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The Effect of Making Atomic Models on the Interest in Learning Chemistry of Class X Students at Prawira Marta High School

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ABSTRACT

Chemistry is often seen as difficult and boring due to its abstract nature. To increase students' interest, one effective method is using hands-on experiments, such as creating atomic models with rubber balls. This approach helps students better understand atomic structure and corrects misconceptions. This article summarizes Classroom Action Research conducted in two cycles during the 2023/2024 academic year with grade X students at Prawira Marta High School. The research aimed to boost students' interest in Chemistry through planned, implemented, observed, and reflected activities. Instruments used included lesson plans, worksheets, observation sheets, and questionnaires. Indicators of increased interest were happiness, enthusiasm, attention, and active participation. Results showed that students' interest in Chemistry improved across all indicators from Cycle I to Cycle II, with Cycle II showing very good criteria in all aspects. It can be concluded that making atomic models significantly increased the interest in learning Chemistry among grade X students at Prawira Marta High School.

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INTRODUCTION

Human potential and abilities can be formed through education. Education obtained through school is also called formal education. Senior High School is one of the levels of formal education implemented in Indonesia. Several subjects began to be introduced at the high school level, one of which was Chemistry. Chemistry learning is included in the category of Natural Sciences which is abstract so that it often makes students misunderstand the principles of Chemistry (Rahayu & Fitriza, 2021). This is because there are many concepts of Chemistry that cannot be directly observed with the naked eye. In actualizing this abstract concept, the application of the Independent Curriculum to Chemistry learning makes educators aware of the differentiation of student competencies as a whole so that students' innovations and scientific thinking competencies can develop (Naibaho & Suryani, 2023).

The many concepts taught often make it difficult for students to visualize them, which has an impact on decreasing interest in learning. It is important for a teacher to arouse interest in learning because students who show interest in learning show increased learning achievement because students hone their scientific and rational thinking skills during learning (Sirait, 2016). There are several points that can show interest in learning chemistry, namely attention, feelings of happiness, interest, involvement, and satisfaction (Hemayanti et al., 2020). In previous research, the indicators of learning interest were listening to learning, there was interest in the material being studied, students showed enthusiasm, were involved in the learning process, and were not passive during learning (Adnyana & Yudaparmita, 2023).

In an effort to arouse interest in learning, many challenges are encountered in learning Chemistry. The subject of Chemistry emphasizes the combination of various different concepts and principles so that it requires the presence of a teacher who is able to integrate and present more effective learning. Teachers are required to be skilled, innovative, and observant in seeing the opportunities and needs of students in learning Chemistry. Teachers can improve the quality of education by determining and applying the right learning methods to students (Phelia et al., 2021). In addition, teachers can increase students' interest in learning by applying media in learning because learning media is an effective means of passing on information to students (Wulandari et al., 2023). Not only that, but two-way communication also that occurs between teachers and students can arouse interest in learning in students so that it becomes one of the main functions of a teacher (Sari et al., 2021).

Students can have an interest in learning with various methods, one of which is to relate an event to the material being studied (Charli et al., 2019). There are various methods that can be applied in learning Chemistry, including demonstrations and practicums. As a support in this method, the use of learning media will present real experiences and make students enthusiastic about learning, as well as improve students' memory (Munika & Kurniati, 2020). Technological advances affect the education sector, so teachers need to master the competence of using media and its application in a learning for the success of students in achieving their learning outcomes (Krause et al., 2017). The science learning process requires a tool called science props to encourage students to be actively involved and participate in the learning process. In the application of the demonstration method, teachers need these supporting tools because applying modeling learning with simple chemistry teaching aids can increase students' understanding of concepts (Musahidin et al., 2022). Teaching aids have more value because their use is long-term and adaptive so that they can attract students' interest in learning (Fatmawati, 2023). Previous research has shown that teaching aids are the right medium for students to explore unreal concepts and images (Yonzon et al., 2023). In learning Atomic Structure material, there are many choices of teaching aids that can be used by teachers, for example posters, slides, and atomic models or KIT. The introduction of atomic models to students shows a high percentage of student understanding, which is 92% in making atomic models scientifically (Yavuz & Savaşcı-Açıkalın, 2018).

In the Chemistry lesson on Atomic Structure and Its Application in Nanotechnology which was carried out in class X of SMA Prawira Marta Kartasura Sukoharjo, when students were asked to identify the atomic parts in the atomic model drawn by the teacher on the blackboard, students showed confusion in determining the atomic parts. In addition, students have difficulty understanding the orbits in the Rutherford atomic model and the atomic shell in the Bohr atomic model based on the image of the atomic model on the Student Worksheet. At the end of the lesson, the students showed a less enthusiastic response in the discussion activities given by the teacher. This phenomenon is in line with the findings of previous research that students have difficulty understanding atomic structure, so teachers need to apply the right learning strategies and media to the material because students' thinking skills are not the same from one to the other (Girón-Gambero & Franco-Mariscal, 2023). In addition, the atomic structure is abstract and cannot be seen directly by the eye (Muslim et al., 2021). Atomic Structure material is one of the basic concepts of chemistry, if students misinterpret the concept, it can have an impact on students' low understanding and confuse them later when learning other chemical concepts.

This research was carried out based on experience in teaching and learning atomic structure materials that showed low interest among students so that it had an impact on students' understanding of the material being studied. The purpose of this study is to determine the influence of making atomic models on the interest in learning chemistry of grade X students at Prawira Marta High School. The creation of an atomic model using a rubber ball was chosen in this study so that students are more enthusiastic in participating in Chemistry lessons, can identify and determine atomic parts, and straighten out misconceptions about atomic structure.

METHODS

This research is Class Action Research. Improving learning in one subject, class, or school can be done through Classroom Action Research carried out by individual teachers (Astutik et al., 2021). The research was carried out in the even semester of the 2023-2024 Academic Year at Prawira Marta High School for two months with a research schedule of April 8 - June 9, 2024. The students are class X with an overall number of 19 students.

The research was carried out in two cycles as seen in Figure 1. Cycle I will be carried out from April 22, 2024 to May 5. Cycle II will be held from May 6, 2024 to May 19, 2024. The stages of action used are planning, action, observation, and reflection in each cycle. The preparation of the Learning Improvement Plan (RPP) is carried out at the planning stage. The implementation of the research was carried out using the practicum method, filling out the LKPD, and discussion. Data collection was carried out by means of structured observation and questionnaires. Observation sheets in teaching activities can use checklist to mark predetermined observation indicators (Hong et al., 2020).

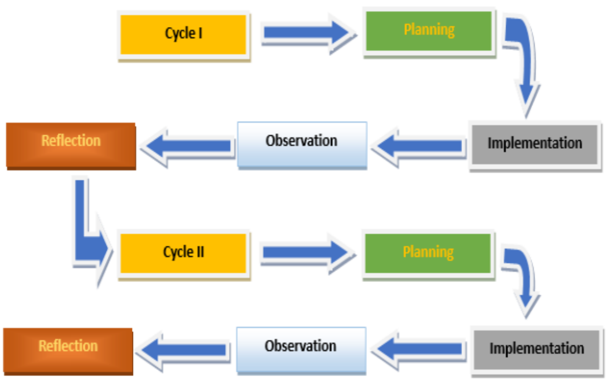

Figure 1. Description of the Classroom Action Research Cycle

The data used is primary data where researchers must obtain data from the first source using certain instruments (Tan, 2021). The research instruments consisted of the Learning Improvement Design (RPP) Cycle I, Cycle II RPP, Cycle I Observation Sheet, Cycle II Observation Sheet, Student Worksheet (LKPD), and questionnaire. The learning model applied during the Classroom Action Research uses a guided inquiry learning model.

The indicators of learning interest in this study are that students show a feeling of joy in learning chemistry, students show high enthusiasm for learning chemistry, students have a special interest in learning chemistry, and students fully contribute to chemistry learning (Muhammad & Yolanda, 2022). Calculation of the number of percentages of learning interest indicators using the Percentage Formula (Fitron & Mu'arifin, 2022):

$$P = \frac{F}{N}\, x\; 100\;\%$$

Where P is the percentage of assessment, F is the frequency (the number of students according to the indicator), and N is the maximum number (the total number of students). The percentage interval distance is used to determine the percentage distance from 0% - 100%(Fitriyani et al., 2020). The criteria for the percentage of values are based on the intervals in Table 1.

Table 1. Criteria for the percentage of grades

Number	Information
80 - 100%	Excellent
60 - 79,9%	Good
40 - 59,9%	Enough
20 - 39,9%	Not Good
0 - 19,9%	Bad

The collection of Cycle II questionnaire scores uses the *Likert Scale because the* Likert *Scale* can be used as a research instrument in presenting quality data for those who use it (Suasapha, 2020). The Assessment Scale (*Likert* Scale) is made with a rating range from 1-5 with the interpretation of the number 1 is very lacking; 2 is less; 3 is enough; 4 is good; and 5 is excellent.

RESULT AND DISCUSSION

Pretest

The results of the pre-action observation data showed that students had difficulty in determining atomic parts, were wrong in identifying atomic models, and showed low interest in the implementation of the discussion method in class. The discussion did not go well because only a few students contributed to expressing their opinions. Table 2 presents the data on the students' grades doing assignments on the Student Worksheet (LKS) and shows achievement achievements with very good grade criteria with a small number.

Table 2. Student pre-test scores on atomic structure materials

LKS Values	Number of Achievements (Students)	Value Criteria

81-100	3	Excellent
61-80	8	Good
41-60	8	Enough
21-40	-	Not Good
0-20	-	Bad

Cycle I

Activities in the Cycle I stage are divided into three main parts, namely initial activities, core activities, and closing activities. In the initial activity, the researcher as a teacher opened the lesson and greeted the students. Then the teacher performs aperception by relating to the previous lesson, namely the material of Atomic Structure and its Application in Nanotechnology. After that, the teacher conveyed the purpose of learning improvement, namely increasing students' interest in learning Atomic Structure material through experimental activities to make atomic models using rubber balls. Furthermore, there are several stages in the core activities, namely orientation, problem formulation, hypothesis submission, data analysis, and conclusion. In the orientation activity, the teacher asked students to form groups and use learning resources that are relevant to the material being studied. Then the teacher showed the drawings of the atomic models of Dalton, Thompson, Rutherford, Bohr, and Quantum Mechanics in front of the class. The formulation of the problem presented is that students explain the fundamental differences in different atomic theories based on atomic structures and atomic models made with rubber balls.

Students in groups create an atomic model using provided materials by drilling holes in rubber balls, tying them with wire, arranging the balls according to their chosen atomic model, and securing the wire on a styrofoam base. They use glue guns to stabilize the model. After forming hypotheses through group discussion, students analyze data and draw conclusions based on their models, summarizing their findings in a brief written report.

In the closing activity, the teacher guided the students to summarize the learning and gave assignments as a form of reinforcement of the material studied. During Cycle I, the researcher was accompanied by the appointed Supervisor 2 and made observations using a structured observation method. Supervisor 2 puts a checkmark in the indicator column that appears on the student.

Based on the calculation of data in Table 1, the students who showed a feeling of joy in learning chemistry amounted to 16 people with a percentage of 84.2% and very good criteria as seen in Table 3. Then 16 students showed high enthusiasm with a percentage of 84.2% (very good criteria). Students who showed special attention were 14 people (73.7%) with good categories and the number of students who fully contributed was 15 people (78.9%) with good categories.

Reflection was carried out after Cycle I was completed and there were several findings recorded by Supervisor 2, namely students did not get a Student Activity Sheet specifically for experimental activities to make an Atomic Model with a rubber ball, the lesson hours were not enough so that there was one group that did not finish making the atomic model on time, and the grouping of students was still homogeneous.

Table 3. Observation data of Cycle I

Indicator	Total Achievements	Percentage	Criterion
Feelings of joy	16	84,2 %	Excellent
High enthusiasm	16	84,2 %	Excellent
Special attention	14	73,7 %	Good
Full contribution	15	78,9 %	Good

Cycle II

Based on the observation data on the observation and reflection sheet, it is necessary to make improvements again in Cycle II. The stages in Cycle II are learning improvements in accordance with the reflection of Cycle I with several changes such as adding lesson hours, making Student Worksheets, and grouping is arranged more heterogeneously.

The stages of activities in Cycle II are the same as Cycle I including initial activities, core activities (orientation, problem formulation, hypothesis submission, data collection, and conclusion), and closing activities. Students again create Atomic Models with different group members. In making an Atomic Model, students use guidelines and steps according to the LKPD that is shared. The activity of making the Atomic Model in Cycle II took place quickly and in accordance with the specified time allocation. Observations were made in Cycle II and are contained in Table 4.

Table 4. Observation data of Cycle II

Indicator	Total Achievements	Percentage	Criterion
Feelings of joy	18	94,7 %	Excellent
High enthusiasm	18	94,7 %	Excellent
Special attention	16	84,2 %	Excellent
Full contribution	16	84,2 %	Excellent

Based on the data presented in Table 4, the percentage of high feelings of joy and enthusiasm was 94.7%. Meanwhile, the indicator of special attention and the contribution of the perpetrator was 84.2%. During Cycle II, students can properly identify parts of the atomic structure including electron orbits and electron shells. After working on the Atomic Model in groups, students fill out a questionnaire according to Table 5 which is distributed and filled out individually.

Table 5. Questionnaire on experimental activities to make atomic model teaching aids using rubber balls

No.	Question	Very Poor	Less	Enough	Good	Excellent
1.	Do you like the activity of making props?					19
2.	Do you feel excited during activities?				4	15
3.	Don't you feel bored when doing activities to make props?				4	15
4.	Do you feel given the opportunity to be creative in the activity of making atomic model props?			4	5	10

5.	Do you know where the electrons are in the Rutherford atomic model?		9	5	5
6.	Do you know where the nucleus of the atom is in Bohr's atomic model?		9	5	5
7.	Can you tell the difference between the atomic models of Dalton and Thompson?		10	4	5
8.	Do you want to learn chemistry with other practicum methods?			2	17
9.	Do you like atomic structure materials?	4	5	5	5
10.	Did you like chemistry?		4	10	5

The achievement of learning goals can be realized by increasing student enthusiasm and making appropriate learning plans by competent teachers (Novitasari, 2023). In this study, the learning model applied is guided inquiry by conducting a practicum method of experimental activities to make an atomic model with a rubber ball. This learning model puts students at the center and plays an active role in finding, analyzing, and concluding a problem.

The use of the guided inquiry model in Cycles I and II is very suitable to be applied because the model can show an increase in critical thinking competence in students (Sarifah & Nurita, 2023). In addition, the use of LKPD in Cycle II makes students more detailed in carrying out experimental steps. This is because the use of LKPD can support the teaching delivered by teachers and can help students understand the principles of chemistry and maximize the contribution and active role of students in learning (Muslimah, 2020). The Questionnaire on experimental activities used as seen in Table 5 and the results of the questionnaire can be seen in Figure 2.

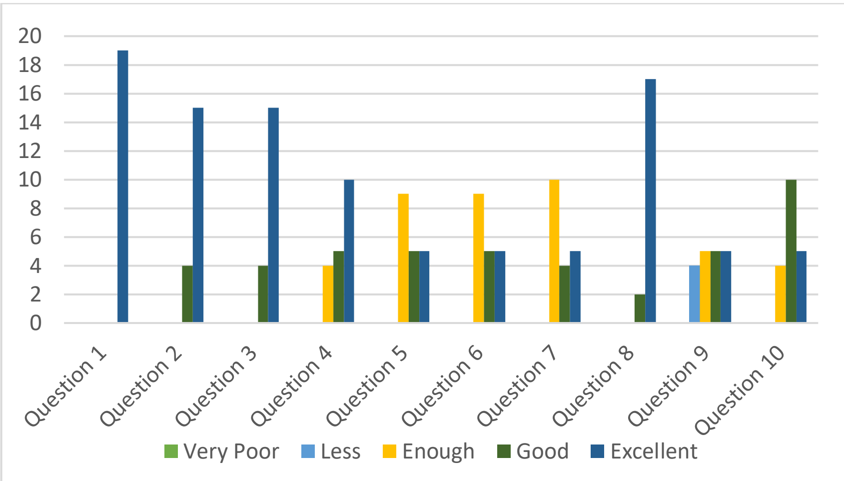

Figure 2. Results of questionnaire data on atomic model making activities

Teachers can increase students' interest in learning by applying media in learning because learning media is an effective means of passing on information to students (Wulandari et al., 2023). The selection of Atom Model media to increase students' interest in learning is an appropriate step because indicator data shows an increase in learning interest indicators. Based on observations made in Cycle I and Cycle II presented in Table 6, there appears to be an increase in all indicators, namely feelings of joy, high enthusiasm, and special attention of 10.5% each. Meanwhile, the full contribution indicator experienced an increase in percentage by 5.3%. The criteria in Cycle I show very good and good. Meanwhile, the improvement of learning in Cycle II showed very good criteria in all indicators. The increase in the percentage of learning interest indicators is presented in the form of a diagram in Figure 3.

Based on the answer to question 1 in Table 5, all students showed their love for the activity of opening the props. The high interest in experimental activities makes the atomic model have a significant impact on increasing interest in learning chemistry using the practicum method. This can be seen in the 8th question where 17 students chose the criteria of strongly agreeing with the chemistry learning of other materials with the practicum method. This method can increase student contribution where students learn to carry out the role of group leader or member, draw conclusions, and prepare written reports so that this method can create meaningful learning (Bae et al., 2021).

Table 6. Comparison of percentage of chemistry learning interest indicators Cycle I and Cycle II

Indicator	Total Achievements		Percentage		Criterion	
	Cycle I	Cycle II	Cycle I	Cycle II	Cycle I	Cycle II
Feelings of joy	16	18	84,2%	94,7%	Excellent	Excellent
High enthusiasm	16	18	84,2%	94,7%	Excellent	Excellent
Special attention	14	16	73,7%	84,2%	Good	Excellent
Full contribution	15	16	78,9%	84,2%	Good	Excellent

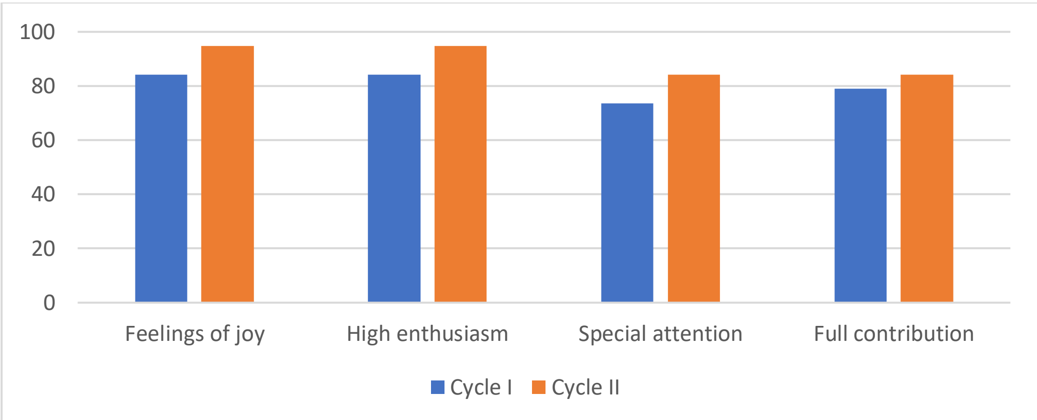

Figure 3. Comparison percentage of chemistry learning interest indicators Cycle I and Cycle II

In question 9 regarding students' liking for Atomic Structure material, there is a questionnaire answer that shows the less criteria. This happened because students were absent from the Chemistry learning before the Pretest was held and students had not studied the Atomic Structure comprehensively. This behavior affects the mastery and understanding of the material being studied. This is confirmed by previous research that there is a relationship between student absenteeism and learning achievement so that student absenteeism in class can have a negative impact in the future (Klein et al., 2022).

Figure 4 shows the activities during the learning improvement in Cycle I and Cycle II where students make an Atomic Model determined by their respective groups. According to the data in Table 1 and Table 2, students showed high enthusiasm in making Atomic Model props using rubber balls. The use of teaching aids in learning can make students fully contribute, increase student retention or memory, and have a good impact on learning interest (Tamari et al., 2015). The benefits of implementing interactive learning between teachers and students include students contributing directly, the emergence of interest in learning because students actively study the material, and the flexibility in the learning process (Sadykov & Trnáctová, 2019).

Figure 4. Learning Improvement Activities in Cycle I and Cycle II

CONCLUSION

Based on the Classroom Action Research carried out during 2 cycles, the observation results showed an increase in each indicator of learning interest, namely feelings of joy, high enthusiasm, and special attention by 10.5% each. Meanwhile, the full contribution indicator experienced an increase in percentage by 5.3%. The criteria in Cycle I show very good and good. Meanwhile, the improvement of learning in Cycle II showed very good criteria in all indicators. Students also able to identify parts of the atomic structure including electron orbits and electron shells by using atomic model that they created during Cycle I and Cycle II. Therefore, it can be concluded that the experimental activity of making an Atomic Model using a rubber ball can increase the interest in learning chemistry of class X students of Prawira Marta High School.

Based on this conclusion, the author gives advice to various parties, including for students to remain enthusiastic in participating in chemical training and improve cohesiveness and cooperation in the working group. For teachers to prepare for learning carefully, reflect after learning, and be more creative in choosing learning methods. Meanwhile, for schools to be more innovative in creating a climate and atmosphere in schools so that they can make students more enthusiastic in learning and pursuing knowledge.

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