The Effect of Mind Mapping and Learning Style on Concepts Mastery and Students' Representation Skills

D. Lengkana[1], and A. Surbakti[1], and D. Amala[1]

[1] Biology Education, FKIP UNiversitas Lampung,
Jl. Prof. Dr. Sumantri Brojonegoro No. 1 Bandar Lampung, Lampung, Indonesia

Email: dewi.lengkana@fkip.unila.ac.id

Abstract. This study aims to explore the effect of 1) students' mind mapping towards concepts mastery; 2) students' learning styles towards concepts mastery; 3) interaction between mind mapping and learning styles towards concepts mastery and 4) students' mind mapping towards students' representation skills on respiratory system. The sample of this study were 86 students of class VIII MTs N 1 Pesawaran which is selected randomly technique. The research instrument used pretest-posttest to know the students' mastery concepts and representation skills improvement and questionnaires to identify students' learning styles. The design used was nonequivalent pretest-posttest control group design. Data of students' concepts mastery and representation skills in the form of pretest-posttest and n-gain analyzed using Ancova and Least Significant Difference Test (LSD). The results showes that 1) students' mind mapping have a significant effects of students' concepts mastery; 2) students' learning styles have a significant effects of students' concepts mastery; 3) there is no interaction significantly between mind mapping and learning styles towards students' concepts mastery; and 4) there is interaction significantly between mind mapping and learning styles towards representation skills.

Keywords: *mind mapping, learning styles, concepts mastery, representation skills*

1. Introduction

Visualization of the abstract concepts can strengthen learners' memory of the concepts learned [1]. Visual thinking can be a bridge from abstract-verbal to clear form so that there is a development of thinking and understanding of concepts related to problem solving [2]. The key to success in facing the challenges of the 21st century, namely problem solving is to "literate science" because individuals who are literate in science can use the scientific information they have to make decisions when facing problems in life. The idea of modern education namely literacy used as learning to understand ideas through the media of words that arises from the subject of reading and writing [3].

Learners can be said to master learning when students can construct the meaning of learning messages, both oral, written, and graphic. In the respiratory system material can be delivered orally both with lectures, discussions, and presentations. In addition, the characteristics of the respiratory system material require writing in the form of notes, graphics, and images because they are related to organs and respiratory mechanisms. Mastery of the concepts and structure of matter makes a material comprehensively understood for students easier to remember the material. The optimal mastery of concepts by students will have enhancing students' achievement [4].

To master a concept students are asked by educators to take notes in order to facilitate students remembering the knowledge learned. Observations from students' notes show that their ability to take

notes is still diverse which can be seen from their notes only in long written form without pictures or symbols with irregular sentence placement. Few students take notes using images, but the image is not in accordance with the concept of the subject matter. The ability to take notes can help students build concepts and make it easier to develop their abilities. Ineffective note taking can cause the learning process to be less meaningful and the mastery of students' concepts of subject matter becomes low.

Questionnaire results and educator interviews in the field of science learning with researchers conducted at Public MTs who have implemented the curriculum 2013. Respiratory system material is in basic competencies 3.9 so the competencies that must be achieved by students are analyzing and understanding. In addition, the material characteristics of the Respiratory System in humans are abstract and related to the processes that occur in the body, as well as many terms, making it difficult for students to understand the material. To master the concepts needed an effort to note which can contain picture, symbols, and writing that can connect the concept comprehensively. While during the learning process of science materials has only focused on the ability of students to only memorize with lecture learning methods that do not consider the ability of students to make notes, this causes students not to be actively involved in getting learning information, so that in this material students get an average score is 60. This value does not meet the minimum completeness value standard, which is 75.

The mind mapping method is a creative note-taking method that makes it easier for individuals to remember a lot of information by forming a pattern of interrelated ideas, with the main topic in the middle, while subtopics and details become branches. The mind mapping note taking method allows educators to communicate reciprocally with students. The method of mind mapping is also unique, because something unique is easier for students to remember [5].

The use of mind mapping note taking method can make students not only hear explanations from educators, but also take an active role in the learning process in order to understand and master the material. The method of note taking mind mapping in learning is used because the characteristics of students at middle school age are formal operational stage where students can think abstractly and logically. At this stage, intelligence is shown through the logical use of symbols related to abstract concepts [6]. Bruner recognized three modes of representation that must be present at all stages of development. These three modes of representation (enactive, iconic, and symbolic) are not necessarily hierarchical, but some learning can only be achieved by passing through each type in a specific developmental order [6].

The study had been able to show that mind mapping is more effective in improving the academic performance of students in Physics when compared with mastery learning approached and conventional teaching method [7]. In addition, there are findings that emphasize that having knowledge represented in mind mapping would significantly affect learners' understanding level and speed. Such knowledge representation methods have positively affected students' perception about the understanding of key concepts implicit in challenging texts in an easy and better way than the traditional ways [8]. This finding motivate researchers to conduct research with the title "The Effect of Mind Mapping and Learning Style on Concepts Mastery and Students' Representation Skills". The purpose of this study is to determine the effect of mind mapping on mastery of concepts; learning styles towards mastery of concepts; the interaction between mind mapping and learning styles towards mastery of concepts; and students' mind mapping towards students' representation skills on respiratory system.

2. Metodh

This research was conducted in the Academic Year 2018/2019 at MTs Negeri 1 Pesawaran. The population in the study were all class VIII MTs Negeri 1 Pesawaran which amounted to 317 students divided into 9 classes. The sample of this study were 2 experimental classes and 1 control class, amounting to 86 students.

This research is a quasi experimental research, with the research design is a pretest posttest non-equivalent control group design which can be seen in table 1 below.

Table 1. Pretest-Posttest Non Equivalent Control Group Design

Class	Pretest	Treatment	Posttest
Experiment	O_1	A_1	O_2
Control	O_3	A_2	O_4

A1 = Mind mapping method
A2 = Lecture method
O1, O3 = Pretest
O2, O4 = Posttest

The procedure in this study consists of three stages, namely the preparation, implementation and final stages. At the preparation stage, researchers conducted a preliminary study, study literature, study the curriculum, compile learning tools, compile research instruments, and validate instruments by the supervisor, and test the validity, reliability, level of difficulty, and the power of different test instruments on students.

The stage of conducting the research, the first step is to provide a questionnaire sheet to identify the learning style of students, give pretest to measure mastery of concepts and representation skills of students, and provide training to students in making mind mapping before being given treatment, then applying mind mapping methods in learning, after being given treatment, posttest was done to measure the increase in mastery of students' concepts.

The final stage of the research is, processing data from the identification of students 'learning styles, measuring students' skills in making mind mapping with rubric adaptation from Ohassta. processing the pretest and posttest data, then comparing the results of test data analysis before treatment and after being treated to determine whether there is a difference in mastery of concepts students between learning with the method of mind mapping with the common note taking method.

The type of data in this study is quantitative data. Data collection uses test instruments in the form of multiple choices to measure mastery of students' concepts refers to aspects of concept mastery indicators according to explaining, comparing, exemplifying, summarizing, classifying, inferring, and interpreting. To evaluate the ability of representation, a rubric with 5 levels of scoring is used. One form of a rubric to assess students' representation ability according to Hwang is shown in table 2. Questionnaire identification sheets for learning styles. The test instrument before being used in the research is first conducted a feasibility test of validity, reliability, level of difficulty and power difference.

Table 2. Representation Rubric

Score	Criteria
5	Correct answers, correct explanations, and representation elements such as icons, symbols, labels, graphics, or tables are true and complete
4	Correct answers, inaccurate explanations, and representation elements such as icons, symbols, labels, graphics, or tables are true and complete
3	Correct answers, incorrect explanation, and representation elements such as icons, symbols, labels, graphics, or tables are incorrect and incomplete
2	Incorrect answers, incorrect explanations, and representation elements such as icons, symbols, labels, graphics, or tables are incorrect and incomplete
1	Incorrect answers, incorrect explanations, and representation elements such as icons, symbols, labels, graphics, or tables are incorrect and incomplete

The analysis technique is carried out for quantitative data in the form of pretest, posttest, and n-gain using the Ancova statistical hypothesis test. Before the hypothesis testing is carried out, a prerequisite test is conducted, namely the normality test using the Kolmogorov smirnov test and homogeneity test using the Levene's Test of Equality of Error Variances. The N-gain score is interpreted according to the interpretation in table 3.

Table 3. N-gain criteria

Gain	Interpretation
$0,7 \leq g \leq 1,0$	High
$0,3 \leq g < 0,7$	Moderate
$0,0 < g < 0,3$	Low

3. Discussion

The learning styles of students obtained from the distribution of questionnaires identifying the learning styles of 86 students, it is known that in the experimental class the visual learning styles were 25 students, auditory as many as 12 students, and kinesthetic as many as 11 students. While in the control class, it was known that visual learning styles were 14 students, auditory as many as 11 students, and kinesthetic as many as 13 students. The visual and auditory learning style in the experimental class based on figure 1. is more than the kinesthetic learning style, whereas in the control class the visual and kinesthetic learning style is more than the auditory learning style.

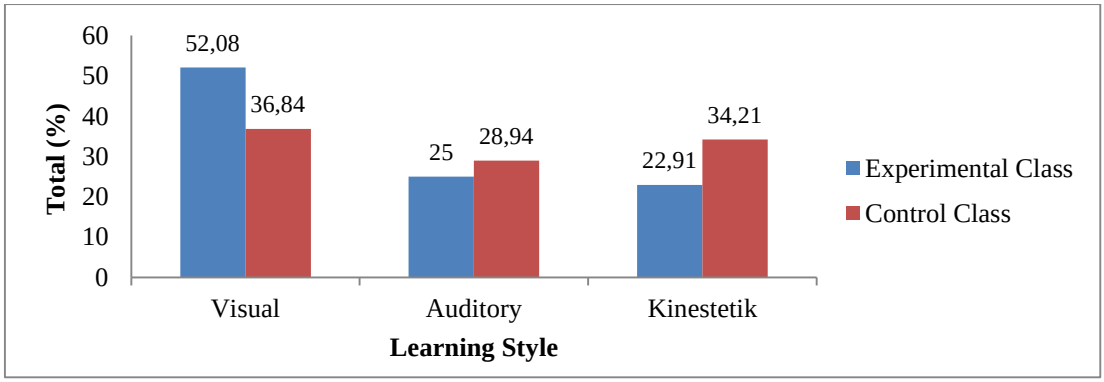

Figure 1. Comparison of Learning Styles of Students

The effect of the method of mind mapping note taking on mastery concepts, learning styles on mastery of concepts, interaction between mind mapping and learning styles towards mastery of concepts, and interaction between mind mapping and learning styles towards representation skills in this study were tested with Ancova. Before testing using Ancova, prerequisite tests were carried out, namely variance normality and homogeneity which can be seen in table 4.

Table 4. Normality and Homogeneity Test Results

Data	Metodh	Normality Test (*Sig.*)		Homogenity Test (*Sig.*)	
		Pretest	Posttest	Pretest	Posttest
Concepts mastery	*Mind mapping*	0,363	0,282	0,226	0,146
	Common note taking	0,069	0,321		
Representation skills	*Mind mapping*	0,098	0,271	0,698	0,463
	Common note taking	0,244	0,332		

The data from the experimental class for concepts mastery and representation skills pretest normality test were obtained by sig. 0.363 and 0,098, posttest was obtained by sig. 0.282 and 0,271. The normality test the control class for concepts mastery and representation skills pretest was obtained sig. 0.069 and 0,244, posttest was obtained sig. 0.321 and 0,332. The results of the normality test data mastery of both pretest and postses concepts in the two sample classes indicate that the data are normally distributed (sig.> 0.05). The homogeneity test of the pretest and posttest mastery concept data has a significance value of 0.226 and 0.146, furthermore pretest and posttest representation skills data has a significance value of 0.698 and 0,463 which indicates that the data of mastery concept and representation skills is homogeneous (sig.> 0.05). After fulfilling the prerequisite test, a statistical test using Ancova was performed which showed the results as in table 5.

Table 5. Test Results for Ancova Mastery Concepts

Source	F	*Sig.*
Corrected Model	10,152	0,000
Intercept	18,701	0,000
Metodh	10,434	0,002
Learning Styles	9,089	0,003
Metodh*Learning Styles	1,753	0,189

The effect of note taking method on mastery of concepts based on the results of statistical tests in table 5. obtained a significance value of 0.002 (sig. <0.005). This is also in accordance with the BNT test (see in table 6) the mastery of concept values in the two note taking methods obtained a significance value of 0,000 <0,005. This is supported by data on the achievement of mastery of concepts in students who learn by using the method of mind mapping note taking higher than students who learn with the common note taking method that can be seen in figure 2.

Table 6. Results of the LSD Test of Mastery Concepts on Both Note Taking Methods

(I) Note Taking Method	(J) Note Taking Method		*95% Confidence Interval for Difference*[a]	
		Sig.[a]	*Lower Bound*	*Upper Bound*
Mind Mapping	Common Note Taking	0,000	0,140	0,339
Common Note Taking	*Mind Mapping*	0,000	-0,339	-0,140

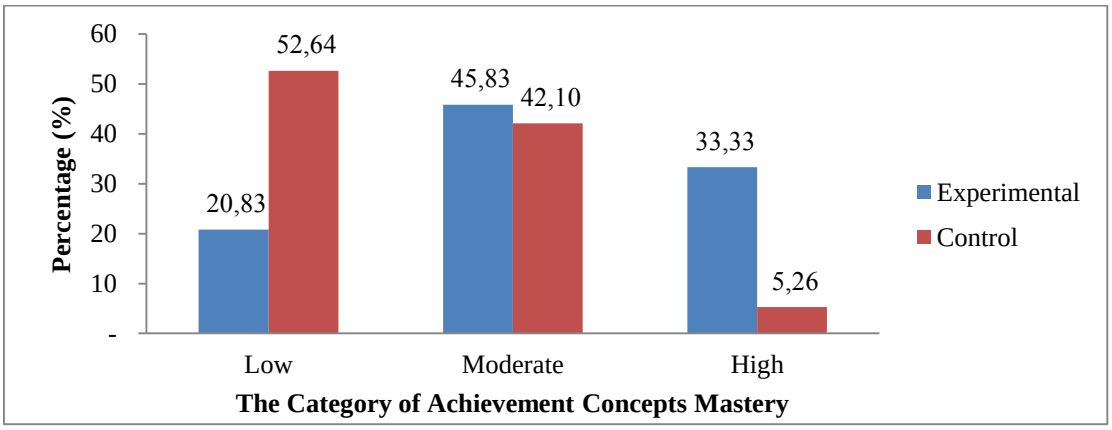

Figure 2. Differences in Achieving Mastery of Concepts

Mastery concepts of students who learn by using the mind mapping note taking method is higher than the common note taking method because students in making mind mapping are required to be able to determine the main topic and connect between concepts. In addition, the use of symbols, images, and with the use of many colors makes it easier for students to remember interconnected concepts. The students with common note taking do not connect between concepts and do not use images, symbols, and many colors, so students are less able to integrate the concepts that are recorded. This is supported by the opinion of Paivio which states that external representation will activate verbal and non-verbal systems in the human memory system [9]. The verbal system specifically acquires knowledge related to language. Non-verbal systems are responsible for processing knowledge involving images. The formation of visualization concepts requires a number of information, data, concepts, or objects that are arranged so as to provide meaningful understanding [9].

Students learning styles influence the mastery of students' concepts, this is based on the results of the analysis using Ancova statistical tests in table 5. Achieving mastery of concepts in figure 3. shows that students who have a higher visual learning style, compared to students who have a style kinesthetic and auditory learning in the experimental class, while in the control class that uses the common method of note taking the highest achievement of concept mastery are students with auditory learning styles.

Students with visual learning styles have a higher level of concepts mastery than auditory and kinesthetic (Figure 3) because students can pay attention to presentations by students and educators, and make mind mapping note taking that help students visually see relationships and patterns of new information. Through mind mapping, students can make connections, see patterns, access related memories that have been stored before, and develop memory paths [10]. Students with visual learning styles will easily receive information using two-dimensional assistance such as images, graphics, models, and others [11].

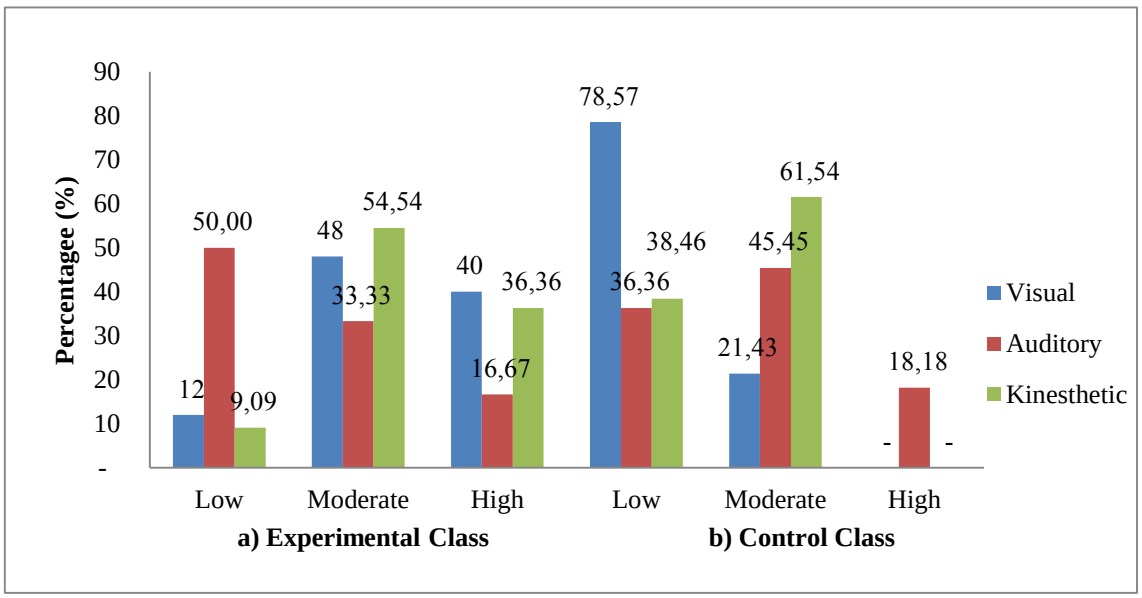

Figure 3. Comparison of Achievement of Mastery Concepts with Different Learning Styles

In the experimental class the achievement of mastery of the concept was mostly in the high category by visual and kinesthetic students while in the control class by auditory students. This can be because students during learning do mind mapping activities that are in accordance with their own creativity. This mind mapping activity involves hand movements to make maps, paths and connections between concepts. This is in accordance with states that a continuous process to connect concepts can improve brain work [12]. The development of representation capabilities is carried out in each phase

of learning through reading activities, implementing, translating from phenomena to images, complex process charts and diagrams, concept maps and mind maps [9].

Students with auditory learning styles have the lowest level of concept mastery achievement in the experimental class (Figure 3) because students during learning are focused on listening to the educator's explanation, listening to the discussion, and presenting the mind mapping that has been made. This is in accordance with the opinion that students with auditory learning styles at the time of presentation in front of the class, causing long-term memory storage that affects the ability to connect concepts [10]. However, during the learning process the educator does not explain too many concepts in detail to the students, and only a few students present the results of the mind mapping that has been made.

Table 7. Test Results for Ancova Representation Skills

Source	F	*Sig.*
Corrected Model	33.686	0.000
Intercept	32,244	0.000
metode * gayabelajar	33,686	0,000

The method of note taking with learning styles has an interaction with students' representation skills based on the results of the analysis using Ancova statistical tests in table 7. The average N-gain of the experimental class representation skills is higher than the control class with moderate increase in interpretation while the control class is low increase (Figure 4). Representative skills of students can be predicted based on ways of disclosure through oral, written in the form of symbols, images, graphics, or tables [13]. The results of this study are in accordance with the results of the study which concluded that by using the mind mapping method, students' skills in integrating knowledge into multi-representation subjects developed [14].

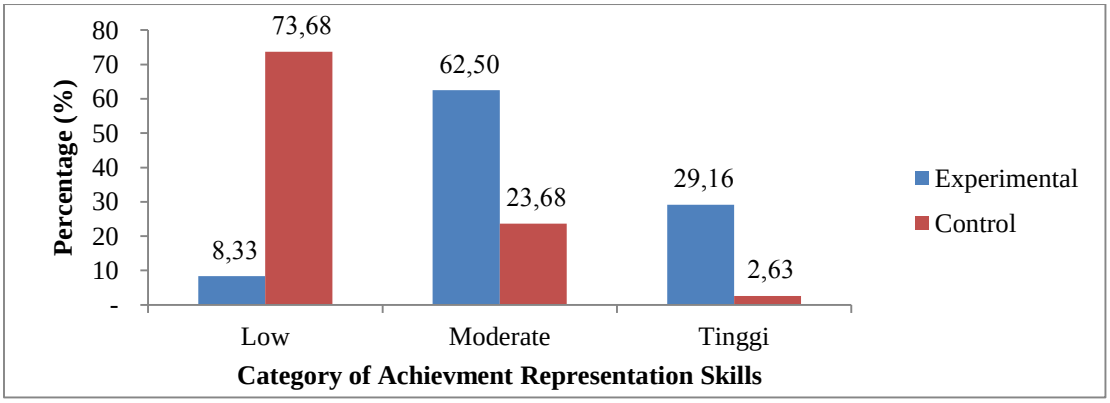

Figure 4. Differences in Achievement of Representation Skills

The level of representation skills that can be achieved by students can be seen in table 8. It shows that the highest level (level 5) in the experimental class is found in the concept of respiratory organs and disorders, and efforts to maintain the health of the respiratory system. In the control class the highest level of skill representation can be achieved by students is level 4. Achievement of the highest level on the concept because students have had prior knowledge of the concept before learning is given. Achieving this highest level also shows that students are able to make a comparison table to answer the problem. This is in accordance with the opinion of Schulman that students build an understanding of their initial knowledge [15]. New knowledge relates to the things that already known to students by applying initial knowledge with new experiences and ideas [15]. According to Brown

that initial knowledge is arranged in a scheme, where the initial mental representation obtained from old experiences helps students understand new things [15].

The level of representation skills in table 8 below shows that the level most achieved in the experimental class is level 3, meanwhile, the control class is level 2. While students using mind mapping are required to summarize the material and projecting into a map such as symbols, images, and other elements of representation. This is supported by the opinion of Solso which states that external representation will activate verbal and non-verbal systems in the human memory system [9]. Verbal systems are related to language and non-verbal systems involve images / images. In addition, Hill's opinion states that images and words function as impulses received through the senses and stored in memory and transmit them to working memory that organizes words, sentences, and images as verbal representations for processing in the long-term memory which will be more easily recalled if the information is represented in two ways [9].

Table 8. Achievement of Student Representation Skills in Experimental and Control Classes

Concepts	Level	Number of Students (%)							
		Experimental Class				Control Class			
		Learning Styles			Total	Learning Styles			Total
		V	A	K		V	A	K	
Respiratory process	1	8.0	8.3	0.0	6.3	21.4	0.2	15.4	19.4
	2	36.0	25.0	9.1	27.1	71.4	0.7	38.5	58.3
	3	40.0	50.0	54.5	45.8	7.1	0.1	38.5	19.4
	4	16.0	16.7	36.4	20.8	0.0	0.0	7.7	2.8
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Respiratory organs	1	4.0	8.3	9.1	6.3	0.0	12.5	0.2	8.6
	2	8.0	33.3	0.0	12.5	78.6	50.0	0.8	71.4
	3	44.0	50.0	45.5	45.8	21.4	37.5	0.1	20.0
	4	36.0	8.3	36.4	29.2	0.0	0.0	0.0	0.0
	5	8.0	0.0	9.1	6.3	0.0	0.0	0.0	0.0
Disorders and efforts to maintain the health of the respiratory system	1	4.0	16.7	9.1	8.3	35.7	10.0	15.4	21.6
	2	8.0	0.0	0.0	4.2	21.4	30.0	38.5	29.7
	3	52.0	33.3	18.2	39.6	42.9	40.0	38.5	40.5
	4	24.0	41.7	27.3	29.2	0.0	20.0	7.7	8.1
	5	12.0	8.3	45.5	18.8	0.0	0.0	0.0	0.0
Respiratory volumen	1	4.0	16.7	0.0	6.3	21.4	0.0	15.4	13.5
	2	24.0	16.7	27.3	22.9	35.7	0.0	23.1	21.6
	3	60.0	50.0	63.6	58.3	42.9	100.0	61.5	64.9
	4	12.0	16.7	9.1	12.5	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Description: V (visual); A (Auditory); K (Kinesthetic)

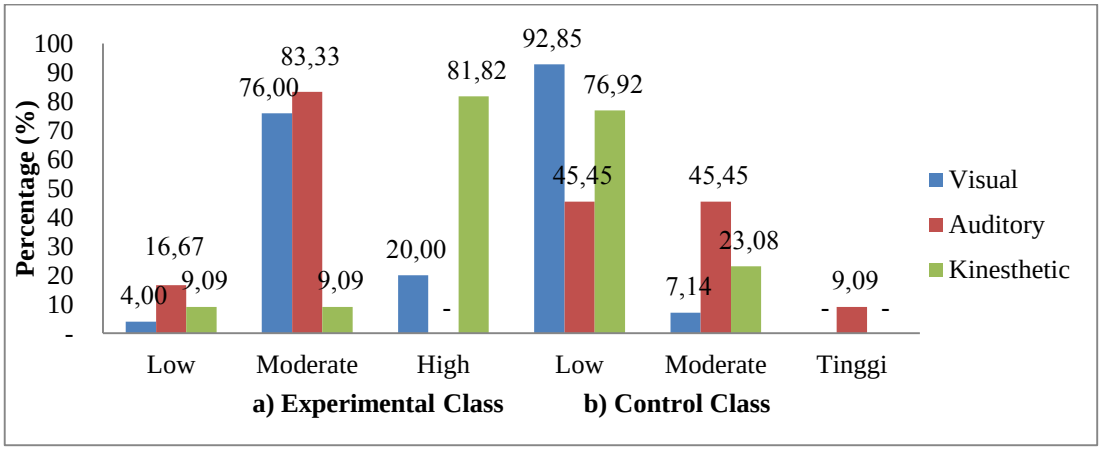

Figure 5. Comparison Chart of Achievement of Representation Skills

Student representation skills are seen in table 8. and Figure 5. shows that the highest level in the experimental class is mostly achieved by students with kinesthetic and visual learning styles while in the control class by students who have auditory learning styles and kinesthetic learning styles. This shows that the achievement of the representation skills of students with auditory learning styles is better then visual and kinesthetic learning when learning with common note taking because it is accompanied by the use of lecture methods. The best way to learn for these learners is to learn from verbal lectures or through class discussions or listening to others. The tones of voice, pitch, speed etc. are important to them. If a lesson is given to them in the written form, it may not be that much beneficial to them until they don't read it aloud or use a tape recorder. Written information may have little meaning until it is heard [16]. Students with kinesthetic and visual learning styles can improve representation skills by making mind mapping (Figure 5) because of hand movements in making mind mapping. This is in accordance with the opinion which states that body cues and body movements can stimulate the increase of pathways for information storage [12]. The development of representation capabilities is carried out at each phase of learning through reading activities, implementing, translating from phenomena to images, complex process charts and diagrams, concept maps and mind maps [9].

4. Conclusion

The mind mapping note taking method influences the mastery of students' concepts. This is proofed by the increase in higher concept mastery of students who use mind mapping note taking methods rather than common note taking. This implies that Mind mapping has the capacity to help students associate ideas, think creatively, and make connections that might not be achievable in the common note taking method. Learning styles of students also influence the mastery of students' concepts. Achievement of the highest concept mastery by students with a visual learning style, however, the interaction between the method of mind mapping note taking with students learning styles does not affect the mastery of students' concepts. This is because the achievement concepts mastery of students with higher auditory learning styles uses the common note taking method. The interaction between the method of mind mapping note taking with the learning styles of students influences the representation skills of students, this is proofed by the higher representation skills of students in the experimental class compared to the control class in students with kinesthetic and visual learning styles.

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