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The Correlation Between Memory Ability on the Concept of Atomic Structure and Student Learning Outcomes on Chemical Bonding Material

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Abstract

Chemistry lessons require memory skills because some chemical materials are continuous with each other, including chemical bonds and atomic structure. The memory ability of some students is considered low in remembering the material presented, therefore it is necessary to know the relationship between the memory ability of the concept of atomic structure with student learning outcomes on chemical bonding material. The research location is MAN 4 Kampar in the odd semester of the 2023/2024 school year. The research method used is quantitative research type correlational research. The sample used in this study consisted of X1 and X2 grade students at MAN 4 Kampar. The sampling technique used purposive sampling technique. Data collection techniques for memory ability research and learning outcomes using question-based tests, memory ability questionnaires, and documentation. while the indicators used in this study are recall, recognition and redintegrative. with the help of data collection tools obtained results for recall indicators, the percentage distribution of questionnaire data is 27.82%. The recognition indicator obtained a percentage of 31.41% and then the reintegration indicator obtained a percentage of 40.77%. From these three indicators, it can be concluded that redintegrative or the ability of students' memory to recall by connecting the information they have into a complex concept obtained a higher percentage compared to other indicators. Meanwhile, the data analysis technique in this study used the Pearson moment correlation formula. The results obtained from data collection show r count = 0.543 with a two-sided sig value of 0.000, and the r table value at the 5% significance level is 0.316. The significance value of 0.000 <0.05 and the value of r count> r table, it can be concluded that Ho is rejected and Ha is accepted, which means that there is a relationship between the ability to memorize the concept of atomic structure and the learning outcomes of chemical bonds.

Keywords: Atomic Structure, Chemical Bonding, Learning Results, Memory Ability

1. Introduction

The student learning process is influenced by two factors, namely internal factors and external factors (Pantiwati et al., 2016). Intelligence is one of the internal factors and is important in student learning activities. Memory is one of the seven factors of intelligence. Izza et al (2023) states that the role of memory is very important for students in the learning process. When someone carries out learning activities, then all the knowledge they gain requires memory ability to be able to recall the information they have received, this means that learning activities cannot be separated from the memory process and vice versa.

Memory ability or memory plays an important role in the learning process (Trisnawaty et al., 2021). This is in line with the statement by Winiasih et al (2018) that each student has different memory abilities which can influence the ability to capture and receive different learning materials. A student who has a high memory will more quickly understand the material presented by the teacher, then store it in his short-term memory and then send it to his long-term memory.

According to Atkinson and Shiffrin 1969, memory theory is divided into three, namely: sensory memory, short-term memory, and long-term memory. Atkinson and Shiffrin focused on the process of storing and retrieving information from long-term storage (Atkinson & Shiffrin, 1969). The information received and processed in human memory has limits. This is due to the large amount of new information received and the inability to reveal old information, meaning that this will be able to have an impact on student learning success (Risda et al, 2023).

Learning success is the success achieved by students during the learning process, which is usually measured by the learning outcomes achieved by students (Izza et al., 2023). Learning outcomes are student performance in achieving predetermined learning objectives. The learning outcomes examined in this research are learning outcomes in the cognitive domain or knowledge domain of a subject (Bahriah et al., 2021).

Chemistry is a subject that is of little interest to most students. This is due to students' lack of memory to memorize and understand concepts in chemistry lessons (Rusnawati Ruslan, Weny J.A. Musa, 2018). This makes chemical material seem difficult because most chemical concepts are abstract and complex so they require in-depth knowledge to study them (Rahman et al., 2022).

Chemical bonds are one of the materials that is difficult for students to understand. Students can understand chemical bonding material as long as they are able to connect the underlying concepts (Diannisa, 2023). Chemical bonding is a topic that specifically discusses the tendency of an electron to be released and accepted by an atom (Hutabarat & Sanova, Aulia, 2021). We can see that the concept underlying chemical bonding is the concept of atoms, or more precisely atomic structure. Atomic structure is a basic concept that students must master in order to understand further chemical concepts, including chemical bonds (Rusnawati Ruslan, Weny J.A. Musa, 2018).

Based on observations made by researchers at MAN 4 Kampar school through field experience practice activities (PPL), that class X students still have difficulty remembering and understanding material that is interconnected, one of which is chemical bond material with the previous material, namely atomic structure. Therefore, it is necessary to conduct research to determine the relationship between the ability to remember the concept of atomic structure with student learning outcomes in class X chemical bonding material MAN 4 Kampar.

2. Methods

This research was carried out in the odd semester of the 2023/2024 academic year at MAN 4 Kampar. The population of this study was all students of class X MAN 4 Kampar and the sample of this research was students of classes X1. The sample used in this research consisted of students from classes X1 and X2 at MAN 4 Kampar. The sampling technique uses purposive sampling technique.and This research design uses a quantitative approach with the type of research being correlational research. According to Cresswell, a quantitative approach is an effort to investigate problems which is based on taking data, determining variables which are then measured with numbers so that analysis can be carried out according to applicable statistical procedures (Isma Patonah, Mutiara Sambella, 2023). Meanwhile, the aim of correlational research is to test a hypothesis by measuring a number of variables and calculating the correlation coefficient between these variables to determine which variables are correlated (Kurniawati, 2019). The instruments used in this research were chemical bond learning results test questions, atomic structure memory ability test questions, and a memory ability questionnaire. This research instrument uses 10 memory ability test items, 10 learning outcome ability test items and 17 memory ability questionnaire items. all questions and questionnaires have gone through the validity and reliability test stages.

Analysis of the test instrument uses a content validity test and empirical validity test as well as a reliability test of the test items with the help of the SPSS 23 application. The reliability test uses the Cronbach's Alpha method with the criteria that a research instrument is said to be reliable if the reliability coefficient value is > 60 (Siregar, 2013).Next, a differentiating power test is carried out which is determined using the following formula.

$$DB\ \frac{\sum TB}{\sum T} - \frac{\sum RB}{\sum R}$$

Table 1. Amount of Question Discrimination Rate

The Large Number of Question Discrimination (D)	Classification
less then 0,20	*Poor*
0,20 – 0,40	*Satisfactory*

0,40 – 0,70	*Good*
0,70 – 1,00	*Excellent*
negative	-

The level of difficulty test is also carried out on the test data to see the level of difficulty for each question item which is expressed in the following formula:

$$TK = \frac{\sum B}{\sum P}$$

The distribution of difficulty level ranges can be seen in Table 2, as follows:

Table 2. Range of Difficulty Levels of Questions

Range	**Category**
0,00 – 0,19	Very difficult
0,20 – 0,39	Difficult
0,40 – 0,59	Currently
0,60 – 0,79	Easy
0,80 – 1,00	Very easy

(Zein dan Miterianifa, 2016)

Researchers represent the criteria for overall student test achievement by providing categories in Table 3 below.

Table 3. Test Criteria Categories

Value	Category
80 - 100	Tall
50 - 79	Currently
0 - 49	Low

(Sihotang et al., 2021)

Analysis of questionnaire data was carried out using validity tests by expert lecturers and reliability tests on questionnaire data using the Alpha Cronbach method using the SPSS 23 application. Data on atomic structure memory abilities and chemical bond learning outcomes data were then tested for correlation using the Pearson Moment method using the SPSS 23 application. to get the correlation coefficient. The purpose of obtaining the correlation coefficient is to determine the relationship and level of strength between student memory abilities and student learning outcomes.

3. Result and Discussion

This research is correlational research, because the aim of this research is to determine the relationship between memory abilities in the concept of atomic structure and student learning outcomes in class X MAN 4 Kampar chemical bonding material. This research uses

quantitative methods to test research hypotheses with data collection tools in the form of tests and questionnaires. The samples in this research were students in classes X1 and X2 at MAN 4 Kampar. The variable in this research is memory ability as the independent variable and the dependent variable is learning outcomes.

3.1 Memory Ability Test

Student memory ability test data was obtained from analysis using SPSS 23 and the results are summarized in Table 4 below.

Table 4. Description of Memory Ability Test Scores

Variabel	N	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Memory Ability	41	33	80	58,66	10,485

Based on the test scoring categories, the results of students' memory abilities on atomic structure material can be categorized in Figure 1 below.

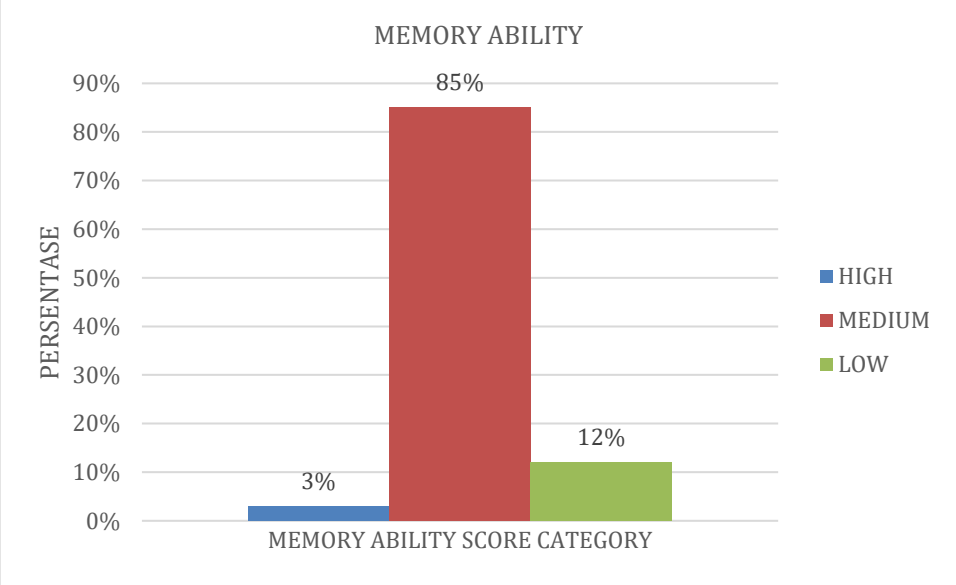

Figure 1. Categories of Student Memory Ability Scores

Based on the indicators of students' memory abilities, it can be seen in Figure 2 below.

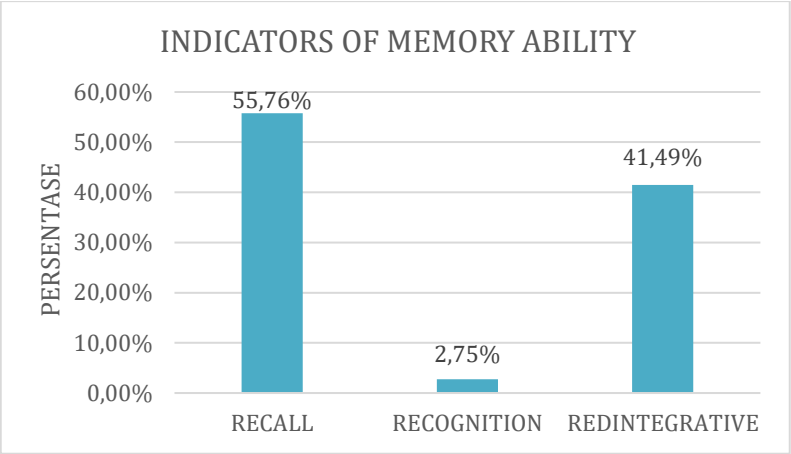

Figure 2. Analysis of Memory Ability Test Results Indicators

The results of the descriptive analysis of memory ability through the memory ability test instrument on atomic structure material obtained results in the high, medium and low categories. Based on category, the majority of students have moderate memory abilities with a percentage of 85%. Then students who have high memory abilities only get a percentage of 3%. Meanwhile, students with low memory abilities obtained a percentage of 12%. Based on indicators of student memory abilities which include:

1) Recall This means memorizing the information learned without any instructions given to students. Recall is one type of process in remembering information. This is in accordance with Drever's opinion (Panggabean & Ritonga, 2023) which states that memory is one of the characteristics possessed by living creatures, useful experiences that we forget influence future behavior and experiences, one of which is recall. In this study, 4 essay questions were given, none of which were given instructions. In this indicator, the results of the student memory ability test obtained a percentage of 55.76%.
2) Recognition This means recognizing the information learned from the instructions given to students. In line with the principle of astronomy (Matlin, 1994) states that a context can stimulate memory if the memory is given good instructions. Therefore, recognition is needed to support students' memory in reacquainting themselves with things they have learned (Umainingsih Mita Beti, Alexon, 2017). In this study, 1 essay question was given, in which the question was given instructions. The results of the memory ability test on this indicator obtained a percentage of 2.75%.
3) Redintegrative means a memorization process that involves and connects stored information to complex concepts. According to Hilgard's theory (Nofindra, 2019), redintegrative is a memory process that connects information into a fairly complex concept. In this study, 5 essay questions were given that correspond to the redintegrative indicators. The results of the memory ability test on this indicator obtained a percentage of 41.49%.

Memory is an important component, sometimes many students easily forget the lesson material that has been taught. This happens because students store the material

taught only in short term memory (short term memory) not in long term memory (long term memory). A good memory is a need for every student to learn optimally (Nofindra, 2019). The ability to remember the past and reuse that information for current use is a function of long-term memory (Bhinnety, 2015).

3.2 Learning Results Test

Data regarding learning outcomes was obtained through a learning outcomes test with 10 questions. Data on learning outcomes test scores were analyzed using SPSS 23 and the results are summarized in Table 5 below.

Table 5. Description of Learning Outcome Test Scores

Variabel	N	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Learning Result	41	15	98	52,63	22,456

Based on the test scoring categories, student learning outcomes in chemical bonding material can be categorized in Figure 3 below.

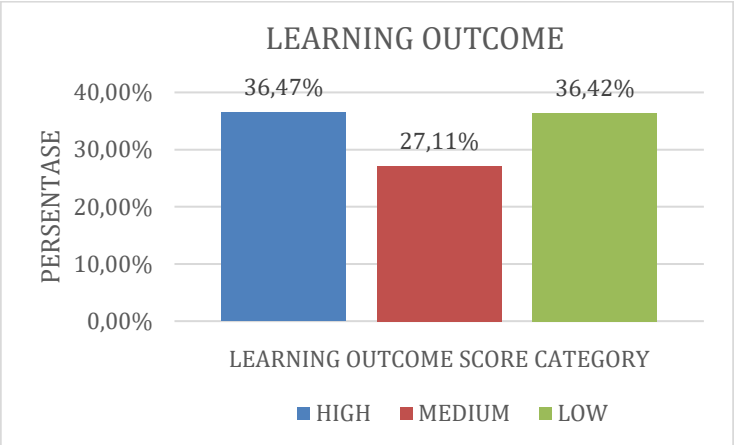

Figure 3. Student Learning Outcome Score Categories

Based on the score categories, the learning outcomes of students in classes X1 and For the high score category, the percentage obtained was 36.47%. The medium score category obtained a percentage of 27.11%. Meanwhile, for the low score category obtained by students, the percentage was 36.42%.

3.3 Memory Ability Questionnaire results

The questionnaire used in this research is useful as supporting data to explore students' memory abilities through three indicators, namely recall, recognition and redintegrative. Based on students' answers regarding the memory ability questionnaire that was given to classes X1 and X2 at MAN 4 Kampar, the percentage of students'

answers per indicator is obtained in Figure

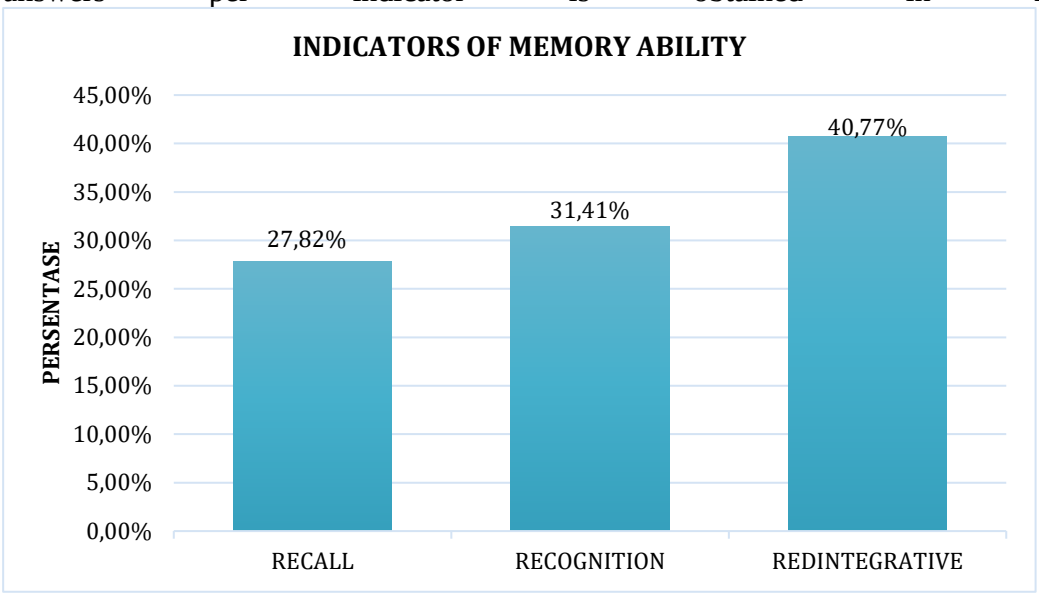

Figure 4. Percentage of Memory Ability Questionnaire

The questionnaire instrument in this research aims to provide supporting data for students' memory abilities. The questionnaire statement distributed included 17 items. The questionnaire items include 5 recall statements, 5 recognition statements and 7 redintegrative statements. The results of distributing questionnaires based on indicators obtained the percentage of indicators. For the recall indicator, the percentage distribution of questionnaire data was 27.82%. The recognition indicator obtained a percentage of 31.41% and then the redintegrative indicator obtained a percentage of 40.77%. From the three indicators, it can be concluded that redintegrative or students' memory ability to recall by connecting the information they have into a complex concept obtained a higher percentage than the other indicators.

3.4 Hypothesis Test

Hypothesis testing in this study uses Pearson Moment Correlation. If the significance value >0.05 then Ho is rejected and Ha is accepted. The data that has been obtained from the two variables as attached in appendix N were analyzed using SPSS 23, resulting in the results summarized in Table 6 below.

Table 6. Correlation of Memory Ability with Student Learning Outcomes

		Memory Ability	Learning Outcomes Test
Memory Ability	*Pearson Correlation*	1	.543**
	Sig. (2-tailed)		.000
	N	41	41
Learning outcomes	*Pearson Correlation*	.543**	1

	Sig. (2-tailed)	.000	
	N	41	41

***. Correlation is significant at the 0.01 level (2-tailed).*

The significance value in the correlation output above, obtained a sig value. (2-tailed) of 0.000. This means that significance is <0.05, then Ho is rejected and Ha is accepted. Another way that can be used to analyze this correlation is to look at the rxy value. Based on the data, the rxy value is 0.543. rtable at the 5% significance level is 0.316. When compared with the rcount value of 0.543, the rcount value > rtable. This means Ha is accepted and Ho is rejected.

The memory ability test on the concept of atomic structure is carried out before the chemical bond material is studied, this is because the atomic structure material is a prerequisite for chemical bond material. Researchers measured memory abilities with recall, recognition and redintegrative indicators in order to see how students remembered and reacquainted themselves with the material they had studied before new material was introduced. From the three indicators of memory ability outlined in the form of atomic structure questions, the average score obtained by students was 58.66 and the average score obtained from the learning results test on chemical bonding material was 52.63. It can be seen that memory ability is very important in relation to student learning outcomes. In accordance with Gagne's opinion (Rahmat, 2018) states that in learning there is a process of receiving information, which is then processed to produce output in the form of learning outcomes.

This is further supported by the concept of memory, namely the ability to record, integrate and store information from habits, thoughts, feelings and actions to be recalled when necessary. Memory is also related to all activities and plays an important role in the learning process to achieve learning goals (Trisnawaty et al., 2021). Memory plays an important role in cognitive development, information received by long-term memory will help students undergo the formal education process (Forsberg et al., 2023). The memory abilities of each student can influence the learning outcomes achieved. Memory ability has the most important role in the learning process. The stronger a student's memory, the easier it will be for students to understand lessons at school and open up opportunities for students to achieve good learning outcomes. If students have low memory abilities, this will have an impact on low learning outcomes.

The knowledge and understanding resulting from students' memory abilities is very useful for achieving future goals, if students have good memory abilities (Izza et al., 2023). There is not only a relationship between memory abilities and learning outcomes, but there is also a relationship between atomic structure material and chemical bonding material. Atomic structure is material that contains the basic concepts of chemical matter. The concept of atomic structure has an abstract aspect involving macroscopic, microscopic and symbolic views. The aim of learning is to ensure students understand these three aspects, but there are still students who experience difficulty in mastering the concept of atomic structure (Sururin Nufus dan Ifah Silfianah, 2023). This concept is important because it is a prerequisite for studying subsequent material. Students must study well, because if students do not understand or do not remember the concept of atomic structure it will make it difficult for students to learn other concepts, such as

chemical bonding which requires understanding in determining protons, neutrons, electrons and the electronic configuration of an element (Diannisa, 2023).

4. Conclusion

Based on an analysis of the relationship between the ability to remember the concept of atomic structure and student learning outcomes in chemical bonding material using Pearson moment correlation, it turns out that there is a significant positive correlation, namely a correlation index of 0.543 with the interpretation of this relationship. is in the medium category.

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