



Note-taking roundhouse diagram strategy: improving student retention on body defense system concepts

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ABSTRACT

Note-taking Roundhouse diagrams strategy is a students' conceptual framework for new notes. This study aims to improve student retention on body defense system material through note-taking roundhouse diagram strategy. The method used was the one-group pretest-posttest design. The sample in this study was taken by simple random sampling technique. The number of samples in this study was 30 students. The instrument used in the study was multiple choice. This research was conducted during six meetings. Three meetings using roundhouse diagram with pretest and posttest. After four weeks, three more meetings were held to collect the second posttest (retest). The data were analyzed by t-test statistical analysis. Based on the results of the t-test statistical analysis at a significant level $\alpha = 0.05$, it can be seen that $t \text{ count} > t \text{ table}$ for short-term retention and long-term retention. The retention category also showed very satisfying results. Average results of N-gain score for short and long-term retention were in excellent category. It can be included, the note-taking roundhouse diagram strategy on the body's defense system concept can improve student retention.

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INTRODUCTION

Learning is a critical process of interaction between teachers and students in a learning environment (Inah, 2015; Puspita, Kurniawan, & Rahayu, 2017). A Study has a meaning that is an attempt by someone to obtain a new change in behavior as a whole, as a result of his own experience in interacting with his environment (Slameto, 2010). The presence of the teacher in the learning process plays an important role. The teacher is directly involved in the formation and intellectual development of students (Juhji, 2016; Nurhaidah & Musa, 2016; Warsono, 2017; Dasem, Laka, & Niwale, 2018; Hasanah, 2019). Therefore, the teacher must have the skills in choosing the right strategy when delivering material to students, so that the material can be accepted quickly and support the learning outcomes. In the era of globalization and information, to achieve the desired learning outcomes, students are required to do the learning process correctly and adequately (Mansyur, Salahuddin, & Ismail, 2018).

The low students' learning outcomes can be caused by weak thinking ability and understanding of concepts. When the demands of learning on material concepts is high, students need an appropriate specific strategy in building their knowledge (Barlian, 2013; Harjali, 2016; Kusumawati, Sumardi, 2016). Students can readily accept knowledge if it is built in the mind of students themselves as striving to organize experiences to schemes (Dahar, 2011).

Notes, drawings, and diagrams are examples of visuals that can be used to help students build schemes. Well-organized notes can be used to show relationships, strengthen information, and identify lost information (Ward & Lee, 2002). Taking notes in writing is something important, recording information that is heard and seen while the lesson is taking place, making it easy to remember about points, concepts, and see the interrelation of both (Dewi & Indrawati, 2014; Cristal, Sano, & Yusri, 2013).

Taking notes helps students build the knowledge they want to remember. The ability of students to remember a learning material is called retention. Retention is the ability of students to remember material that has been taught by the teacher at a particular time. Retention means student can remember information in a short as well as in a relatively long period. According to Kintsch (1970), that retention is an embodiment of learning outcomes. This means that when student retention is excellent, the learning outcomes will also be useful.

Based on the observations of researchers, the activity of taking notes was limited to transferring writing from textbooks or writing explanations from teachers. Note-taking activities like these tend to produce notes that are less interesting and make students lazy to read the notes. Some noted strategies include using mind maps, vee diagrams, fish bones, and roundhouse diagrams. The strategy of taking notes using a roundhouse diagram is a note-taking strategy that involves the images, colors, and keywords (Mccartney & Wadsworth, 2012). The persistence of the material learned so that it is not easy to forget can be done by using keywords. This is because sentences that are strange, meaningful, or that involve visual elements are the sentences that are easiest to remember (Solso, Machin, & Maclin, 2007). Images are a way that can also be used to convey what is thought effectively and can easily be remembered.

When information enters our memory system (from sensory input), it is necessary converted into a form that can be overcome by the system so that it can be stored. Information can be changed and coded in three ways, visual or icon, acoustic or sound, and semantic or meaning. Evidence shows if the principle encoding system in short term memory (STM) is acoustic coding. The principle coding system in long term memory (LTM) seems to be semantic coding (meaning). However, the information in LTM can also be coded visually and acoustics. If we cannot remember something, that is maybe because we cannot remember again. The difference between STM and LTM is noticeable. STM is stored and retrieved sequentially while LTM is stored and taken by the association Mcleod (Mcleod, 2007)

This is supported by Reed (2011), who explains that images tend to be easier to remember compared to words that are concrete, and are usually easily stored in memory compared to abstract words (Reed, 2011; Khairroh, Rusilowati, & Nurhayati, 2014). Images can also increase imagination,

which makes memory performance increase (Ami, Susantini, & Raharjo, 2012). Meanwhile, Hackney & Ward (2002) explains that students' memories can be strengthened by visual information and writing in the form of diagrams.

The strategy of note-taking roundhouse diagrams is very suitable for use in biological material that contains many concepts and is difficult to understand. This is because the placement of information in the roundhouse diagram can accommodate the ability of the eye and can strengthen brain processes (Ward & Wandersee, 2002). Biological material that contains many concepts and is difficult to understand, one of which is the body's defense system material. The body's defense system material consists of abstract concepts and contains concepts that are very complex so difficult for students to understand (Alfiraida, 2018). Often students' understanding of this concept is still not optimal, for example, activities on the human body's defense system are challenging to explore in detail because there are no direct objects that can be learned — precisely the body's defense response, such as non-specific response and specific response.

The material of the body's defense system is divided into three scopes, namely the functions and components of the body's defense system, the response of the body's defense system, also disease and its prevention in the body's defense system. The purpose of each learning session is dependent on the learning is given to students during the day. Overall it can be seen and felt that the purpose of learning is to explain the mechanism of the body's defense system against foreign objects in the form of antigens and germs because this type of body defense system material makes roundhouse diagrams very suitable for use. The reason is that the roundhouse diagram can help students to learn complex concepts and retain that knowledge (Hackney & Ward, 2002).

Several studies report that the application of roundhouse diagrams can improve students' cognitive and metacognitive abilities, motivation, and learning outcomes (Wibowo, Asri, & Titik, 2012; Rukmana, Suciati, & Indrowati, 2013). However, there are no studies report the effect of roundhouse diagrams on student retention in learning biology, especially in the body's defense system concept. There has not been much research on the relationship between retention and the body's defense system material. However, retention studies have been carried out on other biological concepts. Lubis & Simatupang (2014) explained that there was an increase of 76,22% of the retention power of students towards biological concepts through the use of Adobe Flash media in the direct learning model. However, the use of this media has not been able to facilitate students to build their knowledge where students determine their images and keywords that they want as a representation of the concept they want to remember.

This study is critical in answering the problem of students' retention, which is still low. The note-taking roundhouse diagram strategy can overcome weak student retention abilities. The note-taking roundhouse diagram strategy can help students understand the difficult concepts of the body's defense system. Also, it can make learning more enjoyable.

METHODS

Research Design

The method used in this study is an experimental design. The research design used was the one-group pretest-posttest design (Sugiyono, 2012). In this research design, there was a pretest before treatment. Thus the results of the treatment can be more accurate because it can compare the situation before treatment being given. This study has six meetings. Three meetings using a roundhouse diagram with a posttest at the end of the lesson and three subsequent meetings doing a retest after four weeks from the posttest. The research design is described in Table 1.

Table 1
One Group Pretest-Posttest Design

Pretest	Treatment	Posttest 1	Interval	Posttest 2 (Retest)
O ₁	X	O _{2a}	Four weeks	O _{2b}

Population and Samples

The population in this study were 61 students, namely all students of class XI IPA in Indralaya Utara, South Sumatera. The sample selection in this study used the simple random sampling technique, which is a sampling technique where all individuals in the population have the same opportunity to be selected as a sample (Sugiyono, 2012). Random sampling is by lottery, which is by taking an opportunity for each individual to become a sample member. In this study, the class name was written on paper, then rolled and put into a glass and shook it until one paper came out. The class name on paper will be the sample class. The sample obtained in this study was class XI IPA, with a total of 30 students.

Instrument

The instruments used to collect data in this study were written tests. Written tests are used to obtain data about student retention results. The instrument in this study was named the Human Body Define Concepts Test (HBDCT). The final test was divided into two, namely the final test on short-term retention (posttest) and the final test on long-term retention (retest). The final test on short-term retention (posttest) was done after learning was carried out, and long-term retention (retest) was carried out four weeks after the posttest. The final test helps researchers to see the use of roundhouse diagrams on student retention scores. The written test instrument consisted of ten multiple-choice questions for each meeting. Each question was made of a grid-based on the purpose of learning, question indicators, and cognitive process level. The instrument was equipped with a grid and test items arranged by the researcher based on the learning objectives to be achieved in the learning process. The instrument used in this study was considered as valid and reliable. The validity and reliability of the instruments in this study were tested using ANATES V4 software. Also, the instrument was examined by a supervisor.

Procedure

This research was conducted during six meetings for one month. Three meetings using roundhouse diagram with pretest and posttest. After four weeks, three more meetings were held to collect the second posttest (retest). The steps of learning during three meetings using roundhouse diagram were 7 phases (Table 2), and student activities are described in Figure 1.

Table 2

The Steps of Learning

Step	Description
1	The teacher opens learning by conveying apperception, motivation, learning objectives. After that, students work on the pre-tests provided.
2	Students pay attention to the teacher's explanation of the material defense system of the human body.
3	Students are divided into five groups consisting of 6 students.
4	Students discuss with group members and make notes on the roundhouse diagram, with the following steps. <ol style="list-style-type: none">Identify the main topics of the material being studied and understand what information should be targetedWrite the main title by using "dash (-)" and the words "and" for subtitles. The main title and subtitle are written on the inner circle, which is divided by the S curve. The main headline is placed centrally, while the subtitle is placed on the edge of the S curve.Write down the objectives to be achieved by making the roundhouse diagram. This goal provides the focus and direction to be achieved from the concept being studied.Divide the whole concept into seven or five parts. The concept is made into a short question that contains core ideas.Summarize each concept with complex reminder sentences according to its own words (paraphrasing) or by keywords. These concepts are then included in the roundhouse diagram. Placement begins on the during with the 12 o'clock position and moves clockwise.

Step	Description
f.	Create pictures related to reminder sentences. Images (icons) are made to connect one concept with another concept.
5	The results of the notes on the roundhouse diagrams of each group are posted on the board, so all students know the work of the other groups.
6	The teacher checks whether there is a wrong concept in the student notes in the roundhouse diagram of each group.
7	At the end of the learning, students work on the posttest



Figure 1. Note-taking using roundhouse diagram

Data Analysis Techniques

The obtained score to determine student retention is the sum of each student's answer score. The formulation to determine the initial and final test scores is to compare the obtained scores with the maximum score multiplied by one hundred.

$$\text{Final Score} = \frac{\text{Obtained Score}}{\text{Maximum Score}} \times 100$$

(Sudijono, 2012)

The acquisition of student learning outcomes after and before using a roundhouse (gain) diagram is calculated by looking at the difference between the posttest scores and the pretest scores. After that, the normalized gain was calculated. Its function is to maintain no assumption of the same acquisition value between two or more students, and learning achievement is still based on the initial and final test scores for which the assessment standards have been determined.

$$\text{Normalized Gain} = \frac{\text{Gain (Posttest Score} - \text{Pretest Score)}}{\text{Ideal Score} - \text{Pretest Score}}$$

(Hake, 2002)

The percentage of student retention was calculated by comparing the retest score with the posttest score multiplied by one hundred percent. The retention percentage categories can be seen in the following [Table 3](#).

$$R = \frac{\text{Skor Retest}}{\text{Skor Postest}} \times 100\%$$

(Haibach, Reid, & Collier, 2011)

Table 3

The retention percentage categories.

Retention (%)	Category
80 – 100	Very Good
70 – 79	Good
60 – 69	Sufficient
50 – 59	Less
0 – 49	Very Less

(Syah, 2016)

Hypothesis testing was done by the t-test. It aimed at proving the use of roundhouse diagrams in biology learning in increasing students' retention. Ho of this study stated there was not an improvement in students' retention, while Ha stated a significant improvement in students' retention.

RESULTS AND DISCUSSION

This study presents learning that can increase students' retention — packed with exciting and undull learning activities. All students have the same opportunity when learning to use this strategy. Not only that, from this study, students have valuable and meaningful experiences so that they can strengthen their memory. The average scores of students' pretest and posttest, gain, n-gain can be seen in the following [Table 4](#).

Table 4

Average Results of Pretest-Posttest, Gain, and N-gain Scores

Average	Scores				N-Gain Category
	Pretest	Posttest	Gain	N-gain	
	41,72	77,42	35,70	0,60	medium

[Table 4](#) shows that the average posttest of students improved compared with the average pretest, the pretest score of students was 41,72; the posttest score was 77,42. The gain score was 35,70, and the n-gain score was 0,60, so that the n-gain was in the medium category. This increase in score indicates an increase in students' short-term retention after using the strategy of taking a roundhouse diagram. The average pretest-retest test, gain, and an n-gain score of students can be seen in the following [Table 5](#).

Table 5

Average Results of Pretest-Retest, Gain, and N-gain Scores

Average	Scores				N-gain Category
	Pretest	Retest	Gain	N-gain	
	41,72	64,62	22,90	0,38	medium

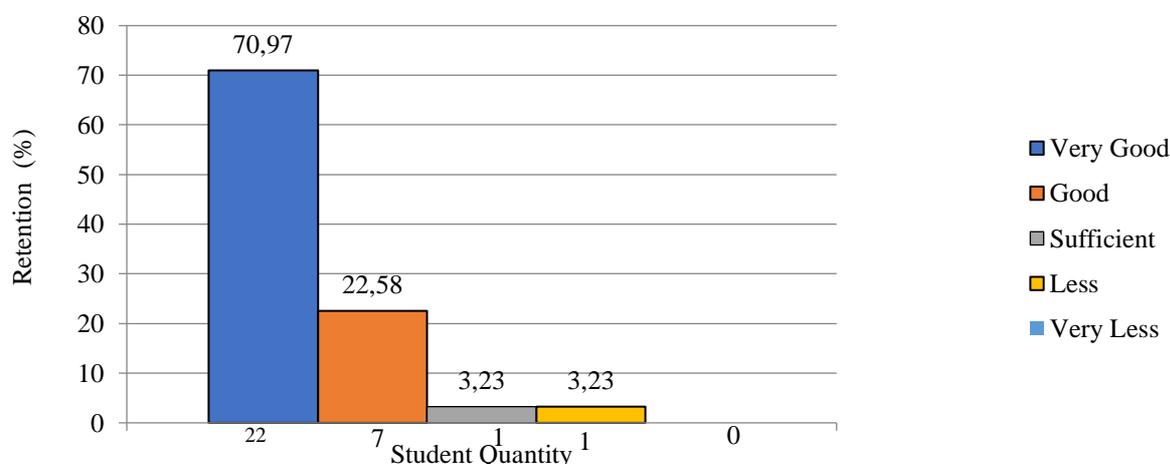
[Table 5](#) shows that the average retest of students increased compared to the average pretest. This increase in score indicates an improvement in students' long-term retention after using the strategy of taking a roundhouse diagram. Short-term retention was measured using the final test score of one (posttest) conducted at the end of each lesson three times the meeting on the body's defense system concepts. Furthermore, long-term retention was measured using the final two test scores (retest), which are conducted at intervals of four weeks from short-term retention. The results of the average analysis of the short-term and long-term retention scores can be seen in [Table 6](#).

Table 6

Analysis Results of Short-term and Long-term Retention Scores from Three Meetings

Topics	Short-term retention	Long-term retention
Functions and components of the human body's defense system	80,64	69,68
The response of the body's defense system	59,35	50,00
Disease and its prevention in the body's defense system	92,26	74,19
Average	77,42	64,62

Table 6 shows the difference between the average short-term retention score and the average long-term retention score for three meetings. The average long-term retention score has decreased to the average short-term retention score. The decrease in the difference between the average short-term retention score against the long-term retention score of 12.79. The percentage of retention is sought to find out the number of students who have retention with excellent, good, sufficient, less, and decidedly less category.

**Figure 2.** The Percentages of Student Retention

Based on Figure 2, students with excellent retention occupied the highest percentage among the others. This proves that using a roundhouse diagram has the effect of improving retention when learning the body's defense system.

Hypothesis Test Results

Hypothesis tested data of pretest and posttest for short-term retention, then followed by long-term retention. The following data are the results of the t-test for short-term retention and long-term retention.

Table 7

Hypothesis Test Calculation Results

Retention	t _{count}	t _{table}
Short-term	19,37*	2,042
Long-term	11,34*	2,042

Note: * = significantly different

Based on the t-test for short-term retention and long-term retention, the results show that the value of $t_{count} > t_{table}$. It can be concluded that the note-taking roundhouse diagram strategy increases the ability to remember or retention of students. Students can well remember the concepts of the body's defense system.

In this study, the fifth groups have members who are enthusiastic about learning (Figure 3).

This can be seen from their enthusiasm for making notes on roundhouse diagrams and often asking questions to teachers when they lack understanding of the learning concept. To construct a note on the roundhouse diagram, students build mental representations of what already they know (Ausubel, 1968). They are passionate about making these notes because they take notes using roundhouse diagrams involving images, colors, and keywords. They discuss with members of their respective groups in making notes according to their wishes.



Figure 3. The students' enthusiasm in learning using roundhouse diagram

Pictures, colors, and keywords used by students in recording learning material in a roundhouse diagram make the material easy to remember. Students identify keywords and make critical knowledge in short statements (Figure 4). Then, students rely on personal interpretation to relate keywords to an image. Students recall verbal or visual information they have for inclusion in the roundhouse diagram (Hackney & Ward, 2002). One factor that increases retention performance is the use images and keywords because they have associations in memory (Solso, Machin, & Maclin, 2007). Atkinson and Shiffrin (1968) that information in short-term memory will be transferred into long-term memory by carrying out several control processes. This control process is a strategy that determines how the information is processed. The control process consists of repetition, coding, and drawing. Repetition is repeating verbal information to remain active in short-term memory or transfer it into long-term memory. Coding is a semantic elaboration of information, so it is easy to remember. Making a picture is creating a visual picture, so the material is more comfortable to remember.



Figure 4. The example of students' roundhouse diagram

Enthusiasm in participating when learning occur can be seen from many question arise from student. This situation showed that students have an interest in learning. Sardini (2013), students who have high learning interests will have good learning outcomes. Because of the interest in learning, make students able to complete notes using colors, pictures, and keywords on roundhouse diagrams very well. The pictures made on the roundhouse diagram are the encoding or representative of the concept of learning material, which is easy for students to remember. In line with Hackney & Ward (2002) which states if the visual image created in a roundhouse diagram is a coding and analogy technique to make students easier to memorize the material. Besides, subconcepts injuring are represented by simple sentences as reminders (keywords). The same thing was expressed by Wibowo, Asri, & Titik (2012) that high school students have been able to perform concept abstractions in their cognitive structures to be able to create visual codes for learning. It is through this technique of creating visual codes that they can better understand the concept of biology. A good note on the roundhouse diagram makes the concept of learning material more precise and can be well understood by students; this can increase student retention.

Based on Table 6, the average short-term retention score is higher than the long-term retention score. The decrease is caused by a considerable amount of time between the short-term retention test and long-term retention test. This causes students to forget the material being taught because the storage of information is not one hundred percent stored in memory. This forgetfulness event can reduce student retention. Reed (2011), the information in short-term memory will disappear quickly unless maintained by recalling the information. A fast forgetfulness level indicates that we must practice verbal information to stay awake in short-term memory. Another cause is that new information received within this period can suppress old information. In line with Syah (2016), a student will experience a retroactive disturbance if the new subject matter brings conflict and disruption to the recall of old subject matter, which has already been stored in the student's permanent reason subsystem. In this case, the old subject matter will be complicated to remember or reproduce. Solso (2007), most of the ability to remember and forget, is controlled by neural processes that govern the whole process without conscious effort. If the material presented is complex and abstract, it cannot give students sufficient opportunities to process and understand the information submitted to the processing of information received is not perfect. If information processing is perfect, there will be long-term retention like the model of human memory in Figure 5.

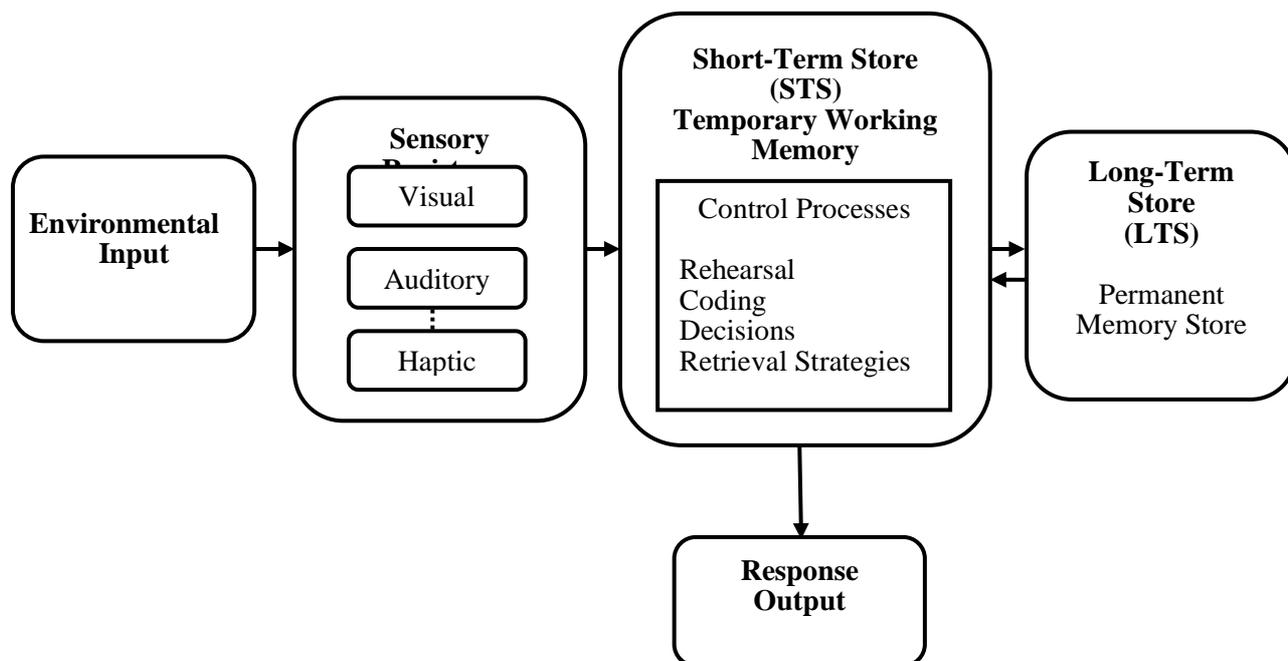


Figure 5. The Model of Human Memory (Atkinson & Shiffrin, 1968)

When student taking notes using a roundhouse diagram, they will involve colors, pictures, and

keywords. When taking notes, students receive stimuli that are accommodated by the sensory devices (receptors) that process these stimuli. The stimulus will be transmitted to the next nerve and then processed to form a harmonious pattern (McCartney & Figg, 2011). Sensory impressions that are not considered relevant will disappear and has no effect anymore. The matching pattern will be entered into short-term memory if the incoming information is retained longer through the storage process (Ward & Wandersee, 2002). This storage process allows further processing that is created as an organizational form, such as concepts, schemes, and verbal formulation. Short-term retention capacity is limited, both from the amount of information and the time available. If it is not processed correctly, it will be pushed out and replaced with new information. If it can be processed for an extended period, it will become long-term retention. The result of the average percentage of retention in students, found that the retention of students in learning using roundhouse diagrams falls into the first category. Ward and Wandersee (2001), that right and useful notes will help students remember in more detail about key points, main concepts and see their links.

CONCLUSION

Based on the results of research, it can be concluded that the strategy of taking notes using roundhouse diagrams on learning the biology of the body's defense system concept can improve students' retention.

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