Effect of Jigsaw Strategy and Learning Style to Conceptual Understanding on Senior High School Students

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Amiruddin Kade (✉)
Tadulako University, City of Palu, Indonesia
puangamir@yahoo.com

I Nyoman Sudana Degeng
State University of Malang, City of Malang, Indonesia

Muhammad Nur Ali
Tadulako University, City of Palu, Indonesia

Abstract—Conceptual understanding should have serious attention due to the low score of Physics subject on national examination in Palu. The difference between learning style and jigsaw strategy is able to combine abstract conceptualization and active experiment towards the conceptual understanding for students whose learning style is converger and diverger. The research design was quasi experiment. The sample is the eleventh class of Senior High School students in Palu that are chosen using cluster random sampling (multistage), that is, 167 students. The research instrument was Kolb's Learning Style Inventory (KLSI) of conceptual understanding test on Physics (Tes Pemahaman Konsep Fisika or TPKF). The data was analyzed by using ANOVA, with the significant level is 5%. The result shows that: (1) cooperative learning strategy of jigsaw type has more benefits than direct learning strategy in conceptual understanding on Physics, (2) student group of which learning style was converger has higher conceptual understanding than that of which learning style was diverger, (3) there are interaction influence between learning strategy and learning style towards the conceptual understanding on Physics.

Keywords—Jigsaw, direct learning, learning style of conceptual understanding

1 Introduction

Learning style in 21st century is expected to make students to participate actively in developing self-understanding as well as their environment awareness [1]. Student understanding relates to the ability of answering question [2]. Senior High School students commonly have not been able to give answers through their own words, to interpret picture or diagram into mathematics ideas, and to arrange argument and generalization. Student ability demanded in *Kurikulum Tingkat Satuan Pendidikan*

(KTSP) is their participation in learning process, in which students get involved by asking questions, holding discussion, and sharing ideas with teachers or other classmates. This ability is highly related to students understanding [3].

Understanding is the main foundation for self-improvement in using various methods to create ideas, creating new and valuable ideas, and explaining, revising, analyzing, and evaluating their own ideas in order to improve and maximize creativity [4]. Another opinion states that understanding construction is more important than memorizing fact [5]. Therefore, understanding as the representative of learning result should reached in all subjects, including Physics.

Student understanding depends on how they choose strategy, media, and method [6]. Learning process can reach its success if each individual's difference is paid attention [7]. One of the individual differences is the student's learning style [8]. Every student has difference in understanding and processing information given to them. This difference is a learning style, defined as students' preference on learning process or activity [9]. Learning style represents how an individual understand and apply an information that they receive [10]. There are 4 (four) types of learning style stated by Kolb or well-known as Kolb learning style, namely: assimilator, diverger, accommodator, and converger. In this research, the researcher only uses two learning styles of Kolb, that it, diverger and converger, due to the empirical facts of the research subjects.

Learning style relates to student's preference to certain subject, including Physics. That the students dislike Physics subject will influence the success of students learning process. A research performed by *e Trend International Mathematics dan Science Study-Repeat* (TIMSS) reports that Indonesian student achievement in science is in the 32nd position out of 38 countries (in 1999), 37th position out of 46 countries (in 2003), and 35th out of 49 countries (in 2007). The average Indonesia score in TIMSS 2007 is 433, lower than the average score, that is 500, and reaches only Low International Benchmark [11]. Additionally, data given by the Central Valuation of Education of the Ministry of Education and Culture shows that the average result of Physics in the National Examination in 2011 in Palu is 7.39, while the national average is 8.17.

The learning problems stated before is related to the implementation of learning strategy since students should participate more in the learning process. That way, students will be able to master the concept and improve their critical thinking, as well as their ability to work with others. Direct learning, that is commonly used by Physics teachers, does not really improve student ability [12]. The direct learning, especially used to teach Physics at Senior High School, is started by giving explanation about the material, followed by examples of exercises, and ended by working on exercises [13].

Learning strategy holds important role in improving conceptual understanding [14]. The improper teacher's strategy drives to make students not interested in learning. One of the strategies demanding students to get involved actively in learning process is cooperative learning strategy [15]. The benefits of this technique are to improve academic achievement and to help students accept diversity, as well as to

develop their social skill [16]. It is shown that learning process will be more meaningful if it focuses on the group learning method.

Cooperative learning method that is possible to be implemented is jigsaw. This learning type is expected to increase the student ability to improve their knowledge, skill, and critical thinking on their own. Jigsaw relates to the conceptual understanding on Physics if there is interaction between teacher and students or students and other students during the class triggering students' participation. The students are given opportunity to understand certain Physics concept and its connection gained from sharing ides among students [17]. In such learning method, teacher is able to give questions to stimulate students to solve certain problem in the class.

Implementing cooperative learning, Jigsaw is one example, is able to improve higher order thinking ([18]. Conceptual understanding is a part of higher order thinking [19]. Therefore, theoretically, cooperative learning is commonly able to improve conceptual understanding. Cooperative learning is an effective learning strategy for improving student achievement and social skill, as well as developing their behavior and perception about the importance of group learning, meaning that cooperative learning focuses on students or well-known as Student Center Learning or SCL [20].

Previous researches conducting jigsaw learning in a school without limiting teachers' background. Those researches are performed at some schools, and the teachers becoming sample should have experience at teaching Physics for more than 5 years. Based on the background and theoretical review above, in which learning strategy has its strengths and weaknesses, the researcher need to examine the influence of cooperative learning strategy of jigsaw type, compared to direct learning method that currently used by Physics teacher at Senior High School in Palu, towards the conceptual understanding on Physics, by paying attention to the learning style of each student.

This research aims to analyze the influence of cooperative learning strategy of jigsaw type and direct learning towards conceptual understanding of Senior High School students whose learning style is converger and diverger.

The objective studies of the research are:

- Conceptual understanding on Physics between students using cooperative learning strategy of jigsaw type and those using direct learning.
- Conceptual understanding on Physics between students whose learning style are different, that is, converger and diverger.
- Interaction influence of learning strategy and learning style towards conceptual understanding on Physics.

2 Method

2.1 Research design

This research uses quasi experiment design "The untreated control group design with pretest and posttest". The research design is nonequivalent control group design. In this research, there are two groups, that is, experiment group and control group (comparator). Experiment group is treated by using cooperative learning strategy of

jigsaw type (PKjigsaw), while control group is treated by using direct learning strategy (PL). The sorting factor is learning style moderator variables consisting of 2 types, namely diverger and converger. Quasi experiment design in 2x2 of factorial version is presented on Table 1.

Table 1. Experiment Research Design

Learning Style Moderator Variables	**Learning Strategy Treatment**	
	Cooperative learning of JIGSAW type	***Direct Learning***
Diverger	$Y_{111,}$ Y_{112},Y_{113}, Y_{11n},	$Y_{121,}$ Y_{122},Y_{123}, Y_{12n},
Converger	$Y_{211,}$ Y_{212},Y_{213}, Y_{21n},	$Y_{221,}$ Y_{222},Y_{223}, Y_{22n},

Information:
Y111, Y11n =Conceptual understanding of student group with Diverger learning style by using cooperative learning strategy of jigsaw type.
Y211, Y21n =Conceptual understanding of student group with Converger learning style by using cooperative learning strategy of jigsaw type.
Y121, Y12n =Conceptual understanding of student group with Diverger learning style by using direct learning strategy.
Y221, Y22n =Conceptual understanding of student group with Converger learning style by using direct learning strategy.

2.2 Sample

The subject of this research is the students of the eleventh grades of Senior High School students in SMA Negeri Palu. From 9 (nine) SMA Negeri in Palu, there are three schools selected, namely SMA Negeri 1, SMA Negeri 2, and SMA Negeri 4. Those schools are selected due to the consideration that those schools have almost the same characteristic, all of the teachers have education background on Physics and have teaching experience for more than 5 years. After selecting those three schools, then 6 classes are selected through cluster sampling or multistage representing the eleventh grade with the same academic ability. Every school selected has parallel class, so the situation is the relatively the same.

2.3 Procedure

This research is divided into two groups which get different treatments. Those treatments are:

- Group one, learning Physics using cooperative learning strategy of jigsaw type
- Group two, learning Physics using direct learning

The two treatments are performed in the same duration of time, order, portion of the subject. The material plan is written in Learning Implementation Plan.

2.4 Instruments

This research uses two types of research instruments, namely:

Learning style instrument referring to that made by Kolb's Learning Style Inventory (KLSI) to measure individual's ability in learning style. The measurement of learning style is conducted using Kolb's Learning Style Inventory that has been translated into Bahasa. The instrument contains 12 points of statement in the form of multiple choices consisting of 2 alternative responses. It measures four types of learning style, namely active experimentation/AE, concrete experience/CE, reflective observation/RO and abstract conceptual/AC.

Point one until six consist of two alternative responses, that is, CE and AC, while point seven until twelve consist of two alternative responses, that is, AE and RO. The dichotomy of choices is in accordance with learning style theory by Kolb, stating that CE and AC as well as AE and RO are bipolar, so the two types of learning style is paired in one continuum.

The scoring is examined by summing up each alternative response. The combination of the four learning styles becomes four learning style, namely converger (the score addition of AC and AE), diverger (the score addition of CE and RO), assimilator (the score addition of AC and RO), and accommodator (the score addition of CE and AE).

A research done by Ruber and Stoult shows that scale alpha reliability of KLSI in English version is 0.73, while in Bahasa version is 0.61. The result in Bahasa is included in the high category and meets the requirements of being a test instrument. Therefore, learning style instrument of Kolb's Learning Style Inventory (KLSI) is no longer tested.

Conceptual understanding instrument of Physic is measured by using conceptual understanding on Physics test (TPKF) developed by researcher based on the material presented during the research process.

The arrangement of exercise is started by making some grilles based on the conceptual understanding indicator and learning purpose of Physics for the eleventh grade of Senior High School students in order to make the exercise met the contents validity, distributed indicator of conceptual understanding, and item validity.

Content validity performed in this research consists of: conformity with the learning purpose reflected in the indicator of learning result, test that is arranged in a clear and simple form, test conformity to measure the level of conceptual understanding on Physics, and conformity of conceptual understanding level on Physics. To analyze the test item validity, differentiator of each test item, and the difficulty level of each point, there is a trial for student group considered having the same characteristic as students becoming the research subject and having received the material.

The test using in this research is conceptual understanding test in the form of multiple choices consisting of 34 items. Then, there are 30 items out of 34 items that meet the requirement of being empirical validity. Afterwards, the test is consulted to the content validity to ensure that there is no unmeasured concept within the test. Based in the consideration of experts and data of the test result, items that are valid to measure the conceptual understanding on Physics are 30 items out of 34 items arranged.

2.5 Data analysis

The data analyzed in this research is as follows:

- Conceptual understanding on Physics between group treated using cooperative strategy of jigsaw type and that treated using direct learning strategy.
- Conceptual understanding on Physics between groups which have different learning strategy, that is, converger and diverger.
- The influence of interaction between learning strategy and learning style towards conceptual understanding on Physics. After then, the data collected in this research is analyzed using descriptive analysis and analysis of variance (ANOVA).

3 Result

3.1 Learning style

The learning style in experiment class and control class is analyzed based on Kolb, that is, diverger and converger, to determine percentage, according to the instruments given, as seen in the Table 2. Based on the analysis, it is shown that students from experiment and control class have different learning style. In the experiment class, diverger learning style is used more than converger, while the number of the student in the control class using converger are higher than those using diverger.

Table 2. Description of Learning Style based on Learning Strategy

Strategy	Learning Style	n	%
PK_{Jigsaw}	*Diverger*	44	53,01
	Converger	39	46.99
	Total	83	100,00
PL	*Diverger*	41	49,39
	Converger	43	50,61
	Total	84	100,00
Total	*Diverger*	85	50,89
	Converger	82	49,11
	Total	167	100,00

Table 2 shows that percentage of Diverger in **PK_{Jigsaw}** group is higher, that is 53.01%, than PL group, that is, 49.39%. Generally, the number of students in this research using diverger learning style is higher, that is, 50.89%.

3.2 Conceptual understanding on physics

Table 3. Post-test of Conceptual Understanding on Physics based on Learning Strategy

Learning Strategy Group	n	Score		Range	mean	SD
		Max	*Min*			
PK_{Jigsaw}	83	30	21	9	25.75	2.20
PL	84	27	17	10	21.96	2.24

Table 3 shows that learning strategy of jigsaw gives positive impact towards the conceptual understanding on Physics, where the average score of $\mathbf{PK_{Jigsaw}}$ is higher, that is, 25,75 ± 2,20, while the average score PL group is 21,96 ± 2,24.

3.3 Anova test

Table 4. Test of Between-Subjects Effects

Tests of Between-Subjects Effects					
Dependent Variable: Conceptual Understanding					
Source	***Type III Sum of Squares***	***Df***	***Mean Square***	***F***	***Sig.***
Corrected Model	690.563[a]	3	230.188	52.012	0.000
Intercept	95085.151	1	95085.151	21484.760	0.000
Strategy	616.705	1	616.705	139.346	0.000
Learning Style	50.179	1	50.179	11.338	0.001
Strategy * Learning Style	43.711	1	43.711	9.877	0.002
Error	721.389	163	4.426		
Total	96360.000	167			
Corrected Total	1411.952	166			
a. R Squared = .489 (Adjusted R Squared = .480)					

Table 4 shows that there is significant difference of conceptual understanding on Physics between experiment group and control group, where p 0.001 ($p<0.05$). Therefore, it can be concluded that jigsaw learning strategy gives significant impact, that is, the increase of conceptual understanding on Physics in the experiment class than is more significant than in the control class using direct learning.

4 Discussion

The research result shows that the student conceptual understanding on Physics in Senior High School between group using cooperative learning strategy of jigsaw type and the other group using direct learning is significantly different (p = 0,000). The students who apply cooperative learning is better than those learning on their own, and the cooperative learning strategy is higher than conventional learning strategy. Students treated using cooperative learning of jigsaw type feel that the lesson becomes more interesting, and they are able to improve deeper critical thinking [21], [22].

The different conceptual understanding between students using cooperative learning of jigsaw and students using direct learning is due to the fact that the students using cooperative learning of jigsaw type become more responsible for the success of their group [23]. The responsibility gives incentive for students to help and to support each other, reaching for the optimal result. When a student is success, he/ she will help the others. Cooperative learning of jigsaw type gives more opportunity to students to interact with other students well, either within their group or expert group.

A research conducted in Kenya applying cooperative learning strategy of jigsaw type in experiment and conventional learning in control class [24]. This research shows that students treated using cooperative learning strategy of jigsaw type have better result on their study, compared to those using conventional learning strategy. cooperative learning of jigsaw type is effective in developing conceptual understanding on Physics, especially on atom lesson, for high school students [25], [26].

According to some researches mentioned above, cooperative learning of jigsaw type gives significant influence towards the conceptual understanding on Physics. Conceptual understanding on Physics, as one of the learning results, is a result of meaning construction generated from learning messages, in the form of either nonverbal, verbal, graph, or others, that are given during the learning process. The learning process consists of interpreting, giving examples, classifying, summarizing, making inference, comparing, and explaining lesson. All aspects of conceptual understanding may be increased for the excellence of cooperative learning of jigsaw.

The research result shows that there is significant difference in the conceptual understanding on Physics between students using diverger and converger learning style. Students using converger learning style have the ability to organize and to accept information from text, to learn from their own work, as well as to use their own strategy to make some notes and to highlight important parts. They are also able to read unclear or missing parts. Students get involved actively in discussion by learning from some questions or instructions given to them. Students using converger have more opportunity to use narration, to create their own learning strategy, or to ask questions about some points that they still do not understand, and hold their communication style to talk with their instructor[27].

Some empirical evidences presented shows that learning style gives significant impact towards conceptual understanding. It is in accordance with a psychological theory stating that learning style becomes one of the variables attached to the students, so it give a lot of contribution towards student learning result. In this research, the selected learning style means converger and diverger used as moderator variables towards dependent variables, that is, conceptual understanding.

The research result shows that there is significant interaction influence between learning strategy and learning style towards conceptual understanding on Physics (p=0,002). The interaction between learning strategy and learning style towards conceptual understanding shows that there is learning paradigm change leading to constructivism. It is in accordance with a statement that one of the basic changes in the last year is the learning paradigm change from behavioristic paradigm into constructivism paradigm. Constructivism, as a foundation of cooperative learning strategy of jigsaw type creates creative thinking. Learning is the process of creating environment

to generate the will to learn [28]. Learning is a construction process (by learners), not instruction (to learners)[29].

There is interaction between reading skill and questions type towards learning result[30]. Based on the theoretical and empirical review above, it can be concluded that the implementation of cooperative learning strategy of jigsaw type gives significant influence towards the conceptual understanding, of which learning result is different, based on the student learning style. Interaction between learning strategy of jigsaw type and learning style of converger significantly improves the conceptual understanding on Physics at Senior High School students. It means that high school students have combined learning style of abstract conceptualization character and active experimentation on Physics subject when they are using cooperative learning strategy of jigsaw type.

In this research, students in experiment class treated using cooperative learning of jigsaw type have better conceptual understanding on Physics than those in control class. It can be concluded that students have more opportunity to use their knowledge on Physics, as they do in the research. Moreover, students may also participate in the learning process actively during discussion, either in or outside class. In the previous research, cooperative learning teaches students to learn from different source and to construct their knowledge based on their need, so they will have their own cognitive character. The procedure of cooperative learning of jigsaw is effective due to the fact that students are able to create comfortable and supportive learning environment. They can be more active to get involved in the learning process, and they finally get benefits in mastering the lesson reflected into the good score.

5 Conclusion

The research result supports the theory and the previous researches stating that

- There was significant difference in conceptual understanding between students treated using different learning strategies, namely cooperative learning strategy of jigsaw type and direct learning.
- There was significant difference in the conceptual understanding on Physics between students whose learning style was converger and students whose learning style is diverger.
- There was interaction influence between learning strategy and learning style towards the conceptual understanding on Physics.

Therefore, it can be proven that cooperative learning strategy of jigsaw type significantly depends on the student learning style towards the high school students' conceptual understanding on Physics

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8 Authors

Amiruddin Kade has done Physics Education and is Faculty of Teacher Training and Education at Tadulako University, City of Palu, Indonesia **Email:** puangamir@yahoo.com

I Nyoman Sudana is from Degeng Learning Technology from State University of Malang, City of Malang, Indonesia. **Email:** nyoman.sudana.d.fip@um.ac.id

Muhammad Nur Ali is a Faculty of Social and Political Sciences, Tadulako University, City of Palu, Indonesia. **Email:** ali.mnur@yahoo.com

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