



The Relationship Between Learning Style and Critical Thinking Skills in Learning Kinetic Theory of Gases

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Abstract: This study aims to determine the relationship between learning styles and critical thinking skills in learning gas kinetic theory. This type of research is pre-experimental with a level 3 factorial design that uses three classes to be sampled, namely XI IPA 1, XI IPA 2, and XI IPA 3 in SMAN 7 Mataram. The learning style data collection technique used a questionnaire, while the critical thinking skill data used a multiple-choice test and description. The data obtained were analyzed using two-way ANOVA assisted by IBM SPSS Statistics 21. Based on the analysis obtained an F value of $0.03 < 0.05$, which illustrates a relationship between learning styles and students' critical thinking skills on learning kinetic theory of gases.

Keywords: Learning styles; critical thinking skills; kinetic theory of gases

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Introduction

Education is a very complex activity that includes a series of learning processes such as knowledge, skills, and habits carried out in training, teaching, and research. Almost all dimensions of human life are involved in the educational process, either directly or indirectly (Nurhayati et al. 2020). Various components play an active role in the success of education itself: goals, vision-mission, curriculum, methods, tools, environmental infrastructure, academic climate, leadership, education, educational staff, and students. The purpose here is following the UU No. 20 Tahun 2003 concerning the National Education System. National education aims to develop the potential of students to become human beings who believe and fear God Almighty, have good character, are healthy, knowledgeable, capable, creative, independent, become citizens of a democratic and responsible country.

Education as a forum for producing generations who have competencies according to their fields of

expertise also needs to carry out concrete strategies in facing the challenges of the 21st century. According to Chaeruman (2010), there are several skills that students must master in facing the challenges of the 21st century, including information and communication technology skills, critical thinking skills, problem-solving skills, effective communication skills, and collaborative skills.

One indicator of the success of students in the educational process is getting good and increasing learning outcomes. Student learning outcomes are obtained through learning outcome tests that show student achievement or progress in learning. This requires students to have higher-order thinking skills. One of them is in 21st-century skills, namely critical thinking skills.

Critical thinking is an intellectual thought process that deliberately assesses the quality of its thinking using reflective, independent, clear, and rational thinking (Rizaldi et al., 2019). This process is a form of critical thinking that needs to be developed in

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solving problems, formulating conclusions, gathering possibilities, and making decisions. Critical thinking is an attitude to think deeply about problems and things that are within reach of one's experience of knowledge about methods and logical reasoning and a kind of skill to apply these methods (Nasution, 2018; Nugraha et al. 2017; Rahmawati et al. 2009).

Students' achievement of critical thinking skills is influenced by many factors, including the learning process and conditions. Learning conditions, according to Reigheulth & Merrill (1979), consisted of three variables, namely (1) achievement goals; (2) constraints and characteristics; and (3) student characteristics. Characteristics of students are aspects or individual qualities that students have. According to experts, one of the important factors for one's success in the learning process is the learning style. Learning style is an individual process of absorbing learning material. The learning style of students is one of the important factors that influence success in the learning process. Learning styles are needed by students in the process of absorbing information when learning takes place. According to several experts, there are many types of learning styles, including based on personality, environmental influences, learning tendencies, and learning modalities.

Each student has a different learning style. Some find it more effective and more interesting by listening to a lot, but some feel that reading is very fun, and some feel that the results that will be obtained will be more optimal if direct learning is where by practicing what will be learned. Each individual cannot be considered to have the same abilities because they have different speeds in learning and receiving learning. They also process information in the form of images, sounds, or things done in different ways. Learning style combines absorbing the information obtained, organizing it, and processing the information.

A teaching and learning process is considered successful when the student's absorption of the teaching materials achieved high achievement, both individually and in groups, and the behavior expected in the learning objectives has been achieved by students (Tarlia & Afriansyah, 2016). However, the indicator that is widely used as a measure of the success of teaching and learning activities is the absorption of students. It is known that the absorption of students to teaching materials is also different, some are fast, and some are slow. This difference also occurs in individual learning styles. To absorb information, each individual has a learning style. The learning styles of students are also influential in the learning process. Based on this background, research has been carried out to determine the effect of learning styles on students' thinking abilities on the kinetic theory of gases.

Methods

This study uses a pre-experimental type. This type of research is a research design to determine the cause-effect relationship using only the experimental group, without a control group (comparison) (Sugiyono, 2013). The research design used was a factorial design (level 3). According to Setyosari (2013), this factorial design is used when researchers consider other independent variables (usually moderating variables) in their research. The factorial design (level 3) illustrates that the researcher uses two factors, each of which consists of three levels (categories). The first factor in this study is the conceptual change model, while the second factor is students' learning styles, namely visual, auditory, and kinesthetic learning styles. However, this article will only focus on the effect of learning styles on students' critical thinking skills in learning the kinetic theory of gases.

Student learning style data were obtained using a learning style questionnaire, while thinking skills were obtained using multiple-choice tests and descriptions related to the kinetic theory of gas. The population used was all students in class XI IPA at SMAN 7 Mataram, with the sample used were students in class XI MIPA 1, XI MIPA 2, and XI MIPA 3 as the experimental class. The sampling technique used was the purposive sampling technique because the researcher selected the sampling with certain considerations (Sugiyono, 2013). The researcher considered that the learning outcomes were almost the same between the three classes. In brief, the following shows the factorial design (level 3)

Table 1. Factorial Design 3^2 (level 3)

B	A	Conceptual Change Model (B)		
		CCM Visual (B ₁)	CCM Auditory (B ₂)	CCM Kinesthetic (B ₃)
Learning Style (A)	Visual (A ₁)	A ₁ B ₁	A ₁ B ₂	A ₁ B ₃
	Auditory (A ₂)	A ₂ B ₁	A ₂ B ₂	A ₂ B ₃
	Kinesthetic (A ₃)	A ₃ B ₁	A ₃ B ₂	A ₃ B ₃

(Adapted from Aji and Dasarri in Rizaldi et al. 2019)

Results and Discussion

The learning style data of students in the three experimental classes were grouped based on the tendency of student's answers to the learning style questionnaire that was given at the initial meeting before the written test was carried out in the form of multiple-choice questions. The data grouping of

students learning styles can be seen in Table 2 as follows

Table 2. Students Learning Style Data

Learning Style Class	Visual	Auditory	Kinesthetic
XI IPA1/Exper. 1	9	4	9
XI IPA 2/Exper. 2	8	9	7
XI IPA 3/Exper. 3	14	8	6

Based on Table 2, it can be seen that in experimental class 1, the number of students with visual learning styles was nine students, auditory learning styles were four students, and kinesthetic learning styles were nine students. In experimental class 2, eight students with visual learning styles were eight, auditory learning styles were nine, and kinesthetic learning styles were seven students. Whereas in experimental class 3, the number of students with visual learning styles was 14, auditory learning styles were 8, and kinesthetic learning styles were 6.

Judging from the type of learning style of students in the class, it can be seen that the average value of critical thinking skills in the initial test and final test is in Table 3

Table 3. The Average Value of Students' Critical Thinking Skills

Class	Visual		Auditory		Kinesthetic	
	TA	TB	TA	TB	TA	TB
XI IPA 1	20.30	66.30	28.80	67.90	20.30	57.10
XI IPA 2	21.60	50.60	21.30	46.00	23.10	40.10
XI IPA 3	30.99	62.83	26.06	58.62	13.36	59.45
Average	24.30	59.91	25.39	57.51	18.92	52.22

Where,
TA: Initial Test
TB: Final Test

The average value of the initial and final test results of critical thinking skills in terms of learning styles in all experimental classes is graphically shown in the following figure.

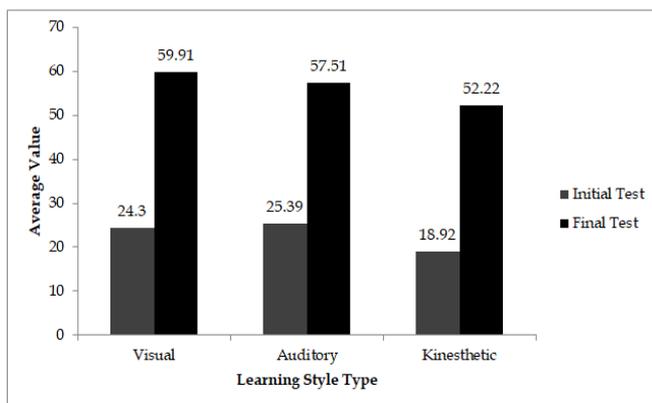


Figure 1. Average Value of Initial and Final Test

The data on the average value of the initial test and final test of critical thinking skills in terms of learning styles in Table 3 are then entered into the N-gain formula so that the results are as shown in the following figure

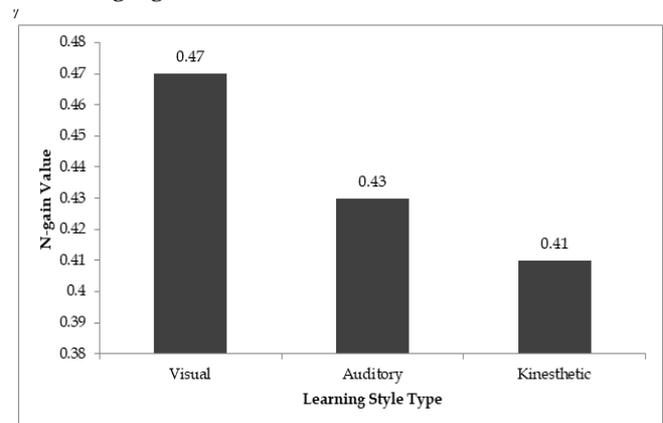


Figure 2. N-gain Value of Students' Critical Thinking Skills

The results of the analysis of hypothesis testing using two-way ANOVA assisted by IBM SPSS Statistics 21 can be seen in the table as follows

Table 4. Test of Between Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Learning Style	1125,342	2	562,67	3,86	0,03
Error	9462,293	65	145,57		
Total	250881,000	74			
Corrected Total	14996,378	73			

RSquared= 0,37 (Adjusted RSquared=0,29)

According to Bire et al. (2014), learning styles are the easiest way students have to absorb, organize, and process the information provided. An appropriate learning style is a key to the success of students in learning. Realizing this makes students can absorb and process information and make learning easier with their learning styles. Judging from the learning styles that students have, as in Figure 1, it can be seen that the average value of the three types of learning styles before being given treatment, namely students with a visual style of 24.30; auditory of 25.39; and kinesthetic 18.92. After being treated with a conceptual change model, the three types of learning styles showed an increase in the average score of students' critical thinking skills with a visual style of 59.91; auditory style of 57.51; while the kinesthetic force is 52.22.

This data shows that students with the type of visual learning style have a better average score than other types of learning styles, so that it can be said that

the type of learning style possessed by students affects the level of critical thinking skills. This is supported by the data in Table 4, that the relationship between students learning styles and critical thinking skills gives an F value of 3.86 with a significance of 0.03. The significance level obtained is then compared with the significance level of 0.05. It is found that $0.03 < 0.05$. This value shows that H_0 is rejected and H_a is accepted, meaning that students' learning styles influence critical thinking skills. These results are in line with the statement from Febriani et al. (2019) that the average learning achievement of students with visual learning styles is higher than students with kinesthetic learning styles. While the research conducted by Sembiring & Mukhtar (2014) where the learning outcomes of students who have a visual learning style are higher than the learning outcomes of students who have an auditory learning style.

Students with visual learning style types seem to experience better learning outcomes than students with other types of learning styles. Visual learning styles are vision-focused learning styles where when learning new things. This type usually needs to see something visually to make it easier to understand and understand. In addition, visual style types are also more comfortable learning with the use of colors, lines, and shapes. Students' learning styles can also lead to individual natural traits such as habits and tendencies in absorbing, processing, and remembering information and learning style skills that will not change with different learning methods and content of learning materials (Asran et al., 2019).

The characteristics of individuals who have a visual learning style according to Tanamir et al. (2020), namely: (1) regularly paying attention to everything; (2) remembering by paying attention to pictures and preferring to read alone; (3) requires a complete picture and purpose and captures details and remembers something seen; (4) planning and managing a long-term schedule; (5) be careful in detail about something; (6) Spelling and being able to see the words in his mind; and (7) has problems remembering verbal instructions except for written instructions. Learning methods that are appropriate for a visual style, namely: (1) learning from interesting pictures and videos; (2) reading books that are not only written but also illustrated; (3) using color markers when taking notes; and (4) create a mind mapping to facilitate learning. Based on the characteristics and learning method, it can be seen that the material of the kinetic theory of gases is included in one of the materials that are difficult to understand because of the microscopic nature of the study so that if it is delivered directly without giving an overview using various supporting applications, one of

which is PhET, it will be difficult to imagine by learners.

Another study conducted by Husein et al. (2017) stated that the animation shown to students could train the logic of thinking of students in solving physics problems. Visual learning can also foster the interest of students and can provide a relationship between the content of the subject matter and the real world (contextual) (Munandar et al., 2018). The PhET simulation used as a tool in the learning process can properly visualize the concept of material that is initially difficult to understand when the learning process is presented by the lecture method or directly from the teacher to the students (Adams in Rizaldi et al. 2020). This condition can facilitate students in developing critical thinking skills, especially in learning-related concepts in the kinetic theory of gases learning materials.

Conclusion

Based on data analysis and discussion, it is known that the N-gain value for each type of learning style is visual of 0.47; auditory of 0.43; and kinetics of 0.41 so that students with the type of visual learning style have a better improvement value than other types of learning styles. The relationship between students learning styles and critical thinking skills in terms of the IBM SPSS 21 calculation is $0.03 < 0.05$, so that It can be concluded that there is a positive relationship between learning styles and critical thinking skills of students in learning the kinetic theory of gases.

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