) was 3.3962.

The result of advanced testing using *scheffe* test showed no significant difference. This indicated that the students who had low logical thinking capacity and were taught by using PBL learning method (A_2B_2) had similar skill in writing scientific works to the students who had low logical thinking capacity and were taught by using CIRC learning method (A_3B_2).

The differences of the skill in writing scientific works happened between the students who had high logical thinking capacity and the students who had low logical thinking capacity taught by using MM learning methods. Based on the descriptive analysis that had been done, the mean value of the skill in writing scientific works on the students who had high logical thinking capacity and were taught by using MM learning method (A_1B_1) was 3.5668. Meanwhile, the mean value of the skill in writing scientific works on the students who had low logical thinking capacity and were taught by using MM learning method (A_1B_2) was 3.4064.

The result of advanced testing using *Independent Sample T-test* to examine the mean difference showed a significant difference. This indicated that the students who had high logical thinking capacity and were taught by using MM learning method (A_1B_1) had better skill in writing scientific works than the students who had low logical thinking capacity and were taught by using MM learning method (A_1B_2).

The differences of the skill in writing scientific works happened between the students who had high logical thinking capacity and the students who had low logical thinking capacity taught by using PBL learning methods. Based on the descriptive analysis that had been done, the mean value of the skill in writing scientific works on the students who had high logical thinking capacity and were taught by using PBL learning method (A_2B_1) was 3.3974. Meanwhile, the mean value of the skill in writing scientific works on the students who had low logical thinking capacity and were taught by using PBL learning method (A_2B_2) was 3.2250.

The result of advanced testing using *Independent Sample T-test* to examine the mean difference showed a significant difference. This indicated that the students who had high logical thinking capacity and were taught by using PBL learning method (A_2B_1) had better skill in writing scientific works than the students who had low logical thinking capacity and were taught by using PBL learning method (A_2B_2).

The differences of the skill in writing scientific works happened between the students who had high logical thinking capacity and the students who had low logical thinking capacity taught by using CIRC learning methods. Based on the descriptive analysis that had been done, the mean value of the skill in writing scientific works on the students who had high logical thinking capacity and were taught by using CIRC learning method (A_3B_1) was 3.5744. Meanwhile, the mean value of the skill in writing scientific works on the students who had low logical thinking capacity and were taught by using CIRC learning method (A_3B_2) was 3.3962.

The result of advanced testing using *Independent Sample T-test* to examine the mean difference showed a significant difference. This indicated that the students who had high logical thinking capacity and were taught by using CIRC learning method (A_3B_1) had better skill in writing scientific works than the students who had low logical thinking capacity and were taught by using CIRC learning method (A_3B_2).

Based on test inter-sell double comparison above, it could be seen that those three learning methods influenced the skill in writing scientific works. MM and CIRC learning methods had more influence than PBL learning method towards the skill in writing scientific works. The influence of MM learning method was similar to or not different with the influence of CIRC learning methods towards the skill in writing scientific works.

From the results above, it could be compared to other researches, e.g. a research conducted by Hegelund and Kock (2003). The research was related to the scientific writing using *The Macro Toulmin Way Models*, which was an argument model applied to describe a genre used in writing a scientific report. The approach employed in this model involved the *top down* approach to make a research draft. From these two researches, it was known that the analysis on the skill in writing scientific works showed identical research results.

Another relevant research was done by Nemati, Jahandar, and Khodabandehlou (2014: 96-100). It showed that the students who were taught by using *Mind Mapping* were better than the students who were not taught by using that learning method. Therefore, the implementation of *Mind Mapping* method gave a positive influence towards the students' writing skill, as shown in the research discussion. The difference between the previous research and this research was the type of writing skills tested, which were writing essays and writing scientific works.

Nemati, Jahandar, and Khodabandehlou (2014: 99) also discussed about implementation of cooperative learning method in a research entitled "The Influence CIRC, Jigsaw, and STAD Learning Models towards the Writing Skills as Seen from the Language Logic Competence". It is known that there was an interaction between learning models and language logic competence towards the reading skill. The interaction was in the form of: the students who had high language logic competence were better to be taught by using CIRC learning model than STAD and Jigsaw CIRC learning models. The relevance of May's research with this research was the analyzed free variable, which was CIRC learning method. Seeing and comparing the previous studies, it appeared that the implementation of cooperative learning in teaching writing skills was effective.

However, different from the previous studies, this research also found that logical thinking capacity also affected the skill in writing scientific works, in which the students with high logical thinking capacity had higher skill in writing scientific works than the students with low logical thinking capacity. There was consistency in the influence of the three learning methods and the logical thinking capacity towards the skill in writing scientific works. Thus, it could be said that there was no interaction. It means that the use of those learning methods (MM, PBL, and CIRC) had no difference in their influence when applied to the students who had high or low logical thinking capacity.

6. Conclusion

- 1) There was difference of skill in writing scientific works between group of students who studied using *Mind Mapping* learning method and the group of students who studied using *Problem Based Learning* method. The difference was the skill in writing scientific works of the group of students who studied using *Mind Mapping* learning method was better than the group of students who studied using *Problem Based Learning* method. Meanwhile *Mind Mapping* learning method was as good as *Problem Based Learning* method.
- 2) There was difference of skill in writing scientific works between group of students who had high logical thinking capacity and the group of students who had low logical thinking capacity. The difference was the skill in writing scientific works of the group of students who had high logical thinking capacity was better than the group of students who had low logical thinking capacity.
- 3) There was no interaction of the influence of the learning methods implementation and logical thinking capacity towards the skill in writing scientific works. It means that:
 - a) The skill in writing scientific works of the students who had high logical thinking capacity was better than the students who had low logical thinking capacity in those three learning methods, namely *Mind Mapping*, *Problem Based Learning*, and *Cooperative Integrated Reading and Composition*.

- b) There was no difference between the influence of *Mind Mapping* and *Cooperative Integrated Reading and Composition* towards the skill in writing scientific works of the students who had high logical thinking capacity and the students who had low logical thinking capacity.
- c) The skill in writing scientific works of the students who studied using *Mind Mapping* learning method was better than the students who studied using *Problem Based Learning* method for the students who had high logical thinking capacity and the students had low logical thinking capacity.
- d) The skill in writing scientific works of the students who studied using *Cooperative Integrated Reading and Composition* learning method was better than and the students who studied using *Problem Based Learning* method for the students who had high logical thinking capacity and the students had low logical thinking capacity.

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