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Relationship Between Learning Style and Students' Cognitive Ability In Chemistry Subjects

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Abstract

The diverse characteristics of chemistry materials require attention to the needs of one of them, namely the tendency of learning styles that students have, for that learning style is something that needs to be studied in relation to students' cognitive abilities. The purpose of this study was to determine the relationship between learning styles and chemistry cognitive abilities of Madrasah Aliyah Negeri Kampar students. Learning style data obtained from questionnaire scores, interviews and observations of students, the value of cognitive abilities obtained from the test results of students' chemistry cognitive abilities on atomic structure material. subject of this research is Madrasah Aliyah Negeri Kampar students, while the object of research is the relationship between learning styles with students' cognitive abilities in chemistry subjects. The sample in this study was taken from class X IPA 1 which amounted to 30 people.. Sampling in this study using purposive sampling technique. Data collection was done through observation, questionnaires, interviews, tests, documentation. The results of this study indicate that students with visual learning style tendencies are more than audio learning style tendencies followed by kinesthetic learning style tendencies and students with visual learning style tendencies on atomic structure material have better cognitive ability scores. Furthermore, the data from the observation of the relationship between learning styles and students' chemistry cognitive abilities were tested using product moment correlation. The results of data processing obtained rxy = 0.838 > rt = 0.361, this means Ha is accepted and Ho is rejected. So that there is a positive and significant correlation between the learning style variable and the variable cognitive abilities of students in chemistry subjects Madrasah Aliyah Negeri Kampar.

Keywords: *Atomic structure material, students' cognitive ability, student learning style*

1. INTRODUCTION

Chemistry is one of the most important branches of science that allows learners to understand what is happening around them (Diah Murti & Hernani, 2023). Chemistry topics are generally related to the basis in the structure of matter, chemistry being a difficult subject for many students (Rahmi et al., 2024). In general, the chemistry curriculum incorporates many abstract concepts, which are central to further learning in chemistry and other sciences. These abstract concepts are important because further chemistry/science concepts or theories cannot be easily understood if the underlying concepts are not sufficiently understood by students (Rahmawati et al., 2020). Chemistry is often considered a difficult subject, thus making students often have no desire to continue their studies in chemistry (Pristiana et al., 2024). One of the causes is due to the diverse characteristics of chemistry.

An important characteristic of chemistry is the constant interaction between macroscopic and microscopic levels of thinking, as well as the presence of chemical (and physical) aspects in learning that pose significant challenges for beginners. Numerous reports support the view that the interaction between the macroscopic and microscopic worlds is a source of difficulty for many chemistry learners (Talanquer, 2022). The different characteristics of chemistry are thought to require teacher creativity in teaching chemistry materials with different styles according to the tendency of students' learning styles (Marchak et al., 2021). For this reason, it is necessary to know students' learning styles so that students find it easier to learn chemistry with their own learning styles and are expected to get better

learning results. By knowing students' learning styles, teachers can adjust their teaching styles to the needs of students (Bernal et al., 2024). There are several reasons why teachers' understanding of students' learning styles needs to be considered in the teaching process, namely: making the teaching and learning process dialogic, understanding learners more differently, making the teaching process more rewarding. As for students, the importance of knowing their respective learning styles is that it can increase students' awareness of suitable learning activities to avoid inappropriate learning experiences, can improvise and help plan the goals of their learning (Fitriani, 2022).

Based on the background of these problems, the problem can be formulated in this study is whether there is a relationship between learning styles with cognitive abilities of students in class X IPA 1 chemistry subject MAN Kampar on atomic structure material? The purpose of this study was to determine whether there is a relationship between learning styles with cognitive abilities of students in class X IPA 1 chemistry subject MAN Kampar on atomic structure material.

2. METHODS

The method used in this research is correlational method. Research with correlational techniques is research intended to determine whether there is a relationship between learning styles (X) with cognitive abilities (Y). The subjects in this study were students of class X IPA 1 at MAN Kampar. While the object is the relationship between students' learning styles with chemistry cognitive abilities of students in class X IPA 1 at MAN Kampar. The research data presented in this study are the use of questionnaires, cognitive ability tests, student interviews, and recorded observations.

This research instrument combines quantitative and qualitative methods to provide a comprehensive approach to data collection. By utilizing Likert scale questionnaires, observation checklists, and interview guides, this instrument aims to capture a variety of perspectives and experiences related to the research topic. Careful design of these tools is essential to ensure the validity and reliability of the research findings. The data analysis technique carried out is descriptive analysis of each variable, namely the student learning style variable and the chemistry subject cognitive ability variable. Data collected from questionnaires and cognitive ability test scores will be analyzed using the product moment correlation formula or technique (Oktomaini et al., 2022).

3. RESULT AND DISCUSSION

Results

Learning style

Descriptive analysis results were obtained by scoring students' answers to positive and negative statements in the learning style scale then calculating the number of scores obtained from each learning style, namely visual, audio, and kinesthetic learning styles. Furthermore, see the highest score among the three learning styles of these students. Based on the highest score, each student is classified whether they are included in the visual, audio or kinesthetic learning style tendencies.

From the results of the recapitulation of the learning style tendency score, there are 13 students whose learning style tendency is visual, 9 students whose learning style tendency is audio, 8 students whose learning style tendency is kinesthetic. Furthermore, the percentage of each learning style (visual, audio, and kinesthetic) is calculated by comparing the number of students who tend to a particular learning style with the total number of students in class X IPA 1 Madrasah Aliyah Negeri Kampar.

Data on the percentage of learning styles of students in class X IPA 1 Madrasah Aliyah Negeri Kampar can be presented in the form of a bar chart in Figure 1:

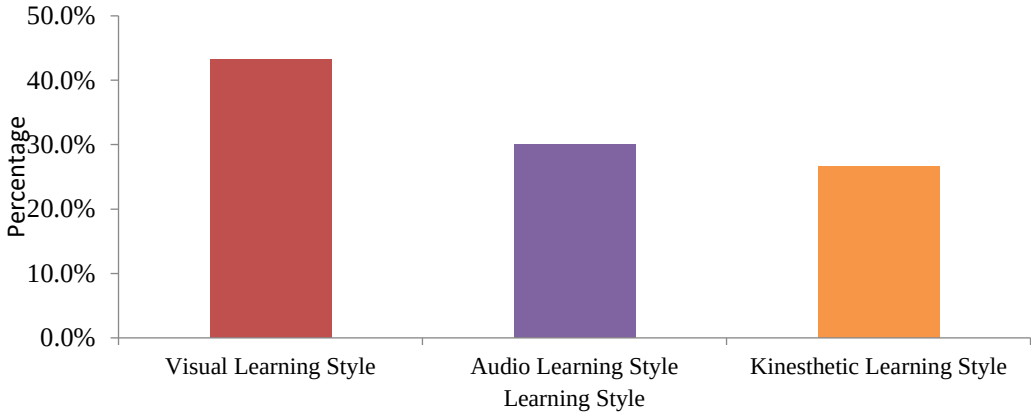

Figure 1. Percentage Bar Diagram of Learning Styles of Students in Class X IPA 1 Madrasah Aliyah Negeri Kampar

Based on Figure 1, it can be seen that the percentage of visual learning style is 43.33%, the percentage of audio learning style is 30%, and the percentage of kinesthetic learning style is 26.67% so it can be concluded that the tendency of learning style of students in class X IPA 1 Madrasah Aliyah Negeri Kampar in the academic year 2016/2017 is visual learning style.

Based on the results of interviews conducted by researchers, there are 13 students who have a tendency to visual learning styles, 9 students who have a tendency to audio learning styles, and 8 students who have a tendency to kinesthetic learning styles. This shows that students have honestly filled out the questionnaire and in accordance with the learning style tendencies between the questionnaire results and the interview results.

Based on the recorded observations, students with visual learning styles do have characteristics of visual learning styles, such as: scribbling meaninglessly during learning, always trying to see the movements of the teacher who is teaching, can sit quietly in the middle of a noisy situation without being disturbed. Then students with audio learning styles also show characteristics of audio learning styles, such as: tends to talk a lot, easily distracted by noise, very enthusiastic when the teacher is lecturing. Furthermore, students with kinesthetic learning styles also show the characteristics of kinesthetic learning styles, such as: like to touch everything they encounter, it is very difficult to stay silent / sit sweetly, like to do something that allows their hands to be so active.

Cognitive Ability

Data on students' cognitive abilities in one of the chemical materials, namely atomic structure, were obtained through multiple choice test scores of 18 questions. Data on cognitive abilities are then analyzed with the help of SPSS version 16.0, the output is as follows:

Table 1. Data Description of Students' Cognitive Ability Values

	N	Minimum	Maximum	Mean	Std.deviation
Test score	30	67	89	77,77	5,992

Data on the percentage of cognitive abilities of students in class X IPA 1 Madrasah Aliyah Negeri Kampar can be presented in the form of a bar chart in Figure 2:

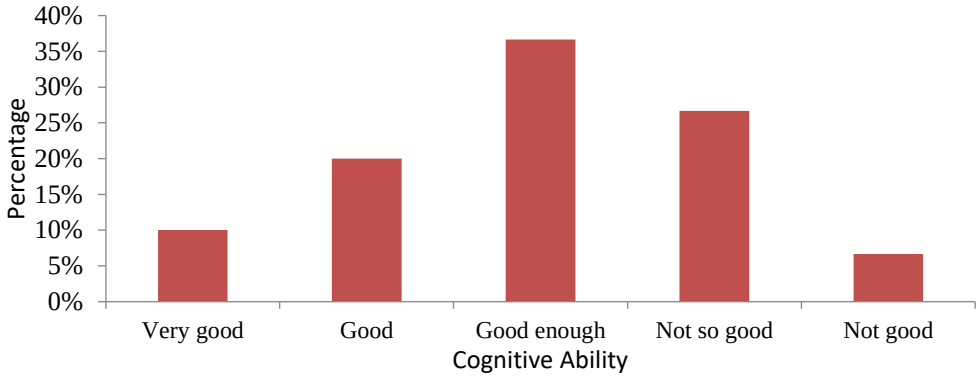

Figure 2. Bar Diagram of Percentage Category Score of Cognitive Ability of Students of Class X IPA 1 Madrasah Aliyah Negeri Kampar

Based on the above categories, it can be concluded that the tendency of cognitive abilities of students in class X IPA 1 Madrasah Aliyah Negeri Kampar is classified in the good enough category.

Hypothesis testing in this study, namely regarding whether there is a correlation between the independent variable and the dependent variable. The final analysis results from the presentation and processing of data from hypothesis testing results show that 0.361 < 0.841 > 0.463, so the author concludes that Ha is accepted and Ho is rejected because rxy> rt both at a significant level of 5% and 1%. Thus, Ha (There is a significant relationship between learning styles and cognitive abilities of students in chemistry subjects of Madrasah Aliyah Negeri Kampar) is accepted and Ho (There is no significant relationship between learning styles and cognitive abilities of students in chemistry subjects of Madrasah Aliyah Negeri Kampar) is rejected. The closeness of the relationship between learning styles and students' cognitive abilities is 70.73%.

Discussion

This research is a correlation study, namely research that aims to see whether there is a correlation between learning styles and cognitive abilities of students in class X IPA 1 Madrasah Aliyah Negeri Kampar. This study uses the help of a learning style questionnaire and cognitive ability test questions to find out the results of data from learning styles and cognitive abilities of students.

Learning style questionnaires and cognitive ability test questions that have previously been validated by expert validators, then distributed first to class XI IPA 1 Madrasah Aliyah Negeri Kampar and analyzed to see valid items. Of the 27 items of the questionnaire statement, 24 items were obtained which were included in the valid category and of the 30 items of test items, 21 items were obtained which were included in the valid category.

Items that are declared valid can be used for this study. The items were then tested on students of class X IPA 1 Madrasah Aliyah Negeri Kampar. For the questionnaire, all valid items were used in this study, while for the cognitive ability test there were 21 valid items and only 18 items were used.

Learning style

Learning style is a consistent way done by a student in capturing stimulus or information, how to remember, think and solve problems (Auliyah et al., 2023). Each individual not only learns at different speeds but also processes information in the form of images, sounds or things that are done in different ways (Syahrir et al., 2023). There are three learning styles according to sensory preferences, namely visual learning style (seeing), auditory learning style (hearing) and kinesthetic learning style (touching) (Supit et al., 2023).

The results of the research conducted by researchers show that each student has a different learning style, 13 students (43.33%) have a visual learning style tendency, 9 students (30%) have an audio learning style tendency, and 8 students (26.67%) have a kinesthetic learning style tendency.

This shows that the most dominant learning style tendency of students in class X IPA 1 Madrasah Aliyah Negeri Kampar is visual learning style.

In contrast to the results of research conducted by Radhwan Hussein Ibrahim and Dhia-Alrahman Hussein who conducted research on 210 nursing students at Mosul University and Kirkuk University with the research title "Assessment of visual, auditory, and kinesthetic learning styles among undergraduate nursing students" which showed a tendency for visual learning styles as much as 40%, a tendency for audio learning styles as much as 29.5%, a tendency for kinesthetic learning styles as much as 30.5% (Bernal et al., 2024). This shows that the dominant learning styles possessed by nursing students are visual and kinesthetic learning styles.

The results of research conducted by James Mite, et al., with the title "The Relationship between Learning Styles and Learning Outcomes of Catholic High School Students of Santa Maria Malang Based on Corrected Score in Biology Learning Through Group Investigation (GI) Learning 2015/2016 Academic Year", showed that out of 65 people, 53.85% of students have a visual learning style, 30.76% of students have an audio learning style and 15.38% of students have a kinesthetic learning style. This shows that the learning style possessed by students of class X MIA 2 and class X MIA 4 SMAK Santa Maria Malang, is a visual learning style.

The results of the research of James Mite, et al., are in line with the research that the researchers conducted but differ from the research conducted by Radhwan Hussein Ibrahim and Dhia-Alrahman Hussein. This can happen because each human being has a different brain circuit and abilities, references that are not the same as one another so that humans will also receive information, store knowledge, and retrieve it in different ways. In short, every human being has a different learning style and understands things differently.

According to Kolb in M. Nur Ghufron, style formation is influenced by several things. The formation of a learning style is influenced by different levels that underlie a person choosing a particular learning style, namely personality type, chosen major, career or profession, work or role being carried out (Resmi, 2022). Then according to Borich and Tombari in Rafy Sapuri explained that learning styles are inseparable from physical, social, emotional, and learning environment factors. The results of the study are different because as previously stated that the emergence of learning styles can be influenced by personality, the chosen major and the learning environment, it is clear that the personality and learning environment of class X IPA 1 Madrasah Aliyah Kampar students are different from the personality and learning environment of nursing students at Mosul University and Kirkuk University. Students at the high school / equivalent level usually learn more by seeing. Students prefer to pay attention to the teacher, in contrast to nursing students who are more dominant in learning by seeing and practicing directly. The environment is also different, nursing students practice more in the laboratory while students learn more in the classroom.

Cognitive ability

The results of the research conducted by the researchers showed that the chemistry cognitive abilities of students in class X IPA 1 Madrasah Aliyah Negeri Kampar in the very good category as much as 10%, good category as much as 20%, good enough category as much as 36.67%, poor category as much as 26.67%, and the category is not good as much as 6.66%. It can be concluded that the cognitive abilities of students in class X IPA 1 Madrasah Aliyah Negeri Kampar are in the good enough category.

The chemistry cognitive ability of students in class X IPA 1 Madrasah Aliyah Negeri Kampar is classified in the good enough category because chemistry is often considered a difficult lesson. One of the reasons is because chemistry has different characteristics for each material. For this reason, attention is needed from teachers to make chemistry learning easy and fun according to students' learning styles.

Relationship between Learning Style and Students' Cognitive Ability

The results of research conducted by researchers show that there is a significant relationship between learning styles and cognitive abilities which is 70.73%. While the relationship between visual learning styles and cognitive abilities shows a determination value of 41.22%, the relationship between audio learning styles and cognitive abilities shows a determination value of 17.06%, and the relationship between kinesthetic learning styles and cognitive abilities shows a determination value of 21.99%. This shows that visual learning styles have the closest relationship with students' cognitive abilities.

a. Relationship between Visual Learning Style and Cognitive Ability of Students of Class X IPA 1 Madrasah Aliyah Negeri Kampar

The results of this study indicate that there is a positive and significant relationship between visual learning styles and cognitive abilities of chemistry subjects of students in class X IPA 1 Madrasah Aliyah Negeri Kampar. From the results of the correlation analysis there is a value of rcount = 0.642> rtable = 0.361. The meaning of the results of the correlation analysis shows that there is a relationship between visual learning styles and students' cognitive abilities. Based on the theory expressed by Dr. Muhammad Yaumi, M.Hum., M.A. that visual learners are those who learn things best through vision, have difficulty absorbing information through verbal presentations without being accompanied by visual images (Gogiashvili & Demetrashvili, 2024).

According to Asep Mahfudz, this learning style explains that a person must first see the evidence to then be able to believe it. There are several typical characteristics of people who like this learning style, first, the need to see something (information/learning) visually to know it or understand it; second, have a strong sensitivity to color; third, have a sufficient understanding of artistic issues; fourth, have difficulty dialoguing directly; fifth, too reactive to sound; sixth, difficult to follow verbal recommendations; seventh, often misinterpret words or speech (Susanti et al., 2020).

To overcome these various problems, visual aids or props are needed that they can see and witness directly such as slides, scribbles, picture cards, posters, cartoons containing learning messages, concept maps, and others, which can make learning fun. As done by the chemistry teacher of Madrasah Aliyah Kampar, namely by guiding students to read chemistry books. However, other methods are needed as mentioned above, varied in fun ways so that students are more enthusiastic and active in learning so that the value of students' cognitive abilities becomes better.

b. The Relationship between Audio Learning Style and Cognitive Ability of Students of Class X IPA 1 Madrasah Aliyah Negeri Kampar

The results of this study indicate that there is a positive and significant relationship between audio learning style and cognitive abilities of students in chemistry class X IPA 1 Madrasah Aliyah Negeri Kampar. From the results of the correlation analysis there is a value of rcount = 0.413> rtable = 0.361. The meaning of the results of the correlation analysis shows that there is a relationship between audio learning styles and students' cognitive abilities. Based on the theory expressed by Dr. Muhammad Yaumi, M.Hum., M.A. that audio learners are those who learn things best through hearing. This type of learning style tends to like the presentation of material through lectures and discussions. Audio learners easily lose concentration when there are noises around them so they are happier if they study or do assignments with one or two friends, because with a small number of friends they can motivate each other to listen to their friends' explanations well (Swargiary, 2023).

According to Asep Mahfudz, audio learning style relies on hearing to understand and remember information. People who have this learning style, have the characteristics: first, all

information can only be absorbed through hearing; second, have difficulty absorbing information in written form directly; third, have difficulty writing or reading (Olyffia & Jauhari, 2024).

To overcome these various problems can be done by using audio devices in learning, making class discussions, letting them read aloud and loudly, by using recordings, which can make audio learners feel happy as done by the chemistry teacher of Madrasah Aliyah Kampar, namely by the lecture method and guiding students to actively discuss and ask questions. But this requires other ways that are more varied so that learning becomes more fun and students are enthusiastic in learning so as to get better cognitive ability scores.

c. Relationship between Kinesthetic Learning Style and Cognitive Ability of Students of Class X IPA 1 Madrasah Aliyah Negeri Kampar

The results of this study indicate that there is a positive and significant relationship between kinesthetic learning styles and cognitive abilities of chemistry subjects of students in class X IPA 1 Madrasah Aliyah Negeri Kampar. From the results of the correlation analysis there is a value of rcount = 0.469> rtable = 0.361. The meaning of the results of the correlation analysis shows that there is a relationship between kinesthetic learning styles and students' cognitive abilities. Based on the theory expressed by Dr. Muhammad Yaumi, M.Hum., M.A. that kinesthetic learners are a learning style where students do physical activities, two important things that are very liked by them are often moving or moving during lessons. They also like to write with their hands, shake their feet, hands, head, or maybe occasionally play with their hair.

According to Asep Mahfudz, kinesthetic learning style is a learning style that relies on touch to provide certain information in order to remember it. People who have this learning style, have characters: first, placing the hand as the main information receiving tool so that they can continue to remember it. Second, just by holding they can absorb information without having to read the explanation. Third, they cannot sit too long to listen to lessons. Fourth, they feel they can learn better when accompanied by physical activities. Fifth, have the ability to coordinate a team and the ability to control body movements (athletic ability) (Olyffia & Jauhari, 2024).

To overcome these various problems, it can be done by increasing field practice, conducting demonstrations or direct performances of a process, making models or examples, letting students stand when explaining something, etc., as done by the chemistry teacher at Madrasah Aliyah Kampar by guiding students to work on problems in the book. But in this case it is also necessary to vary other ways that make children's kinesthetic learning styles become channeled. Because usually children who are physically active are often considered as stubborn children, but that's the way they like it so that what they learn can be remembered and understood clearly.

d. Relationship between Learning Style and Cognitive Ability of Class X IPA 1 Madrasah Aliyah Negeri Kampar Students

The results of this study indicate that there is a positive and significant relationship between learning styles and cognitive abilities of chemistry subjects of students in class X IPA 1 Madrasah Aliyah Negeri Kampar. From the results of the correlation analysis there is a value of rcount = 0.841> rtable = 0.361. The meaning of the results of the correlation analysis shows that there is a relationship between learning styles and students' cognitive abilities. Based on the theory expressed by M. Nur Ghufron and Rini Risnawita that learning style is an approach that explains how individuals learn or the way each person takes to concentrate on the process, and master difficult and new information through different perceptions (Mustofa & Hastuti, 2023). So if students utilize their learning style optimally, it will provide a positive and significant correlation with the high value of students' cognitive abilities.

From the results of this study the magnitude of the influence of learning styles on cognitive abilities is shown by the results of the calculation of the coefficient of determination. After analyzing it turns out that the learning style contributes to the increase in cognitive ability scores by 70.73% and the remaining 29.27% is related to other variables not discussed in this study. The data analysis of this study showed that the learning style variable contributed to the value of

cognitive abilities which is quite meaningful. This indicates that students are aware of their learning style. However, even though they are aware of their learning style, they must further optimize their learning style.

To optimize students' learning styles, it requires the role of the teacher to invite students to recognize and understand their own learning styles and can strengthen these learning styles as much as possible. What the teacher must do is recognize and then understand the learning styles of all students in the class. How to recognize students' learning styles can be done by giving a questionnaire about learning styles as the researcher did. This questionnaire contains a selection of activities that are often carried out by students in their lives that can identify the dominant learning style possessed by students. Basically, students have all three learning styles but there is one learning style that is most dominant in students.

After knowing students' learning styles, teachers can determine what media and methods can be used in learning to suit students' needs. A teacher will not succeed in facilitating all students to achieve optimal results if he only uses one type of method. Therefore, teachers need to vary methods and media in learning. The three types of student learning styles must get the same facilities in learning. This means that teachers must use at least three forms of facilities, namely those suitable for visual types, suitable for auditorial types, and suitable for kinesthetic types (Khoirunnisa & Iba, 2022).

By knowing the learning styles of their students, teachers are expected to design lessons that can optimize students' learning styles. If the teacher's teaching style is in accordance with the student's learning style, students will find learning easy and enjoyable. The teacher's teaching style is a strategy for transferring information provided by the teacher to the students, while the learning style is how information can be received properly by the students. Therefore, every teacher should have data on the learning style of each of their students (Chairawati & Muzakkir, 2020).

From the discussion above, it can be concluded that it is important to know the learning style of students, so that in the learning process students feel comfortable in the learning process, if students feel comfortable learning with their own learning style, it is hoped that students will be motivated to study harder and get maximum results, because chemistry also has different characteristics of material so that it requires teacher creativity in teaching chemistry material with different styles according to students' learning styles in understanding and learning each chemistry material.

4. CONCLUSION

In this study, it was concluded that students with visual learning styles showed significantly better cognitive abilities compared to those with audio and kinesthetic learning styles. The correlation between learning styles and cognitive ability was found to be strong, with an important correlation coefficient of 0.703 for visual learners. This suggests that the way students prefer to learn can have a huge impact on their understanding and performance in subjects such as chemistry. The hypothesis that there is no significant relationship between learning styles and cognitive ability was rejected, confirming the importance of recognizing and accommodating different learning preferences in educational settings**.**

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