SKILL IN DESIGNING EXPERIMENT USING THE STIMULANT QUESTIONS FOR JUNIOR HIGH SCHOOL STUDENTS

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Abstrak

Curriculum of 2013 emphasizes the application of Scientific approach which includes observing, questioning, experimenting, associating and communicating. In fact, not all teachers are master that and teach it to their students. Purpose of this research is to assist teachers making lesson plan in designing experiment and help students to lern in designing experiment. The respondent were 27 students grade 8. Metode of this research is research action class. Instruments used were lesson plans in designing experiment, observation sheets, cognitive test sheets, and questionnaire sheets. Data analyzed in qualitative descriptive. The results showed an average 84.82% of students were able to design the experiment with help of stimulant questions. This is supported by questionnaires filled out by students, the results show that on average 85.93% of students stated it was helped by stimulant question when designing experiments. The test results showed an average 82.96% of students were able to design experiment with help of stimulant questions. From the results of the study can be concluded that through stimulant questions, students can skillfully design the experiments.

Keywords: *scientific approach, skills of designing the experiment, stimulant questions*

1. Introduction

Learning science is learning to know about nature systematically. Science is not just about mastering collection of knowledge in the form of facts, concepts or principles but also a process of discovery. Curriculum of 2013 (K-13) emphasizes the application of a scientific approach which includes observing, questioning, trying, reasoning and communicating activities. The purpose of the learning processes that exist in scientific learning emphasizes that learning does not only occur in the classroom, but also in the school and community. Teachers simply act as scaffolding when learners find some difficulties, as well as teachers are not the only source of learning. Then, attitude is not only taught verbally, but through example and exemplary (Atsnan, 2013)[1].

In fact not all teachers are master in observing, questioning, experimenting, associating and communicating, even less teaching it to the students. Science learning of today is that learners tend to study science as a product, memorizing concepts, theories and laws (MoNE, 2008)[2]. The practice is only to prove, not to find or solve problems. Scientific work in learning activities that are demanded in science lessons have not yet appeared. The researchers gave the example of lasson plan particularly in the process of skill designing experiments using stimulant questions. This activity is carried out to meet the demands of the government in implementing scientific work steps in learning activities that aim to help teachers solve problems.

Planning an experimental activity includes several activities using mind including into the skill of planning process of inquiry. Experimental or investigative planning involves the activity of determining tools and materials for investigation, determining control variables and independent variables, determining what is observed, measured, or written and determining how and how to work (Rustaman, 2005: 97)[3].

One way to develop how students think in order to gain new knowledge in learning can be done by asking techniques, so that learning objectives can be achieved. The correct questioning technique can provide a more meaningful and enjoyable learning quality, resulting in the interaction between teachers and students directly. When giving questions should be attentive, courteous, polite, and non-offensive, and if there are students who can not answer questions, they do not feel humiliated or do not drop their learning spirits (Sumiati and Asra, 2008)[4].

Purpose of this research is to assist teachers making lesson plan in designing experiment and help students to lern in designing experiment. Benefits of this research for researchers and teachers who read it is that to provide the examples of lesson plan in stimulating students to sensitively design experiments. While the benefits of this research for students are students able to skillfully design experiments.

2. Research Methods

This research uses classroom action research method with teacher as researcher. Classroom action research is a tangible step done by the teacher in improving the quality of the learning it does (Widayati, 2008)[5]. Purpose of is to improve the quality of classroom teaching practice. The main focus on students or teaching and learning activities takes place in the classroom (Kunandar, 2011)[6].

This study was designed with the following below:

A. Research Respondent

Respondents are 27 of Junior High School Students grade 8.

B. Planning

Making research instruments that mean it is a lesson plan which part is about designing experiments, observation sheets, test designing sheets, and questionnaire sheets.

C. Doing

Data collection through activities is in accordance with Lesson Plan. During learning activities took place observer fill out the observation sheet. After the material has been taught, the students are given a test sheet to work on and at the end of the students' learning program, they are distributed a questionnaire sheet to fill out.

D. Reflecting

Data from observation sheets, test sheets, and questionnaire sheets obtained were processed to determine effectiveness of the ongoing learning activities. By the following criteria below:

- Observating Sheets: at least 70% of students are able to design the experiment correctly.
- Test Sheet: at least 70% of students get a minimum score of 70 on matter of designing experimental material taught.
- Questionnairing sheet: at least 70% of students said they were able to design experiment correctly.

E. Data Analysis

The research used descriptive research method, with qualitative descriptive data analysis technique.

3. Results and Discussion

3.1. Magnet

Learning objectives: through experiments, students can show that the magnetic forces are not the same in every part of the magnet.

Activity 1 begins with, *"What does it take to know the magnetic force of each part?"*. 85.19% of the students answered magnets and magnetic materials. Continue with, *"How many magnets are there?"*. It can be answered 1 magnet required by 85.19% of students. Continue with, *"What are magnetic materials we can use?"*. Magnetic materials which were answered by 85.19% the number of students is iron powder, small spikes, spring balance, and the contents of staples.

a. Iron Powder

Beginning with, *"What shall we do?"*. As many as 85.19% of students answered the magnet sprinkled with iron filings. Then, *"Which part is sprinkled?"*. Because 85.19% of the students answered only one end, then continued with, *"Is only part A being sprinkled?"* and *"Then which part?"*. Can be answered all parts of magnet sprinkled with iron powder by 85.19% of students.

In order for students to be able to name what will be observed in experiment, the student is herded using question, *"What will we observe?"*. 85.19% of students answered the number of iron filings attached to each section of the magnet. Before doing the experiment, magnet should be wrapped with plastic to make it easier when cleaning the iron powder. Next, *"How to image the experiment?"*. One student was asked to describe his experimental design and the other students were asked to give their opinion on whether to agree with the drawings on the board. Here is an experimental design drawing agreed by 88.89% of students:

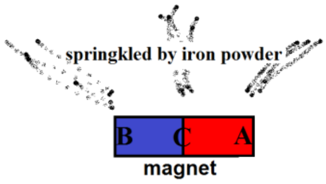


Image1. Magnet is springkled by iron powder

b. Nail

Students are asked a stimulant question about what to do using magnet and nails, *"What are we going to do?"*. As many as 85.19% of students answered put a magnet between the spikes. Then what will be observed in the experiment, *"What will we observe?"*. Answered the number of spikes on each section of magnet by 85.19% of students. Students are herded in order to illustrate the design of the experiment. *"How to image the experiment?"*. Because the students have got the picture based on Experiment 1, so in Experiment 2 this 88.89% of students can be easier in designing the experiment. Here is a picture of the experimental design:

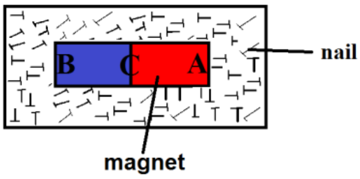


Image2. The magnet is held close to the nails

c. Spring Balance

The experiment began with students being asked a stimulant question, *"What are we going to do?"*. 85.19% of students answered the stick of the spring to the magnet. Continue with, *"taped to the magnet which part?"*. Because of previous trials students already know that magnetic force will be observed on all parts of the magnet so the stimulant question can be easily answered by 85.19% of students. Next the student was asked the next step, *"Once affixed, what will we do?"*. It was answered by slowly drawing its spring balance by 85.19% of students.

Then students were led over what will be observed, *"Then what will be observed to see the magnetic magnitude?"*. 85.19% of students answer the number of the balance sheet will be separated from the magnet. Followed by students being led to draw the experiment, *"How is the experimental image?"*. Because the students have got the description based on Experiments 1 and 2, so in Experiments 3 is 85.19% of students can be easier in designing experiments. The picture of the experimental design can be seen in Image 3:

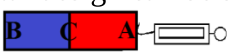


Image3. Magnet are drawn using the spring balance

d. Staples

As in previous experiments, students were asked a stimulant question in order to design an experiment, *"What are we going to* *do?"*. 85.19% of students can answer correctly that is sticking and arrange the staples. Then, *"What is the position of the magnet? Are we just put on the table or we hang or what?"*. It is answered by 85.19% of students.

Continue with, *"Then which parts will be filled with staples?"*. Can be answered both ends and middle sections by 85.19% of students. Furthermore, students are asked to describe the experiment design, *"How to compose the contents of staples?"*. And as many as 85.19% of students can describe the composition of staples contents:

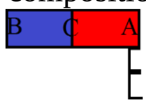


Image4. The staples are arranged on a magnet

Based on the observation of learning activities above:

- Stimulated, logical, easily understood, and stimulatory questions are helpful in designing an experiment to determine the magnetic force of each part by 87.04% of students.
- 88.89% of students assisted in designing experiments to know magnetic strength of each part.
- 85.19% of students declaret that stimulant questions were coherent, logical, easy-to-understand stimulant question, and can assist them in designing an experiment to find out magnetic strength of each part.

3.2. Work

Learning objectives: through demonstration and discussion, students can explain the relationship between angle of tilt and force required to lift object to a certain height.

Activity 2 began by asking, *"How does angle influence (θ) affect the force required to lift the block from A to h height?"*. It is followed by giving pictures to stimulate students in designing experiments. For students to design free variables, bound variables, and controls, it was led by the question: *"If we will see the effect of θ on force required to lift the beam from A to height h", "What do we change (free variables)?", "What will we observe (bound variable)?"*, and *"What is made equal (control)?"*. As many as 88.89% of students can answer the angle(θ) to free variable, the bound variable is force (F) required, and the control is height (h).

Students were then led to mention what objects are needed, *"What do we need?"*. 88.89% of students answered the beam. Followed by the question, *"Besides the beam, what else do we need?"*. It is answered the incline area by 88.89% of students. Then, *"What tool is used to measure large θ?"*, and *"what measuring instrument is used to determine the magnitude of the force and the distance length?"*. It can be missed measure θ using arc, measure the magnitude of force using spring balance, and measure the length of distance using the ruler. Each question can be answered by 88.89% of students.

Then the students began to be herded in order to know how to change the angle of the tilt, *"How to vary the magnitude θ?"*. As many as 88.89% of students answered tilted. Followed by, *"How do I know the amount of force (F) needed to pull the beam from A to B?"*. Answered was associated with the spring balance then with drawn by 88.89% of students. Furthermore, students were herded in order to draw the experiment design, *"How to image the experiment?"*. And as many as 81.48% of students can describe the experimental design:

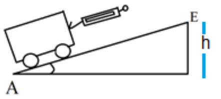


Image 5. The train is drawn using the spring balance

Students were guided to create a data plan using the question, *"Data will be displayed in the form of narration, tables, or graphs?"*. 88.89% of students answered the table. It was followed by the question, *"What's the table? Consist of any column? Look at the free and bound variables!"*. It can be easily answered by 88.89% of students, consisting of no, θ, F, and s.

When would filled the table, students were led by the question, *"Among θ, F, and s which should we specify freely? Write it in the appropriate column!"*. Answered θ by 88.89% of students. It was followed by, *"After that, what will we observe?"*. As many as 88.89% of students answered F and s.

Based on the observation of learning activities above:

- Stimulant questions were declared as logical, logical, easy to understand, and able to help design the experiment to determine the effect of the slope angle (θ) on the force required to lift the beam from A to E with h height by 85.19 % of students.
- 92,59% of students assisted in designing the experiment to know effect of the inclination angle (θ) on force required to lift the beam from A to E with h altitude.
- 88.89% of students declared that the stimulant questions were, logical, easy to understand, and can help them in designing an experiment to determine the effect of the inclination angle (θ) on the force (F) required to lift the beam from A to a certain height (h).

3.3. The Pressure of Solids

Learning objectives: Through demonstration and discussion, students can explain the factors that influence the magnitude of the substance pressure.

Activity 3 began with experiment 1 that was investigating the influence of force magnitude (F) on the amount of pressure (P), *"How does F against P influence?"*. The student is silent and then proceeds with question, *"If we will see the effect of F on P, what do we change (free variables)?", "What will we observe (bound variable)?", and "What is made same (control)? "*. 92.59% of students can answer the free variable Force, the dependent variable Pressure, and the control of the base area.

To find out what is needed in an experiment 1 students were led with the question, *"What do we need?"*. 96.30% of students answered the beam. Followed by, *"Beam as what?"*. It is missed load or force (F) by 92.59% of students. Next, *"How many blocks are needed?"*. Can be answered 1 beam by 92.59% of students.

Then the students were led to mention other things needed, *"Is it just a beam?"*. It is not answered not by 92.59% of students. Continue with, *"Where should be the beam?"*. 92.59% of students answered the table. Furthermore, *"If placed on a hard-textured table, can we trace the trail left behind?"*. As many as 92.59% of students said no. So it went with the question, *"To be able to see his footsteps using a hard or soft base?"*. It can be answered softly by 92.59% of students. Students were directed to mention soft materials that can be used using the question, *"What objects are soft and can we use?"*. There were students who answered plastisin and there is an answer butter. In order for students to choose butter as a medium the question was used, *"Among the ingredients, it is better to use the ingredients that if taken the object will be more easily observed the depth. If using flour, the traces left behind will be easily destroyed making it hard to see. Among the plastics and butter is better seen which one? "*. And as many as 92.59% of students answered butter.

Next the students were led using the question, *"What should we do to enlarge his style?"*. 92.59% of students answered add load. Continue with, *"What is observed to see the pressure?"*. Answered butter depth by most of the students. Then the student was drawn to draw his/her experimental design, *"How is the experimental image?"*. Here is the experimental design drawing agreed by 96.30% of students:

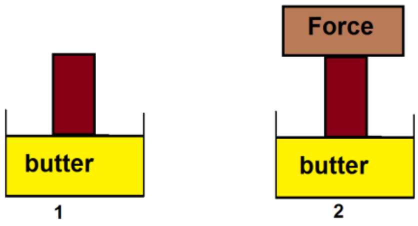


Image6. Pressure with different loads

In Experiment 2, students were investigated to investigate the influence of the large surface area (A) on the magnitude of the pressure (P), beginning by asking the question, *"How does A affect P?"*. The student was silent and continues with, *"If we will see the effect of A on P", "What do we change (free variables)?", "What will we observe (bound variable)?", And "What is made same (control)? "*. 92.59% of students answered the free variables is surface area, bound variable pressure, and the control is size of force.

Followed by herding whatever things were needed, *"What do we need?"*. 92.59% of students answered the beam. Then, *"Where is the beam placed?"*. Because already know from the experiment 1, as many as 92.59% of students can answer butter. Next, *"How many blocks are needed?"*. It's answered 1 block by 92.59% of students. And continued with, *"Why?"*. The reason can be answered by 92.59% of students, that is because the size of the force must be controlled.

Then in the experiments, the students were herded with, *"To change the surface area, what should we do?"*. 92.59% of students responded putting the sides of the beam that were different in breadth. Furthermore, *"What is observed to see the pressure?"*. Can easily answer the depth of butter by 92.59% of students. Students were then drawn to draw the experimental design, *"How is the experimental image?"*. Here is the experimental design drawing agreed by 96.30% of students:

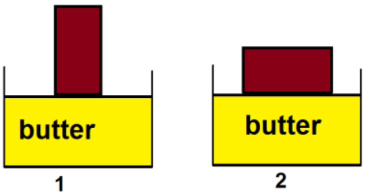


Image 7. Pressure with different surface area

Based on the observation of learning activities above:

- Stimulant questions were declared as logical, logical, easy to understand, and were able to help design experiments to investigate the effect of force on the magnitude of the pressure by 94.45% of students.
- 74.07% of students assisted in designing experiments to investigate the effect of force on the amount of pressure.
- 96.30% of students declared that stimulant questions were, logical, easy to understand, stimulant, and can help them in designing an experiment to investigate the effect of force on the amount of pressure.

3.4.Uniform Rectilinear Motion

Learning objectives: Through practicum and experimentation, students can investigate the characteristics of GLB (Gerak Lurus Beraturan/Uniform Rectilinear Motion) and can explain the relationship of distance, velocity, and time in GLB.

Activity 4 is about the characteristics of GLB and the relationship between distance (s), time (t), and velocity (v) uniformly straight-moving objects.

a. 1st Experiment. GLB Characteristics

The experiment began by introducing the ticker timer to students, *"The steel plate on the ticker timer vibrates according to the house's electrical frequency of 50Hz. What does it mean?"*. 85.19% of students answered there were 50 beats in 1 second. Next to find the time on each tap, *"From 1 point to the next point takes time how many seconds?"*. Answered by 85.19% of students using calculations: $t = \frac{1 ketukan}{50 ketukan} \times 1\ detik = \frac{1}{50} detik\ atau\ 0{,}02\ detik$. In the ticker the timer was fed with carbon paper, so when the ticker timer vibrates it can be seen tapping on the paper connected to the moving train.

Students were then led to mention the required item, *"What do we need?"*. Can be answered ticker timer, train, paper tape by 85.19% of students. After that, *"What are we going to do?"*. Based on the previous discussion on how the ticker timer works, as many as 85.19% of students answered the train is moved on the track on the back in a paper ribbon that is connected with the ticker timer. Then, *"What will we observe?"*. 85.19% of students answered the point on the paper ribbon.

b. 2nd Experiment. The Influence of velocity (v) on distance (s)

It was followed by experiments on the relationship between the distance (s), time (t), and velocity (v) the straight-moving regular object. Beginning with the question, *"For t fixed, if v1> v2, how is the length of s1 compared to the length of s2?", "What do we change (free variables)?", "What will we observe (bound variable)?","What is made equal (control)?"*. 85.19% of students answer the free variable is velocity (v), the bound variable is distance (s), and the control is time (t).

The experiments of the experiment were led by, *"How do I vary the magnitude of v?"*. As many as 85.19% of students strongly encouraged and driven weak. Next, *"What do we use to push things?"*. It is answered by 85.19% of students. Then, *"What objects can we use as objects to be encouraged?"*. It can be missed by train by 85.19% of students.

Next, *"What will we observe to see the effect of v on s?"*. 85.19% of students answered measure the distance. Continue with, *"To measure the distance using what?"*. It was answered by ruler by 85.16% of students. Then, *"What do we use to measure the time?"*. Can be missed using stopwatch by 85.19% of students. Next, *"What do we need?"*. 85.19% of students answered the train, stopwatch, ruler, hand push.

Students were then drawn to draw their experimental design, *"How to draw the experiment for the same time?"*. Here is the experimental design drawing agreed by 81.48% of students:

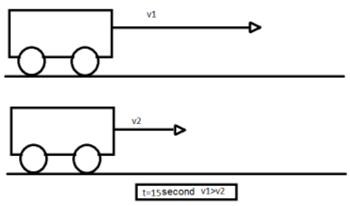


Image8. The Influence of velocity (v) on distance (s)

c. 3rd Experiment. The Influence of Distance (s) to time (t)

Beginning with, *"For v fixed, if s1> s2, how does time t1 compare with time t2?", "What do we change (free variable)?", "What will we observe (bound variable)?", and "What is made equal (control)?".* 85.19% of students answer the free variable is distance (s), bounded variable is time (t), and the control is velocity (v).

In the experiment it was led by, *"How to vary the magnitude s?".* 85.19% of students answered short distance and long distance. Next, *"To measure the distance using what?".* It is answered using a ruler by 85.19% of students.

Next, *"What will we observe to see the effect s on t?".* 85.19% of students answered the time gauge. Continue with, *"To measure what time to use?".* It was answered using stopwatch by 85.19% of students.

Then, *"How do I make the same v?".* Can be missed pushing at the same rate by 85.19% of students. Next, *"What do we use to push things?".* 85.19% of students answered the hand encouragement. After that, *"What objects can we use as objects to be encouraged?".* 85.19% of students has answered by train. And, *"What do we need?".* It was answered by 85.19% of students train, stopwatch, ruler, hand push.

Next the student was led to draw the experimental design, *"How to experiment pictures for a fixed speed?".* Here is the experimental design drawing agreed by 81.48% of students:

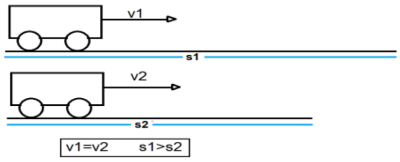


Image9. Influence of distance to time

d. 4th Experiment. The Influence of Velocity (v) to Time (t)

The experiment began with, *"For s fixed, if v1> v2, how does time t1 compare with time t2?", "What do we change (free variables)?", "What will we observe (bound variable)?" , and "What is made equal (control)?".* 85.19% of students answered the free variable is velocity (v), bounded variable is time (t), and the control is distance (s).

In the experiment it was led by, *"How to vary the magnitude v?".* 85.19% of students answered strongly encouraged and driven weak. Next, *"What do we use to push things?".* It has answered hand-picked by as many as 85.19% of students. Then, *"What objects can we use as objects to be encouraged?".* It can be missed by train by 85.19% of students.

Next, *"What will we observe to see the effect of v on t?".* 85.19% of students answered the time gauge. Continue with, *"To measure what time to use?".* It has answered by using stopwatch by 85.19% of students. Next, *"To measure the distance using what?".* It can be missed using a ruler by 85.19% of students. Then *"What do we* *need?"*. 85.19% of students answered the train, stopwatch, ruler, hand push.

Students were then drawn to draw their experimental design, *"How is the experimental image for a steady pace?"*. Here is the experimental design drawing agreed by most 81.48% of students:

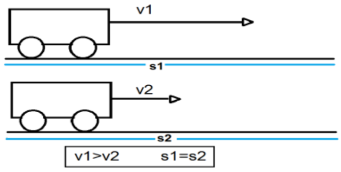


Image10. The influence of velocity against time

Based on the observation of learning activities above:

- Stimulant questions were declared as logical, logical, easy to understand, and are able to help design experiments to investigate the characteristics of GLB and explain the relationship between distance (s), time (t), and velocity (v) by 83.34% of students.
- 77.78% of students assisted in designing experiments to investigate the characteristics of GLB and to explain the relationship between distance (s), time (t), and velocity (v).
- 85.19% of students declared that stimulant questions were, logical, easy to understand, and can help them in designing experiments to investigate the characteristics of GLB and explain the relationship between distance (s), time (t), and velocity (v) objects that move straight irregularly.

3.5. Pressure on Gas

Learning objectives: through demonstration and discussion, students can explain the air pressure in the enclosed spaces and open spaces.

Activity 5 relies on air pressure on enclosed spaces and open spaces. This activity consists of 2 experiments, among others:

a. 1st Experience. Air pressure in enclosed spaces

Began with the question, *"To see changes in air pressure in the chamber when heated, what will we do?"*. 74.07% of students answered the air heats in the room closed. Next, *"What is a closed room?"*. It has answered by using closed containers by 74.07% of students. Continue with, *"When heated means using a container made of what?"*. And as many as 74.07% of students answer containers made other than plastic.

Then, *"What should be observed to see the change in pressure?"*. 74.07% of students answered the close reaction. Continue with, *"How will the lid react if the pressure enlarges when heated?"* and *"How does the lid react if the pressure shrinks when heated?"*. It can be answered by 74.07% of student, if the enlarged pressure will be thrown up and if the pressure shrinks the lid will fit into the container.

Students were led to mention what objects can be used in the experiment, *"What is in the lab that already has the lid?"*. 74.07% of students answered erlenmeyer & closed.

Furthermore, students were required to draw the experiment design, *"How to image the experiment?"*. The following is the sample of experimental design agreed by 74.07% of students:

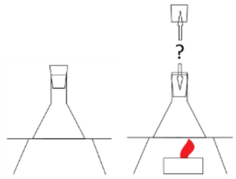


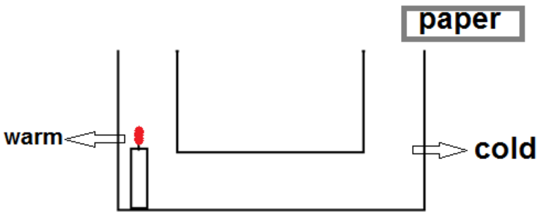
Image11. Air pressure in enclosed spaces

b. 2nd . Air pressure in open space

Experiment began, *"To see changes in air pressure when heated in open space, what will we do?"*. 74.07% of students answered heating air in open space. Furthermore, *"Is this room including open space?"*. It has answered by 74.07% of students. Followed by, *"Can you see the air in this open space?"*. And as many as 74.07% of students said no. Next, *"How to make air movement in open space can we see?"*. Can be missed using smoke so that air movement can be seen by 74,07% of student.

Students were then introduced with a gas convection box, *"This class is too large to be difficult to observe. What if we trap the air using this? Does this include open space?"*. As many as 74.07% of students answered yes. Continue with, *"Then what will we do?"*. It was answered by 74.07% of students, burning paper at one end of the box and lighting a candle. Then, *"What will we observe?"*. Then, it missed the movement of smoke in the box by 74.07% of students.

Furthermore, students were required to draw the experimental design, *"How to image the experiment?"*. The following is the sample of experimental design agreed by 74.07% of students:



Gambar 12. Air pressure in open space

Based on the observation of KBM above:

- Stimulant questions were declared as logical, logical, easy to understand, and were able to help design experiments to see the air pressure in closed spaces and open spaces by 74.07% of students.
- 81.48% of students assisted in designing the experiment to see the air pressure in the enclosed space and open space.

- 74.07% of students declared that stimulant questions were, logical, easy to understand, stimulant, and can help them in designing experiments to see air pressure in closed and open spaces.

Of the five activities showed an average of 84.82% of students were able to design the experiment with the help of stimulant questions. This was supported by questionnaires filled out by students, the results showed that on average 85.93% of students stated helpful through the stimulant question in designing the experiment. The test results showed an average of 82.96% of students were able to design the experiment with the help of stimulant questions. The results showed that the predetermined success criteria was achieved, so the study was discontinued.

4. Conclusion

This research can assist teachers making lesson plan in designing experiment and help students to learn in designing experiment. From the results showed that the predetermined success criteria was achieved, and through stimulant questions, students can be skilled in designing experiments.

5. Suggestion

The lesson plan can apply by teachers to be simple explanation in study. And this research can be continued on the next part or on the part of designing experiments with other materials.

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