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Research Article

The effect of application of learning start with a question concept photosynthesis on students' cognitive learning outcomes, critical thinking and scientific work IPA SMP

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ABSTRACT

One of the roles of the teacher in implementing an education is by using a learning starts with a question method. The learning starts with a question method is a method in which students are directed to learn independently by making questions based on the reading provided by the teacher. This study aims to see the effect of applying learning starts with a question on photosynthesis material on students' cognitive learning outcomes, critical thinking, and scientific work in class VIII SMP Negeri 15, SMP Negeri 7, SMP Kristen Kusu-Kusu, SMP Negeri 11, and SMP Negeri 4. Research data was analyzed quantitatively using descriptive and inferential statistics in the form of anacova analysis to see the effect of applying learning starts with a question on students' cognitive learning outcomes, critical thinking, and scientific work. The results of this study indicate that there is an effect of the application of the learning starts with photosynthesis material on students' cognitive learning outcomes, critical thinking, and scientific work.

Keywords: learning, question, critical thinking, scientific work.

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INTRODUCTION

One of the roles of the teacher in implementing an education is by using a learning starts with a question method. The learning starts with a question method is a method in which students are directed to learn independently by making questions based on the reading given by the teacher. The learning start with a question (LSQ) method is an active learning method that begins by asking questions and then the educator explains what students are asking (Susanto, 2013). The learning start with a question (LSQ) method is a learning method used to increase student activity in learning

in class. The activeness of students in the learning process will create an active learning situation. Active learning is very much needed by students to obtain maximum learning outcomes in this case student cognitive learning outcomes. Cognitive learning outcomes are changes in behavior that occur in the area of cognition. The learning process that involves cognition includes activities from receiving external stimuli by sensory, storing and processing in the brain into information to recalling information when needed to solve problems (Daryanto, 2008).

One of the active learning is scientific work. Scientific work is a basic skill that must be developed and trained, before using the scientific method. Being scientific includes students developing attitudes including curiosity, courage and courtesy, environmental concern, opinion scientifically and critically, cooperation, honesty and diligence (Simatupang, 2014). In this case students are also taught to have faith and critical thinking skills. The ability to think critically is an ability that is needed by someone in order to be able to deal with various problems faced in social and personal life. Critical thinking skills are of course inseparable from science subjects at school. The role of critical thinking skills is very important in science learning which is useful for the application of science in society with full responsibility (Santos, 2017).

Photosynthesis is one of the complex materials, so a student activity or practicum is needed to reinforce existing conceptual ideas so that the material can be well mastered by students. In terms of Ulfaetal's research (2020) one of the biology materials that is a difficulty for teachers and students is photosynthesis material as evidenced by the low student learning outcomes due to the lack of student activity in learning. To realize a good and correct learning, a reciprocal relationship is needed between the teacher and students, namely where the teacher provides a stimulus in the form of pictures, videos or questions and statements related to photosynthesis so that students who do not understand can ask questions. Based on the description above, the researcher will conduct a study with the title the influence of application learning start with a question on concept photosynthesis on students' cognitive learning outcomes, critical thinking, and scientific work IPA SMP.

METHODS

This study uses a quasi-experimental research type, namely a method that has a control class, but cannot fully function to control external variables that affect the implementation of the experiment (Sugiyono, 2009). The research locations were at SMP Negeri 15 Ambon, SMP Negeri 7 Ambon, SMP Kristen Kusu-Kusu Sereh Ambon and SMP Negeri 11 Ambon. This research is on Class VIII students. Where SMP Negeri 4 is used as the control Class. While SMP Negeri 15, SMP Negeri 7, SMP Kristen Kusu-Kusu Sereh, and SMP Negeri 11 were used as experimental classes. The time of this research was carried out in August-September 2022.

1. Research Procedures

The implementation of this research was carried out in several stages, namely as follows:

- Early stage
  a. Conducting observations at schools for research preparation and obtaining information about the teaching and learning process as a reference to be used for the division of the control class and the experimental class.
  b. Making learning tools including syllabus, learning implementation plans (RPP), student worksheets (LKPD), and teaching materials.
- Implementation Stage
  In this stage, the learning process is carried out both in the control class and in the experimental class to achieve the desired research objectives in accordance with the learning design that has been made.
- Data Collection Stage
  At this stage, data was collected through observation sheets, documentation, performance and written tests to be analyzed statistically.

2. Data Analysis

In data analysis, the data will be analyzed descriptively and inferentially with the following explanation:

In learning outcomes it can be said that a treatment is effective or not, researchers use the N-Gain test. N-Gain is a comparison of the gain scores obtained by students with the highest gain scores that students might get (Sugiyono, 2015). The analysis of the influence of student learning outcomes after learning uses the Normalized Gain (Ng) formula as follows:

$$\text{N – Gain} = \frac{Skor\ posttest - Skor\ pretest}{Skor\ maksimal - Skorpretes}$$

The criteria for improving student learning outcomes above can be seen in table below:

Category Interpretation Effectiveness of N-Gain

Persentase %	Interpretation
<40	Ineffective
40-55	Less effective
56-76	Effective enough
>76	Effective

(Hake, R.R, 1999)

Critical thinking and scientific work are analyzed using a Likert scale. Where according to Sugiono (2017), the Likert scale is used to measure attitudes, opinions, and perceptions of a person or group of people about social phenomena. In this social phenomenon research, it has been specifically determined by the researcher. Statistical test using Covariance Analysis (ANACOVA). This analysis is used to analyze the effect of applying Learning Start with a Question on photosynthesis material on students' cognitive learning outcomes, critical thinking and scientific work.

RESULTS AND DISCUSSION

1. Cognitive Learning Outcomes

The experimental classes in this study were SMP Negeri 15 Ambon, SMP Negeri 7, SMP Kristen Kusu-Kusu Sere, and SMP Negeri 11. While the control class is SMP Negeri 4 Ambon. The selection of SMP Negeri 4 Ambon as the control class, because the results of observations made at SMP Negeri 4 Ambon found a lack of student response in the learning process, and the learning process was still centered on the teacher using the lecture method. The conditions illustrate that science learning has not found significant results in learning, because science learning is still carried out in conventional ways (Zakirman et al., 2020; Kesuma et al., 2022). Teachers still provide information to their students in a dominant and one-way manner. The lack of interaction and teacher-centeredness make students less motivated so that learning becomes less meaningful (Pawati, 2016; Eliyarti et al., 2020).

1.1 *Pre-Test*

Pre-test which is a test carried out at the beginning of learning, is used to determine the level of ability that students already have (Asep and Jihad, 2009; Barokah, 2019). While the final test serves to assess the ability of students regarding photosynthesis material after learning is given. This is important to see how far the learning we provide. The post test is very appropriate to do at the end of the teaching and learning activity meeting, namely at the last meeting as a summary or repetition of all the material that has been given (Hisyam et al, 2005; Blegur, 2017). The results of the initial test describe the students' initial abilities before participating in the learning process on photosynthesis material by applying the learning start with a question method. Based on the research data, the initial test scores can be seen in the table below.

Table 1. Qualification of student achievement scores on the pre-test

Interval	Class	Frequency	Presentation	Qualification
SMP Negeri 15 Ambon				
>75		12	38%	Complete
<75	VIII	19	61%	Less
SMP Negeri 7 Ambon				
>75		4	12%	Complete
<75	VIII	29	87%	Less
SMP Kristen Kusu-Kusu Sereh				
>75		1	3%	Complete

<75	VIII	30	96%	Less
SMP Negeri 11 Ambon				
>75		-	-	Complete
<75	VIII	30	100%	Less
SMP Negeri 4 Ambon				
>75		-	-	Complete
<75	VIII	31	100%	Less

Based on the above it can be seen that intervals >70 and intervals <70 indicate that from SMP Negeri 15 Ambon there are 12 students who are in the complete category and 19 students who are in the less category. At SMP Negeri 7 Ambon there are 4 students who are in the complete category and 29 students who are in the less category. And SMP Kristen Kusu-Kusu Sereh there is 1 student who is in the complete category and 30 students are in the less category. Whereas at SMP Negeri 11 Ambon and SMP Negeri 4 Ambon it can be seen that at <70 intervals it shows that all students in SMP Negeri 4 Ambon have grades with less qualifications in mastering the learning indicators that will be studied.

1.2 *Post-Test*

Post-test is carried out at the end of the teaching and learning activity meeting, namely at the last meeting as a summary or repetition of all the material that has been given (Hisyam et al, 2005; Blegur, 2017). SMP Kristen Kusu-Kusu Sereh there were 7 students who had an effective score and fulfilled the KKM out of 31 students. At SMP 11 Amahusu there are 9 students who have an effective score and fulfill the minimum competention criteria (KKM) out of 30 students. And at SMP 4 Ambon there is 1 student who has an effective score and fulfills the KKM out of 31 students.

After the learning process is complete, a final test is carried out to determine students' ability to understand the concept according to the learning method that has been applied. Based on the research data, the final test scores can be seen below.

Table 2. Qualification of student achievement scores in the post-test

Interval	Class	Frequency	Presentation	Qualification
SMP Negeri 15 Ambon				
>75		27	87%	Complete
<75	VIII	4	12%	Less
SMP Negeri 7 Ambon				
>75		22	66%	Complete
<75	VIII	11	33%	Less
SMP Kristen Kusu-Kusu Sereh				
>75		21	67%	Complete
<75	VIII	10	32%	Less
SMP Negeri 11 Ambon				
>75		26	86%	Complete
<75	VIII	4	13%	Less
SMP Negeri 4 Ambon				
>75		5	16%	Complete
<75	VIII	26	83%	Less

Based on the table above, it can be seen that intervals >70 and intervals <70 indicate that from SMP Negeri 15 Ambon there are 27 students who are in the complete category and 4 students who are in the less category. At SMP Negeri 7 Ambon there are 22 students who are in the complete category and 11 students who are in the less category. At SMP Kristen Kusu-Kusu Sereh there are 21 students who are in the complete category and 10 students who are in the less category. At SMP Negeri 11 Ambon there are 26 students who are in the complete category and 4 students who are in the less category. And at SMP Negeri 4 Ambon there are 5 students who are in the complete category and 26

students who are in the less category. So it can be seen that the interval shows that at SMP Negeri 4 Ambon which is a control class, there are still students with minimum competention criteria (KKM) <75 with the most presentations from the 4 existing experimental schools. In the cognitive learning outcomes of students to achieve the final score, the N-Gain score test is carried out. Based on research data, the N-Gain score can be seen in the following table.

Table 3. Category interpretation of n-gain effectiveness

Presentase (%)	Frequency of each school					Criteria
	SMP N 15	SMP N 7	SMP Kristen Kusu-Kusu	SMP N 11	SMP N 4	
<40	9	7	7	6	17	Ineffective
40-57	7	10	12	11	11	Less effective
58-74	8	6	5	4	2	Ineffective
>75	9	10	7	9	1	Effective

Anacova test effect of learning start with question on cognitive learning outcomes

School	Mean	Std.	N
SMPN 4	40.645	13.5703	31
SMPN 7	56.288	22.8114	33
SMPN 11	58.992	21.5031	30
SMPN 15	60.000	33.0364	33
SMPKUSU-KUSU	53.629	18.7954	31
Total	53.986	23.7757	158

Results of analysis using the Anacova test obtained scores for each school, namely SMP Negeri 11 Amahusu by 58.99%, SMP Negeri Kusu-Kusu by 53.62%, SMP Negeri 7 Ambon by 56.28%, SMP Negeri 15 Ambon by 60.00%, and SMP Negeri 4 Ambon by 40.64%. These results indicate that there is an effect of applying learning start with a question on cognitive learning outcomes with a significance value (α<0.05). These results are then further tested using the Post Hoc Test with the LSD Test to find out which schools have different scores and can be seen in table.

Table 5. Post hoc different test students' cognitive learning outcomes

School	Mean	Notation
SMPN 4	40.645	e
SMPN 7	56.288	c
SMPN 11	58.992	b
SMPN 15	60.000	a
SMP Kristen Kusu-Kusu	53.629	d

The table above, shows that there are differences in notation between the learning methods used in the control class and the experimental class. With a significant value of α <0.05. Improving learning outcomes provides an overview of the potential possessed by students when carrying out joint learning activities in education so that they are able to place students in their positions based on their talents and interests as well as the abilities and abilities of students in conditioning and not experiencing problems when participating in the teaching and learning process (Maysarah, 2021: Kasih and Punomo, 2016; Setiadi, 2016).

a. Critical thinking

Critical thinking skills are one of the higher-order thinking skills that emphasize activities in solving problems according to the formulation proposed, identifying causes and being required to find alternative solutions to the problem, so that a logical and reflective conclusion can be drawn (Mariyana et al, 2017; Birgili, 2015). The value of students' critical thinking skills was obtained from formative tests, namely pre-tests and post-tests and students' ability to carry out

practicum activities. In this study, critical thinking in 4 schools, namely the experimental and 1 control schools, was observed during the learning process, and the results can be seen in the following chart.

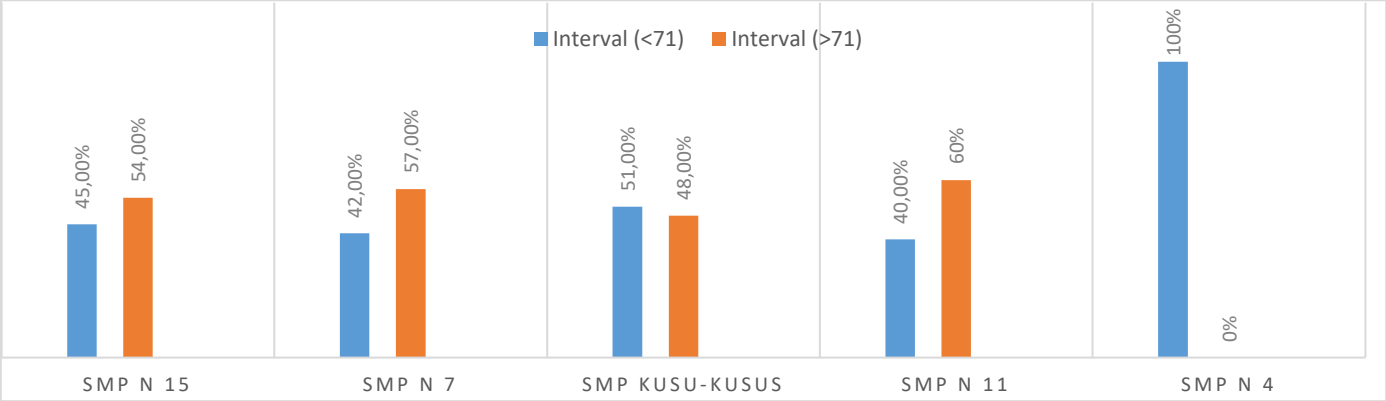


Chart 1. Results of critical thinking ability

The graph shows the distribution of critical thinking skills by 100% with a range of 55-88 in the experimental class at SMP Negeri 15 Ambon, SMP Negeri 7 Ambon, SMP Kristen Kusu-Kusu Sereh, and SMP Negeri 11 Ambon. Meanwhile, in the control class at SMP Negeri 4 Ambon, it showed a 100% distribution of critical thinking skills in the 55-71 range. This means that there is an increase in scores in the experimental class and the control class in the 5 schools. This is in line with the opinion (Sumarmo, 2014; Ennis, 2011) explaining that critical thinking ability is a reflective thinking ability that is full of consideration in making decisions about what is believed and done. The results of the analysis using the Anacova test can be seen in the following table.

Table 6. Anacova test effect of learning start with a question on critical thinking

School	Mean	Std. Deviantion	N
SMPN 4	37.45	3.558	31
SMPN 7	46.61	5.350	33
SMPN 11	47.87	5.740	30
SMPN 15	46.18	6.197	33
SMPKUSU-KUSU	46.84	6.679	31
Total	45.01	6.709	158

The results of the analysis using the Anacova test obtained scores for each school, namely SMP Negeri 11 Amahusu at 47.87%, SMP Kristen Kusu-Kusu at 46.84%, SMP Negeri 7 Ambon at 46.61%, SMP Negeri 15 Ambon at 46.18%, and SMP Negeri 4 Ambon at 37.45%. Shows that there is an effect of applying learning start with a question on critical thinking with a significance value (α<0.05). These results are then further tested using the Post-Hoc test with the LCD Test to find out which schools have different scores which can be seen in the following table.

Table 7. Different test Post-Hoc results of critical thinking

School	Mean	Notasi
SMPN 4	37.45	e
SMPN 7	46.61	c
SMPN 11	47.87	a
SMPN 15	46.18	d
SMP Kristen Kusu-Kusu	46.84	b

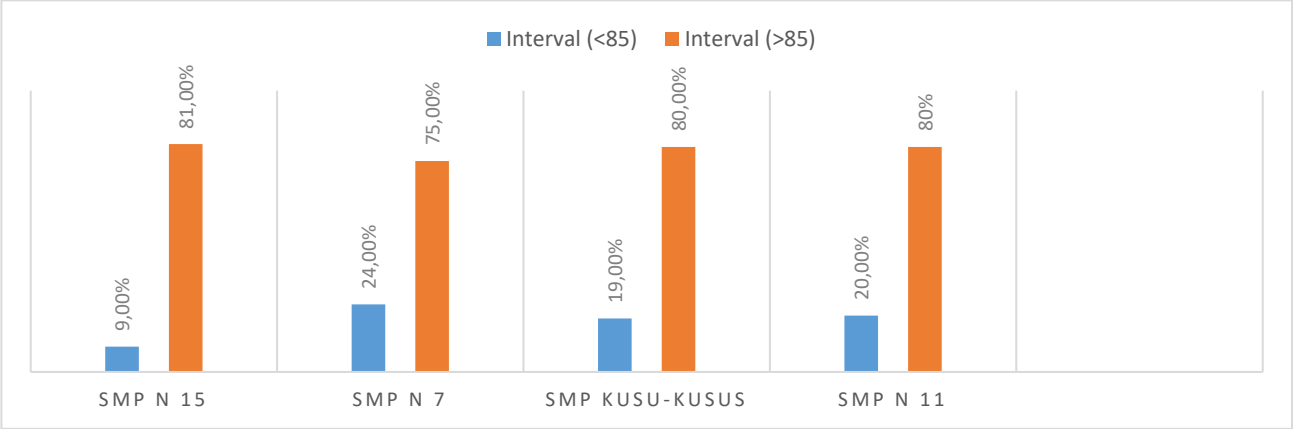
The table above shows that there are differences in notation between the learning methods used in the control class and the experimental class. This shows that there is an effect of the application of learning start with a question on students' critical thinking skills.

b. Scientific work

Implementation of scientific work requires students to do scientific work. Scientific work skills are a process carried out by students through a scientific method to get a solution or answer to a problem (Silva, 2022). Scientific work is part of science subjects which include: investigation/research, scientific communication, development of creativity and solutions such as conducting experiments, analyzing experimental results and making conclusions and includes the development of attitudes and values (Achadah & Fadil, 2020). In this study the results of scientific work ability were obtained through student worksheets (LKPD) for students (Wiji, 2014; Yadav and Mishra, 2013). Where in the experimental class in the four schools, each class was divided into 2 practicum groups, namely 1 group conducting research on the light reactions, and 1 group conducting research on the dark reactions in the photosynthesis process according to the student worksheets in the photosynthesis experiment on hydrilla. At the experimental stage it showed that the ability of students in each school was said to be very good, this was because the experiments carried out in each school were all successful and answered the experimental results with the right sentences as requested in the LKPD (Niebert, 2015; Wulandari, 2020).

The stages of concluding the results of the experiment for SMPN 15 Ambon, SMPN 11 Ambon and SMP 7 Ambon were said to be good, because students were able to conclude the activities and results of the experiment with cooperative groups in groups. Whereas at SMP Kusu-kusu Sereh the results were quite good, this was due to a lack of group cohesiveness in concluding the results of the experiment (Agung et al., 2022: Apriliani & Rahmawati, 2019). Scientific work ability in the experimental class is an observation during the practicum process. Observation results can be seen in the following graph.

Chart 2. Results of scientific work



Persebaran nilai kemampuan kerja ilmiah sebesar 100% dengan rentang nilai 71-100 pada kelas eksperimen di sekolah SMP Negeri 15 Ambon, SMP Negeri 7 Ambon, SMP Kristen Kusu-Kusu Sereh, dan SMP Negeri 11 Ambon. Hal ini berarti terdapat peningkatan nilai pada kelas eksperimen pada setiap percobaan yang dilakukan baik dari reaksi terang maupun reasi gelap. Untuk melihat hasil analisis uji Anacova dapat dilihat pada tabel berikut.

The distribution of scores for scientific work ability was 100% with a range of 71-100 in the experimental class at SMP Negeri 15 Ambon, SMP Negeri 7 Ambon, SMP Kristen Kusu-Kusu Sereh, and SMP Negeri 11 Ambon. This means that there is an increase in the value of the experimental class in each experiment carried out for both the light reaction and the dark reaction. The results of the Anacova test analysis can be seen in the following table.

Table 8. Anacova test the effect learning start with a question on scientific work

School	Mean	Std. Deviantion	N
SMPN 4	20.065	3.2139	31
SMPN 7	28.879	1.7095	33
SMPN 11	29.300	1.8597	30
SMPN 15	29.515	1.7522	33

SMP Kristen Kusu-Kusu	29.290	1.7549	31
Total	27.443	4.2238	158

Anacova analysis obtained scores for each school, namely SMP Negeri 11 Amahusu at 29.30%, SMP Kristen Kusu-Kusu at 29.29%, SMP Negeri 7 Ambon at 28.87%, SMP Negeri 15 Ambon at 29.51%, and SMP Negeri 4 Ambon at 20.06%. These results indicate that there is an effect of the application of learning start with a question on scientific work with a significance value (α<0.05). Then a further test was carried out using the Post-Hoc test with the LCD Test to find out which schools had different scores, as shown in the following table.

Table 9. Different test Post-hoc results of scientific work

School	Mean	Notasi
SMPN 4	20.065	e
SMPN 7	28.879	d
SMPN 11	29.300	b
SMPN 15	29.515	a
SMP Kristen Kusu-Kusu	29.290	c

The difference in notation between the learning methods used in the control class and the experimental class shows that there is an effect of the application of learning start with a question on students' scientific work. This research is in line with Husnul's (2017) concerning the effect of the learning start with a question method on the activity and learning outcomes of class X Maqamarul Huda Bagu in the 2016/2017 academic year. Learning method Learning start with a question is a method that is very fun for students, in the learning process every student dares to express the questions they ask without having to be embarrassed by other friends, and with this learning the teacher knows better where the students' incomprehension lies because all students have asked questions and will be discussed (Sugiyono. 2011; Trianto. 2010).

The results of learning using the Learning start with a question in the first meeting were seen in the experimental class (SMP N11 Amahusu, SMP N7 Ambon, SMP N 15 and SMP Kristen Kusu-Kusu) and control class (SMP N4 Ambon). The teacher tries to explore students' knowledge by asking questions, students don't seem good at responding, some students still don't dare to ask questions and express opinions. In the learning process of the second meeting of the experimental class, students have been able to adapt in using the Learning start with a question method. It can be seen that students have been able to follow the learning according to the teacher's directions listed in the lesson plans, then many students already have the courage to ask questions and answer questions from teachers and classmates and shows self-confidence according to the indicators for assessing critical thinking skills (Ermawati, 2019: Meldina, 2019). In the control class, it was seen that there was no increase in students' critical thinking skills at the second meeting, this was indicated by the responses of students in the learning process who still did not dare to ask questions and answer questions from teachers and classmates (Merlin, 2019). These results indicate an increase in critical thinking skills using the Learning start with a question method.

Active learning such as the learning starts with a question (LSQ) strategy in the learning process requires intellectual, emotional involvement of students through assimilation, and cognitive accommodation to develop knowledge, action, and direct experience in order to form skills, (motor, cognitive, and social) appreciation and internalization of values in forming attitudes (Irmayani, 2017). This is in line with Khoiriah's (2019), which says that the application of the learning starts with a question (LSQ) strategy not only sharpens students' cognitive abilities, but the learning starts with a question (LSQ) strategy is able to build attitudes that students must have. Participating in the learning process so that the actual learning objectives can be achieved optimally, while these attitudes are the ability to receive, participate in discussions through the activity of making and responding to a question (responding), assessing (valuing) by supporting or opposing an idea, consulting with groups by formulating and discussing problems (organization), and the ability to find solutions to a problem (characterization) (Komeng and Purnamasari 2016; Annor and Fathriana 2016).

Learning start with a question (LSQ) learning method, which is a method that invites students to be able to ask questions and find answers to the questions they ask by discussing within their groups so that they better understand the material being taught by the teacher (Qolbiyyah, 2019). Before they ask questions, they must first read and

understand the material provided by the teacher so that they can ask questions that they want to ask from material that they do not understand (Suprijono, 2016). Learning start with a question (LSQ) places more emphasis on students to be more active in asking questions before the teacher gives an explanation of the subject matter (Afandi et al., 2018; Eliyana, E. 2020).

CONCLUSION

1. There is an effect of the application of learning start with a question on students' cognitive learning outcomes in photosynthesis concept in class VIII students with each value in the experimental class, namely SMP Negeri 11 Amahusu at 58.99%, SMP Kristen Kusu-Kusu at 53.62%, SMP Negeri 7 at 56.28%, SMP Negeri 15 at 60.00%, and the control class SMP Negeri 4 at 40.64%.
2. There is an effect of the application of learning start with a question on critical thinking in photosynthesis material in class VIII students with each value in the experimental class, namely SMP Negeri 11 Amahusu at 47.87%, SMP Kristen Kusu-Kusu at 46.84%, SMP Negeri 7 at 46.61%, SMP N46 at 18%, and the control class of SMP N4 at 37.45%.
3. There is an effect of the application of learning start with a question on scientific work in photosynthesis concept in class VIII students with each value in the experimental class, namely SMP Negeri 11 Amahusu at 29.30%, SMP Kristen Kusu-Kusu at 29.29%, SMP Negeri 7 at 28.87%, SMP Negeri 15 at 29.51%, and control class SMP Negeri 4 at 20.06%.

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