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Observing Skills And Questioning Skills: Are They Correlated In The Learning Process?

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Abstract

Observing skills is the first step, and questioning is the second step of the scientific approach. Students ask questions based on their observations. This study aims to determine whether there is a relationship between observing and questioning skills. The population is students of Madrasah Ibtidaiyah Teacher Education who take science courses. The sample consisted of 11 people who were taken randomly. Collecting data on the topic of food digestion, the lecturer displayed a picture of several chickens eating in a cage and around it, there were lots of grass scattered. Students observe pictures and write down their observations, and are asked to write questions. On ecology, the lecturer gave two pictures of tropical forests and newly planted teak forests. Students are asked to observe pictures and are assigned to write questions. On the topic of the respiratory system, the lecturer gave a picture of a family exercising. Below the picture, the heart rate increases during exercise. Data analysis was carried out on the scores of observations and student questions with the Kolmogorov-Smirnov normality test followed by the linearity test. The results were confirmed by a scatter plot and Pearson's product-moment correlation test using SPSS version 16. The results showed a relationship between observing skills on ecological material. There was no relationship between the two skills on the topic of food digestion and the respiratory system.

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Introduction

The PISA results show that the scientific literacy of Indonesian students is low, so it needs to be improved by increasing the nature of science (NOS) ability. Growing of science can increase scientific literacy (Bybee 2002) so that scientists reflect on what science is and how science is done (R. S. Schwartz, Lederman, & Crawford, 2004). The purpose of science education is to prepare students as citizens and consumers of science. It is necessary to transfer the understanding of NOS into new times and situations by involving students in real science stories (Tsai, 2002). Some scientists argue that science is both experimental and empirical. However, the role of theory is indispensable for decision-making and influencing research design (Glasson & Bentley, 2000). The scientific approach combines empirical (observing, questioning) and theoretical (reasoning) (Laelasari & Anggraeni, 2017) .

The revised 2013 curriculum recommends observing and questioning skills as an essential part of skill competency. This competence refers to learning objectives of science, namely learning science, doing science, learning to handle socio-scientific problems, and learning about science. Learning about science includes the development of understanding and characteristics of scientific investigation, the role, and status of the resulting knowledge (Hodson, 2014). Science competencies needed to face global challenges are critical thinking, problem-solving, decision-making, and communication (Häkkinen et al., 2017). Topics requiring critical thinking and problem solving require a step-by-step scientific approach. This approach enhances critical thinking (Wakhidah, 2018; Laelasari & Hilmi Adisendjaja, 2018). Think critically about the topic studied and the phenomena around it. Lecturers need to direct students to be reflective by connecting what they learn and scientific investigation, which is the nature of science (NOS) (R. S. Schwartz et al., 2004). This is in accordance with the application of the scientific approach, namely finding and building the concepts being learned.

The steps of the scientific approach encourage students to solve science problems in accordance with the context of students in the class according to the way of scientists. The steps of the scientific method are similar to inquiry. Inquiry is the world's most accepted way of studying science (Harlen, 2013; Trna et al., 2012). The application of inquiry designs experiments, encouraging students to observe, research, and build knowledge (García-Carmona & Acevedo-Díaz, 2018). The application of the scientific approach begins with the process of observing, questioning, trying, reasoning, and communicating. The skills to formulate questions, observe, and communicate are essential skills in science (Balim, 2009; Weiss, 2003). Observation is fundamental skill in science (Klemm & Neuhaus, 2017). The scientific inquiry process can be carried out at all levels of education with some adjustments (Eshach & Fried, 2005; Kohlhauf et al., 2011; Nayfeld et al., 2011).

The important characteristics of science for students are scientific knowledge that is tentative, subjective, based on empirical, imaginative, and creative foundations, all of which are integrated into a socio-cultural context (Lederman et al., 2014). An interesting aspect of scientists is the process of getting ideas and problems about science (R. S. Schwartz et al., 2004). Observations and conclusions may be related (Schwartz et al., 2012). One gets an idea from observation and thought processes or both. The first step of the scientific approach is observing. Observing is a fundamental skill that everyone must possess, so it needs to be taught in the learning process from the lowest level, even in the pre-school years to the college level. Observation is one of the basic skills in science (Klemm, Flores, Sodian, & Neuhaus, 2020). Acquiring observation skills is important for pre-school and later students. These skills help children transition from seeing to observing to develop scientific process skills and concepts (Klofutar et al., 2020; Students find concepts based on observations and problem formulations based on their observations. Humans study nature by conducting in-depth observation processes and reasoning on the results of their observations (Kohlhauf et al., 2011)

Observing skills are part of the scientific method (Kohlhauf et al., 2011). Scientific reasoning contributes 35% of observing competence (Klemm et al., 2020). The quality of the results of the observations is determined by previous experience (Kohlhauf et al., 2011; Wakhidah, 2016b). The phenomenon shown by the lecturer should trigger students to activate all senses. According to information processing theory, students are motivated to learn if a stimulus is given at the beginning of learning. The stimulus arouses students' curiosity. The observing activity, according to the 2013 curriculum is carried out through seeing, listening and reading activities. Observations can also be made by listening to stories about the history of science (Mantu & Katircioğlu, 2013). A stimulus can be in the form of reading, pictures, lecturers' explanations, smell, sound, or temperature (Slavin, 2006). The scientific context also acts as a stimulus. The science context presented at the beginning of the lesson must be taken into account by the teacher so that it triggers investigations in context and content appropriate to student life. The right stimulus enhances meaningful learning (Cardellini, 2004).

The scientific approach steps have a relationship with one another. The results of the observations become the basis for asking questions (Chin & Brown, 2002). Observation means encouraging students to ask questions. Elementary school students must also be taught questioning skills (Forbes et al., 2013). Asking questions is the second step of the scientific approach. Formulating questions is a complex skill (Singer, Marx, Krajcik, & Clay Chambers, 2000). This activity is carried out after observing the phenomena given at the beginning of the lesson or the lecturers' explanations to get additional information. Asking questions is an indicator that students have the motivation to learn. Asking questions is an indicator of critical thinking. When making observations, students take notes and try to ask questions.

Student questions determine the next step, namely trying. The trying process is closely related to student questions. The teacher must play a role in directing student questions with learning objectives so that there is a match between the results of observations, questions, and student activities to collect information, including conducting experiments. Nuraini and Utama reported that the questioning skills of high school students in Bandar Lampung were in the medium category (61.9) and the low category (47.37) (Nuraini et al., 2017; Utami et al., 2016). The skills of secondary school students in Jember are only 35.48 (Pratiwi, Kamilasari, Nuri, & Supeno, 2019). The quality of junior high school students' questions is also low, namely at factual and rote knowledge (Zuraida, Syamsu, & Tanjung, 2019). The quality of skills of prospective elementary school teacher students is also low (Nurramadhani, 2019).

The step of observing, followed by asking questions based on observations, then students answering their questions with an investigation, is an inquiry step that needs to be promoted to students. These activities, students can construct their knowledge. There is no research and reference regarding the relationship between the ability to observe and ask questions in learning using a scientific approach, even though the two steps are sequential and related. There is a relationship between questioning skills and the learning process (Lestari et al., 2017). Students' success in observing was continued by asking questions. The questions asked by students are then answered by hemselves through the process of gathering information or trying. The results of the information gathering are then analyzed according to the relevant theory. The final step communicates the results. This study aims to determine: Is there a relationship between observing skills and questioning skills on biology topics in learning using a scientific approach?

Method

The pre-experimental study used a one-group pretest-posttest design to analyze the relationship between observing skills and questioning skills in the learning process using a scientific approach. The population is all students of the Madrasah Ibtidaiyah UIN Sunan Ampel teacher education study program, totaling 4 classes who have relatively homogeneous abilities. Sampling was carried out by purposive sampling to get one class that was considered to have homogeneous abilities of 11 people. Learning a scientific approach to topics: food digestion, pollution, ecology, and the respiratory system. This material is used for research due to the difficulty of studying biology on the topic of food digestion (Tekkaya, 2002; Wakhidah, 2016). These topics were chosen because they are science subject matter. On the topic of digestion of food, learning begins with a lecturer displaying in the form of a picture of several chickens consisting of roosters, females, and chicks eating in a cage around which lots of grass is scattered about. Students are given the task of observing the picture. From the observations, students were asked to ask questions. On the topic of ecology, the lecturer gave two images of tropical rainforests in Arizona and newly planted teak forests. Students are asked to observe both pictures and are assigned questions. On the topic of the respiratory system, the lecturer gave a family picture consisting of a father, mother, child, and grandfather exercising. Below the picture, the heart rate increases during exercise.

The results of observations and student questions are written on paper. The results of the observations were scored based on the prepared observation scoring rubric. Student questions are also scored with a previously developed rubric. The score data for observing skills and questioning skills were then analyzed. All data from all topics were tested for normality Kolmogorov-Smirnov. To determine whether the data is normally distributed, the Kolmogorov-Smirnov test is used. If the Asymp.Sig value> 0.05 means the data distribution is normal. If the value is <0.05, the data are not normally distributed. After the data is declared normally distributed, then linearity is tested. This test determines whether there is a linear relationship between the observing and questioning variables. If the Deviation from the Linearity value> 0.05, hen there is a relationship between the observing and questioning variables, if the value is <0.05 there is no linear relationship with Pearson’s product-moment correlation Test. The results of the linearity test were enforced by the scatter plot technique to determine whether there was a linear relationship between observing and asking questions. If the two conditions of Pearson's product-moment correlation analysis are met, an analysis will be carried out using SPSS version 16. The two variable correlation criteria are shown in **Table 1.**

Table 1. Pearson Product Moment Correlation coefficient criteria

No	The value of r	Relationship Category
1	0,000 - 0,199	Very weak
2	0,200 - 0,399	Weak
3	0,400 – 0,599	Moderate
4	0,600 – 0,799	Strong
5	0,800 – 1,000	Very strong

(Sugiyono, 2007)

Results and Discussion

The results of the data analysis indicate that all data from the topics studied are normally distributed so that they meet the assumptions as a condition of the correlation analysis. The results of the normality test on the topics of this study are presented in **Table 2.**

Table 2. Data Normality Test Results

No	Topics	Asymp. Sig	Significance	Information
1	Digestion of Food	0.561	0,05	Normal
2	Ecology	0.875	0,05	Normal
3	Respiratory system	0.757	0,05	Normal

All data are normally distributed so that the requirements for normality are met and followed by a linearity test to determine the linear relationship between observing skills and questioning skills. The results of the linearity test for all the topics studied are shown in **Table 3.**

Table 3. Linearity Test Results

No	Topics	Deviation from Linearity	Significance	Information
1	Digestion of Food	0.917	0,05	Linear
2	Ecology	0.660	0,05	Linear
3	Respiratory system	0.732	0,05	Linear

From **Table 3**, it can be seen that there is a linear relationship between observing skills and questioning skills on all topics. However, it is necessary to look at the linearity using a scatter plot to determine the distribution of the data. The scatter plot chart for food digestion topics is shown in **Figure 1**.

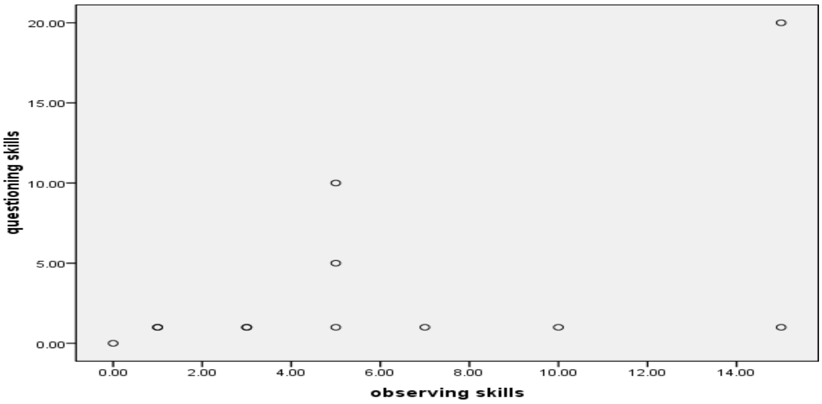

Figure 1. Scatter-plot chart on the Topic of Food Digestion

A scatter plot is a graph that depicts the relationship between 2 variables, namely observing skills and questioning skills. From the picture above, it can be seen that the data distribution does not show a linear relationship pattern. The scatter plot relationship pattern that forms a straight line indicates that there is a relationship between the observing and questioning variables, but the dots do not show the higher an increase in questioning skills does not accompany the observing skill. To ascertain whether there is a relationship between the two variables. The test results using Pearson's product-moment correlation for all topics are shown in **Table 4.**

Table 4. Pearson Product Moment Correlation Test on the Topic of Food Digestion

No	Topic	Correlation coefficient	Sig. (2-tailed)	Significance	Information
1	Digestion of Food	0.514	0.087	0,05	No correlation

Based on the results of the analysis, it can be seen that on the topic of food digestion, there is no correlation between observing skills and questioning skills. However the correlation coefficient is in the medium category.

Scatter plot data on ecology topics show a positive relationship pattern. An increase followed the increase in observing skills in questioning skills. The scatter plot description on ecological topics is shown in **Figure 2.**

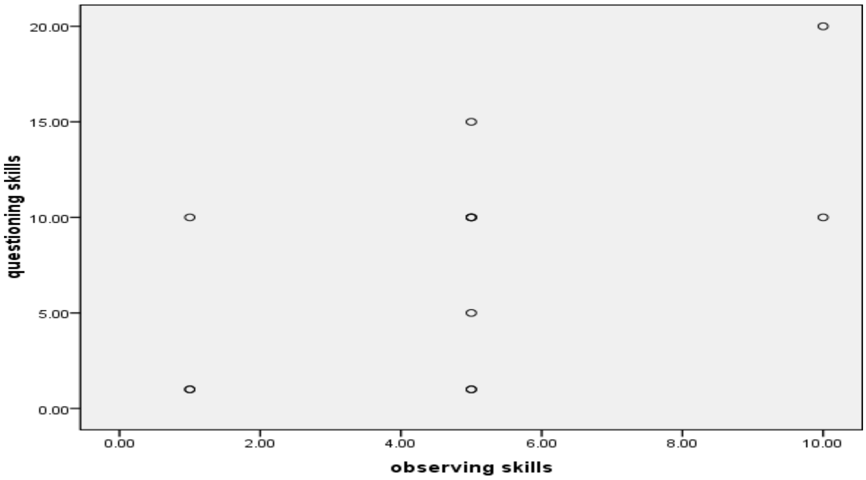

Figure 2. Scatter-plot chart on Ecological Topics

The graph shown on the scatter plot is not sufficiently informed to say there is a relationship between observing skills and questioning skills. The results of the Pearson product-moment correlation analysis are shown in **Table 5.**

Table 5. Pearson Product Moment Correlation Test on the Topic of Food Digestion

No	Correlation coefficient	Sig. (2-tailed)	Significance	Information
1	0,583	0,047	0,05	There is a relationship

There is a relationship between observing skills and questioning skills on ecological topics. The higher the observing skill, the higher the questioning skill. The correlation coefficient is 0.58 (medium category).

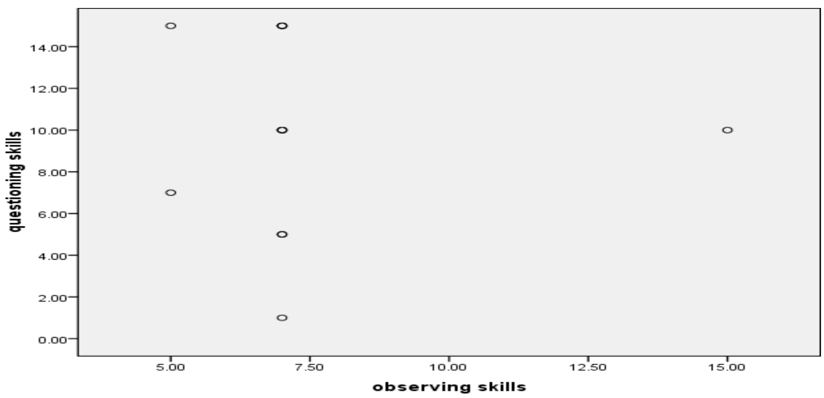

Figure 3. Scatter-plot chart on Respiratory System Topics

Linearity test results have a linear relationship between observing and questioning skills. The results of the scatter plot are shown in **Figure 3**. The figure shows that there is no linear relationship. The pearson product-moment correlation test was carried out to ensure that there is a linear relationship between observing and questioning skills on respiratory material does not appear to be modifying the subject of the Pearson product-moment correlation test. The results of the correlation analysis are shown in **Table 6.**

Table 6. Pearson Product Moment Correlation Test on Respiratory System Topic

No	Correlation coefficient	Sig. (2-tailed)	Significance	Information
1	- 0.026	0.937	0,05	No correlation

The analysis results show the value of Sig. 2-tailed> 0.05, so there is no correlation between observing skills and questioning skills on the respiratory system material. The correlation coefficient is even harmful, meaning that if your observing skills are increased by 1%, your questioning skills will decrease by 2.6%. Students' ability to observe is influenced by previous knowledge. Students who are not accustomed to paying attention to the images presented have difficulty with what is asked.

The three topics used for research were only ecological topics which showed a relationship between observing skills and questioning skills. The topic of digestion and the respiratory system is a difficult topic (Tekkaya, 2002). Digestive material is abstract material that requires higher-order thinking processes. The students could easily see the external digestive organs, but the digestive organs in the stomach could not be seen directly, so the digestion process was difficult to observe. The digestive process can be seen if the lecturer provides additional information and additional learning media, namely videos for simulating the digestion process in the stomach and the journey of food to the anus. Metabolism in the body is also very complex. Digestion of food in the form of carbohydrates is different from fat and protein. The question about the differences in the digestion of fats and proteins did not arise when students asked questions even though the images observed directed learning towards the digestive system in herbivorous, carnivorous and omnivorous animals. Chickens are omnivores. In the picture, besides eating corn, there is a chicken is pegging the grass. The observation process expectation was that students could find that there a hen was pegging the grass, so the students asked, "why do chickens peg the grass". These questions lead students to collect information in the next step of the scientific approach, which is gathering information. Life-long science education should teach observation skills, compare, formulate questions, and develop conclusions from data analysis (Leuchter & Saalbach, 2014). These skills must be supported by cognitive abilities, motivation, and an interest in science.

The role of lecturers is critical crucial in determining the direction of learning according to learning objectives (Wakhidah, 2017). Lecturers should convey learning objectives so students can know the direction of learning. In addition, giving pictures must be accompanied by an adequate explanation of the images so that it helps students carry out the observing process. This explanation also provides directions for learning objectives. The topic of food digestion is extensive, ranging from digestive organs, digestive processes, mechanical and enzymatic digestion, food absorption, digestive enzymes, monogastric or polygastric animals, and digestive diseases.

Many biology education researchers show biology learning is still based on memorization (Lin & Hu, 2003), including students in college. Students do not well understand the process of digestion of monogastric and polygastric animals. Students can only observe a chicken pecking at the grass. Middle-level students and college students have an understanding of basic biological processes (Maskiewicz, 2006). The next student question should be, why do chickens peck at grass? Is the digestive system like a cow? Why don't cats eat grass? The questions should appear in the Asking Step so that they lead to gathering information about monogastric and polygastric animals. Most students only ask something that requires an explanation, so it is a low-level question, how food can be digested in the digestive organs that cannot be seen with the eye. Complex processes occur in the digestive tract.

Abstract topics such as digestion of food are not only memorized but require a thought process. Students find it difficult to think at a high level when studying biology and have a less deep understanding of concepts (Tekkaya, 2002). Deep learning is required for higher-order thinking (Erman, Martini, Rosdiana, & Wakhidah, 2021). To arrive at the question of the difference between monogastric and polygastric digestion requires experience and thought processes and even thinking about something beyond one's observation. The empirical logic of science is seen as the "traditional" science believing that scientific knowledge in the world develops only through inductive methods. The inductive method is based on observation and experiment (R. Schwartz & Skjold, 2012; Zion, Schwartz, Rimerman-Shmueli, & Adler, 2020). Science is also built on a "non-traditionalist" view, namely, those who acknowledge that dreams, intuition, and games are part of science even though they are not part of the scientific method apparently there are several scientific methods (Leblebicioglu et al., 2017). The questions posed by students are likely part of this viewpoint and so are not the result of observations. The digestion of food may be related to human problems that do not need to eat rice but only swallow the tablet for a few days.

The topic of ecology is one of the most challenging topics in biology (Berryman, 2002). However, this topic can still be seen and observed by students well. For example, biotic and abiotic components, the relationship of living things in the environment, and the cycles that exist in the ecosystem so that it is easier for students to observe and understand. The two pictures presented, namely a tropical rainforest picture and an artificial forest with small trees made it easier for students to observe and ask why the two pictures were different? students try to find out the causes of the differences in biotic and abiotic components of the two ecosystems based on the image. The difference in abiotic components in an ecosystem causes differences in the composition of living things in it. The animals in tropical rainforests are more varied than artificial forests with rare plants. The ability to observe students is very much influenced by their experience and understanding. Student knowledge deepens when involvement in the observation process improves observing skills (Amoah & Phillips, 2018). Students who have never been to the forest find it challenging to distinguish the ecosystem under rotten wood. Fungal communities differ between arbuscular and ectomycorrhizal forests (Koele, Dickie, Blum, Gleason, & de Graaf, 2014). The types of living things between tropical rainforests and artificial forests are undoubtedly different. If they do not have previous experience with forests, students do not ask about the diversity of living things in them. A fallen tree in a tropical rainforest is an ecosystem. Questions such as “what is the biotic component of tropical rainforests and artificial forests” are high-level questions. These questions can lead students to the investigation.

People generally think that biology is a lesson to memorize (Çimer & Ursavaş, 2012). Learning factual knowledge tends to think at a low level because it only studies factual knowledge. Understanding concepts and factual knowledge does not allow students to put forward their ideas. Topics that have the opportunity to have alternative conceptions are the ecology and digestion of the system (Tekkaya, 2002; Prokop & Fančovičová, 2010). Factual knowledge about ecological material is not enough to encourage students to ask questions. Questions that arise during learning are questions that ask for an explanation. If the lecturer has answered, the student will be satisfied with the lecturer's answer, and the concept is used as a source of knowledge. Learning using a scientific approach expects students to find concepts through the steps of observing and asking questions. The end result of learning uses a scientific approach in the form of knowledge or concepts found by students through the process of observing-asking-gathering-information-reasoning-communicating.

Observing is a basic science process skill (Alkaslassy & O’Day, 2002). Observation is not only done once during the observing step. The process of observing can be carried out during the step of observing and gathering information from a scientific approach. Observations made when collecting information are observations that aim to clarify and are confirmatory based on observations at the beginning of the lesson. So far, lecturers have assigned students to do a practicum with practicum instructions provided by lecturers or laboratories. Even though the practicum instructions can be designed by students themselves after observing pictures of tropical and artificial forests. To arrive at the investigation, the lecturer plays a role in starting the observation process and asking questions (Wakhidah, Ibrahim, Agustini, & Erman, 2020). Students will have difficulty observing and asking questions if they do not have prior knowledge. The process of observing is effective if students have a pre-conception of the phenomenon being seen (Ozdemir & Clark, 2007). Learning science requires learning directly about phenomena to encourage students to think, use knowledge, and seek scientific evidence (Monteira & Jiménez-Aleixandre, 2016).

The topic of breathing is also difficult. There are many concepts that students must understand and are abstract. The respiratory system is a complex topic. Complex issues that lead to the investigative process encourage student knowledge construction (Cruz-Guzmán, García-Carmona, & Criado, 2020). The concept of the respiratory system includes breathing apparatus, respiratory function, respiratory mechanisms, lung capacity, respiratory rate, gas exchange, cellular respiration, respiratory disorders, and living in animals. The picture presented by the lecturer at the beginning of the lesson is only a picture of a family doing sports. This image enable students to find the concept of respiratory frequency. In secondary schools the basic competencies that discuss the respiratory system are usually held in more than one meeting so the supporting concepts have been taught beforehand. The concept of respiratory frequency was obtained by students after collecting respiratory frequency data based on the physical activity carried out by groups of students, and their respiratory frequency was measured.

In this study, students were not able to ask questions which led to investigations that eventually found the concept of respiratory frequency and physical activity that a person did so that there was no relationship between image observation skills and questioning skills formulating questions related to aspects of scientific content, context, interests, and motivation (Cruz-Guzmán et al., 2020). Good questions lead to student scientific inquiry (Cuccio-Schirripa & Steiner, 2000; Hofstein et al., 2005). Many studies report that students have not been able to think multi-dimensional (Grotzer & Perkins, 2000; Grotzer & Basca, 2003; Maskiewicz, 2006), so that students do not think that exercise can affect respiratory frequency. The role of lecturers to direct students is very necessary so that students can ask and answer their own questions through gathering information. Increased questioning ability improves scientific skills and critical thinking (Huang et al., 2017). Emotional and student involvement can predict from observation skills (Klemm & Neuhaus, 2017).

Observing skills are more effective if students experience the phenomena they are learning (Monteira & Jiménez-Aleixandre, 2016), for example, jogging on respiratory rates rather than just observing images. Direct experience improves observing skills (Klofutar et al., 2020). Questioning skills are higher-order thinking skills (Eliasson, Karlsson, & Sørensen, 2017). Asking questions that connect two variables is difficult for students (Cuccio-Schirripa & Steiner, 2000). High-level questions that contain variable relationships are still rarely asked at various levels of education (Cuccio-Schirripa & Steiner, 2000); Hofstein et al., 2005). Good questions are formulated appropriately, contextually according to observations, and meaningful (Cruz-Guzmán et al., 2020). The meaning of the word means here connects two variables so that the question leads to data collection to answer the question (Wakhidah et al., 2016). Questions like this are rarely asked by students because the experiments carried out by students are usually already prepared by the lecturer, accompanied by practical instructions (McLaughlin & MacFadden, 2014). At the tertiary level, formulating questions that contain variable relationships needs to be taught to students (Cruz-Guzmán et al., 2020). The question "is there an effect of exercise on respiratory rate" is a question that contains two variables which can lead to investigation. The independent variable is the activity carried out (lying down, sitting, jogging, going up and down stairs) and the respiratory rate as the dependent variable. The low ability of students to observe and ask questions is caused by the lack of scaffolding of lecturers in learning (García-Carmona & Acevedo-Díaz, 2018; Gillies & Nichols, 2015; Newman-Carlson & Horne, 2004). Observing skills and questioning skills are cognitive skills. These skills are not skills to imitate like procedural skills. The ability to use knowledge to reason in new situations (Mayer, 2003; Craig et al., 2006). Students given pictures by the lecturer at the beginning of the lesson think about pictures and try to observe and ask about pictures. The questions asked by students really depend on their previous knowledge of the topic being studied and lecturer scaffolding to direct the learning objectives. Students' initial understanding of the material plays an essential role in questioning and thinking (Wakhidah & Erman, 2021).

Conclusion

On the topic of ecology, there is a relationship between observing and questioning skills. On the topic of digestion, there is no correlation between observation skills and questioning skills. On the topic of the respiratory system, there is no correlation. The correlation coefficient on the topic of breathing is even negative, meaning that if the observing skill is increased by 1%, it will cause a decrease in questioning skills by 2.6%. This is an interesting finding, so it is necessary to carry out further research using different phenomena or modifications with videos to give students an overview of the relationship between respiratory frequency and activity. Apart from these findings, it is necessary to carry out further research by providing scaffolding for students so that students can observe and ask questions properly

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