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Article

**Exploring Students Reasoning Patterns
on Reproductive System of Plants and Animals Material**Widra Dwi Anggraini^{1*}, Faninda Novika Pertiwi²^{1,2}Institut Agama Islam Negeri Ponorogo, Indonesia**Corresponding Address : widradwia@gmail.com***Article Info**

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ABSTRACT

The 21st century requires students to have high-level thinking abilities. One of the thinking abilities that students must have is logical reasoning. In learning, especially science, scientific logical thinking is very important. Science learning generally focuses on factual memory and experiments, so that both can improve students' scientific reasoning abilities. In the learning process in class, students have different reasoning patterns in understanding a problem. From this background, the aim of this research is to determine students' scientific logical reasoning patterns in solving problem-based problems that integrate material on plant and animal breeding systems and to determine teachers' strategies in efforts to improve students' logical thinking skills in scientific reasoning. This research was conducted at a junior high school in the city of Ponorogo with a sample of Ninth grade B students. The method used was a qualitative phenomenological approach. Data collection techniques use interviews, diagnostic test instruments and documentation. Based on the research results, the teacher's strategy in developing students' reasoning skills is to provide problem-based problems based on three indicators of logical thinking skills, namely thinking sequence, argumentation and inference skills. Meanwhile, students can use different reasoning patterns in solving problems given by the teacher. This research is new or new from previous research, namely the N-Vivo software is used for data analysis and is presented in depth with qualitative descriptions.

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INTRODUCTION

The ability to reason or called scientific logical thinking is very important in science learning. Science learning is generally focused on factual memories and experiments, so that both can improve students' scientific reasoning skills. In line with international research by Christopher Osterhaus that scientific reasoning is an important ability in society, namely regarding modern knowledge, more and more developmental and educational research shows that school students already have skills in scientific reasoning(Christopher, 2022). For example, science learning in the United States emphasizes that students must be able to think reasonably and scientifically to be able to connect evidence with explanations of a discovery, and be able to argue against the explanations that have been put forward. Through scientific reasoning students can evaluate the benefits of arguing logically not only in classroom learning but also in

everyday life. In line with international research by Vaile Dawson that with scientific knowledge can build and criticize arguments about important socio-scientific issues in society today and in the future (Vaile, 2024). It has also been applied to education in Europe, which seeks to improve students' logical thinking or reasoning skills, one way is by often being directly involved in argumentation (David, 2015; Syiu, 2018).

Reasoning or logical thinking ability is a process of drawing a conclusion based on principles and evidence of facts, so as to obtain new conclusions through what is already known. Romauli (2013) suggests logical thinking is a pattern of thinking based on systematic rules and rules with reasonable thinking patterns, so that there are no misconceptions in concluding a problem. Khasanah (2016) defines that the ability to think logically is the ability to get a truth rationally to certain facts. Based on some of these opinions, it can be concluded that logical thinking ability is a person's thinking process in drawing a conclusion from a problem based on facts. Using reasonable reasoning can be integrated with knowledge and rational thinking (Anggraini, 2021). In line with international research by Pei-Shan Chang, that to explore students' argumentation students are given laboratory-based assignments. This involves students in discussing previously collected data about an experiment. In addition, it involves students in developing competencies in designing and evaluating scientific investigations, and interpreting data and evidence scientifically (Pei-Shan Chang, 2022). In addition, students' logical thinking or reasoning skills can also be trained by providing problems that occur in everyday life by being connected through learning materials, so that it can be seen how students' ability to find solutions and solve these problems is based on students' reasoning skills (Kok sing, 2016; Gretchen, 2019).

Swestyani's research in 2018 states that solving problems requires scientific reasoning, but before scientific reasoning students need a logical thinking process. So that the stages of solving problems begin with a logical thinking process and then use reasoning as the final step to provide an opinion and draw conclusions coherently and precisely. In line with international research by Erika Schlatter scientific reasoning refers to skills that can help students understand science content and the world at large. These skills can include making hypotheses, experimenting, and evaluating results (Erika Schlatter, 2022). Scientific reasoning allows learners to be able to analyze data according to facts or information. Learners who have high scientific reasoning skills tend to be faster at analyzing and constructing information obtained so that they allow learners to understand concepts better. One of the efforts to develop logical reasoning skills in scientific reasoning can be done by providing opportunities for students to express an opinion or argue (Tong, 2023; Laura, 2020).

Argumentation skills according to several experts can be used to explore students' logical thinking or reasoning skills. Fatmawati's research in 2018 states that argumentation is an opinion accompanied by evidence supported by facts and delivered logically and objectively. The ability to argue directly or indirectly will enter into the teaching and learning process that students follow to gain new knowledge. This knowledge is not directly obtained by students, but through an internalization process within themselves, namely students are forced to think logically first about existing concepts and try to find the truth. In line with international research by Mijung Kim & Jerine Pegg that when students engage in complex problem-based tasks their reasoning and problem-solving pathways become complex with creativity and evidence to draw conclusions and solutions (Mijung Kim, 2019). Thus, later in the problem-solving process students will use their argumentation skills to find a solution. Therefore, by arguing students can think logically or reasonably (Jonathan, 2015; Qing, 2019).

Semi's research in 2009 in Herboni's 2016 research states that argumentation in training students' logical or reasoning skills can also be used to convince others of a fact or evidence that has been found. In line with international research by Jimenez-Aleixandre & Erduran in Wonyong Park's research that, argumentation refers to the justification of claims with reasons and evidence. Argumentation is an ability to present a reasonable explanation (Wonyong Park,

2021). So, in exploring students' reasoning patterns, three indicators of logical thinking ability are used, namely order in thinking, the ability to argue, and drawing a conclusion (Hsin-Yi Chang, 2018). One of these indicators is the ability to argue as previously described that argumentation can also train students' logical thinking or reasoning skills which can be packaged in the teaching and learning process which has been integrated into learning materials, especially on plant and animal breeding system material.

The facts in the field are based on the results of observations through direct observation and interviews using an interview guide instrument conducted at one of the junior high schools in Ponorogo City in September 2023. It is known that in classroom learning the teacher has implemented problem-based learning. In this case, the teacher involves students' active role in solving and finding solutions. In the learning process, students are trained to use reasoning or logical thinking skills, so that each student has a different argument. This is in line with research conducted by Sari in 2021 that the reasoning abilities of each student must be different so that the students' solving science learning problems are also different. This is what is unique in the teaching and learning process in the classroom. Based on previous research, many use quantitative methods with SPSS or similar software to process data that is frequently or commonly used. Meanwhile, the qualitative method uses descriptions only and not many people use software to process data. Therefore, this research has novelty from previous research, namely the N-Vivo software is used for data analysis and is presented in depth with qualitative descriptions. From this background, the purpose of this study is to determine the teacher's strategy in an effort to improve students' logical thinking skills in scientific reasoning and to find out students' logical reasoning patterns in solving problem-based problems that integrate the material of plant and animal breeding systems. This research has contributed to developing learning strategies by applying problem-based learning so that students can use their reasoning in solving a problem. In addition, the research also provides knowledge to teachers, especially prospective educators, that the reasoning of each student is different.

METHODS

According to Herdiansyah, Qualitative phenomenology aims to reveal, explore and study a unique phenomenon experienced by individuals. Thus, the method focuses on in-depth observation and can produce a more comprehensive study of a phenomenon (Sholikah, 2023). The subjects of this study were students of class XI B as many as 27 students (19 female and 8 male participants). All students come from MTSN 6 Ponorogo which was selected by purposive sampling. The sample was taken randomly, so that it could explore students' reasoning more thoroughly. Students taken have different backgrounds ranging from gender, cognitive abilities and academic levels.

Data collection techniques in this study used interviews, diagnostic test instruments and documentation. The procedure in this study begins with making test questions first, followed by conducting validation tests to experts, then conducting trials before being given to students, the results of this trial are to measure the level of reliability of the diagnostic test instrument used

To find out the logical thinking skills of students, a diagnostic test is carried out using logical thinking indicators. The following table 1. Indicators of logical thinking according to Andriawan, 2014 and their descriptors (Fuadah, 2022).

Table 1. Logical Thinking Indicators

Indicator	Descriptor
Order of Thought	-Students can mention the information they have obtained -Students analyze or identify the root of the problem
Argumentative ability	-Students express opinions or arguments obtained through logical thinking based on reality -Students can express how to solve the problem

Indicator	Descriptor
Inference	-Students are responsible for the problem and the strategy used in solving it. -Students can choose a way out for solving a problem

To further explore students' reasoning, semi-structured interviews were conducted. Each student was given the opportunity to express their opinions and convey the difficulties encountered when working on the instrument. The interview data in this study was analyzed using N-Vivo software. The interviews conducted can be recorded in audio form and then transcribed into sentence or word decryption. After that, the transcript is entered into the N-Vivo software for further analysis. The analysis process is carried out based on the grounded theory method, which develops exploratory theories based on facts or according to data obtained from the field. Transcripts of interview results that have entered the N-Vivo software are coded, making it easy to analyze. Each interview data is analyzed and compared with other interview data.

RESULTS AND DISCUSSION

Exploring students' logical reasoning patterns based on logical thinking indicators

Based on the results of interviews with students, that there are some students who still have difficulty in explaining material about plant and animal breeding systems. Most students can explain using their reasoning about plant and animal reproduction in general, even the answers they explain are not like what has been taught, but still make sense. For example, when asked to explain the difference between vegetative and generative reproduction in plants, BM.NR.CH answered "vegetative is natural means natural reproduction without mating if generative is not natural means through mating vegetative is natural means natural reproduction without mating if generative is not natural means through mating". Another student, for example :

Question : What is the difference between reproduction of vertebrate and invertebrate animals?

AL.WD.RH answered:

"Vertebrates are animals that have a spine while avertebrates are animals that do not have a spine. So if vertebrates, for example, there are cows that can give birth, then chickens can lay eggs. If avertebrates are rich in worms, maybe they can divide themselves"

However, there are some students who can answer using reasoning but according to the concept on the material of plant and animal breeding systems. They can answer the question well and correctly. For example, given a question about generative animal reproduction in avertebrate animals :

Question : Why laying hen eggs cannot hatch into chicks even though they have been incubated by the mother ?

AR.GB.SYH answered:

"I think it's because there are no chicks in the egg, so even though it's incubated until whenever it doesn't hatch. In addition, the eggs are not produced through fertilization or fertilization so that no embryo is produced as the forerunner of the chick. The possibility of eggs produced is through the injection process"

During the interview, students explained that in classroom learning, teachers also provide opportunities for students to express their opinions both individually and in groups. In line with research conducted by Yulia (2016), arguing can be done individually, that is, each student is given the opportunity to have an opinion, so that they can develop their reasoning. However, through group discussions it will be more effective because they can collaborate on arguments with friends. So that in solving a problem Problems will receive suggestions or opinions for resolution. These various opinions will later be combined into a solution that can be

communicated verbally or in writing. This is also in line with the indicators of logical thinking ability according to (Ni'matus, 2011), namely the sequence of thinking, the ability to argue and draw conclusions. Where in learning the teacher has applied these three indicators.

Indicator 1: sequence in thinking

Based on the results of interviews in learning, students are faced with problem-based problems given by the teacher. The problems given are usually related to problems that are related to the material that has been studied previously. Of the 27 students in class IX B can answer these questions but there are some students who still find it difficult to understand the questions given. For example, why in the grafting process the shoots did not appear, BM.NR.CH answered because maybe the nutrients were lacking or maybe the maintenance was lacking. Some students answered in agreement with the answer given, but there were also students who disagreed so they gave other answers. For example, in the process of grafting the cambium in the wood is not removed so that the skin will form again, eventually inhibiting root growth, logically the shoots will not grow. Based on this question, students are trained to practice logical thinking with a sequence of thinking, namely how students can identify the root of the problem. However, judging from the answers to the questions, only a few students can answer correctly according to the logical thinking indicators.

Students will usually find an answer to a given problem after they reread the material they have learned. They can elaborate the answer by using reasoning patterns so that it will produce a conclusion and find the root of the problem by the problem given. The thinking sequence indicator can train students to understand the meaning of the given problem using reasoning. Based on the diagnostic test results, all students can answer the questions given using their reasoning patterns. For example, given the question of whether vegetative reproduction is easier or more difficult, all students can answer correctly.

Through identification, students can understand the characteristics of the problem, so that they will be able to find solutions to solve it at a later stage (Noviani, 2020). In line with research conducted by Ningsih (2021), it is suggested that with the sequence of thinking, students can mention all the information known and asked in the problem appropriately using their respective reasoning. Students can also express and describe in general the steps that will be used in solving problem-based problems. Based on the results of the interview, students' ability to identify problems has begun to be formed and trained by the teacher. It can be seen how students can answer problem-based questions using their reasoning patterns. In line with research conducted by Sulianto (2011) suggests that by giving problem-based problems the teacher can examine students' reasoning skills by observing how students solve science problems. Through students' varied answers the teacher can distinguish or classify, so as to obtain an overview of the extent of students' reasoning skills in solving problem-based problems. To measure students' scientific reasoning skills, students are given questions that are guided by logical thinking indicators, one of which is the sequence of thinking.

This is in line with research conducted by Putri in 2016 that student reasoning can be trained through the problem identification process. From these problems students can use their reasoning, so as to get a conclusion related to the root of the problem. In addition, reasoning also trains students to think broadly and easily in identifying and analyzing the next steps that will be taken as a solution to a problem. By reasoning, students' knowledge will be further developed and can familiarize students to answer problem-based problems with logic. So, if they are accustomed to thinking logically, students will no longer be stuck with the content of the material, but they can explain themselves only through the concepts they have learned.

Indicator 2: argumentation ability

Based on the results of interviews, students' argumentation skills have been trained by teachers in learning. Teachers train students in arguing through individual and group presentations. In addition, it can also be in the form of questions whose answers are in the form of opinions expressed by students themselves. So that after learning students are not only

trained to find or find the root or cause of the problem but also asked to give an opinion about the existing problems and how the solution in solving them. However, opinions can also be expressed in the context of learning, for example giving opinions related to material, problems and so on.

When expressing arguments students can use their reasoning patterns, so that the answers put forward make sense or are based on logic. However, there are some students who have not been able to express opinions, one of the facts is the lack of understanding of the material studied and scientific words that they do not understand (Prastiwi, 2018). For example, students are asked to argue what is the difference between vertebrate and avertebrate animals, AL.WD.RH put forward his argument:

"Vertebrates are animals that have a spine while avertebrates are animals that do not have a spine. So if vertebrates, for example, there are cows that can give birth, then chickens can lay eggs. If avertebrates are rich in worms, maybe they can divide themselves"

The arguments put forward by each student are different according to their reasoning ability. From the opinions regarding the differences between vertebrates and avertebrates, there are those who provide rebuttals or other opinions about the question. There are many kinds of opinions expressed by each student, so this shows that students have begun to use their reasoning patterns to argue. For example, another example of a question related to reproduction in plants with the question what is the difference between vegetative and generative reproduction, BM.NR.CH expressed his opinion.

"Vegetative is natural means natural reproduction without mating if generative is not natural means through mating so kak"

Other students expressed their opinions with different answers, for example AR.GB.SYH answered:

"Vegetative is natural kak for example plants around us such as bananas, tubers itukak if generative pollination in flowers kak"

There are no difficulties for students in expressing opinions related to the material of plant and animal breeding systems. In addition, the material of the plant and animal breeding system is not too difficult to understand, because plants and animals are living things that are close to students and even many are maintained and cultivated by students themselves. So that when students are faced with questions about generative plant reproduction, they do not find it difficult to express their opinions. Moreover, some students have done how to cultivate plants with this technique. For example, given the question of what if we want to have bougenvile flowers with different colors in one tree, what techniques are appropriately used AL.WD.RH answered:

"Choosing the technique of snapping is combining parts of plants that are different colors but still the same type, it will be two different colors in one tree"

Argumentative Ability is the ability to express opinions obtained through reasoned thinking based on facts accompanied by evidence that is conveyed logically and objectively. The argument contains information related to the steps to be taken and is a solution plan to solve a problem (Devi, 2018). At this stage students have various alternative solutions along with how the flow in it. Thus, through the ability to argue students can describe in detail what steps can be taken as a way out for solving a problem (Fitria 2022). Based on the results of the interview, there were no difficulties for students in expressing their arguments or opinions related to the material of the plant and animal breeding system. Students can also express their opinions through questions given by the teacher both in groups and individually.

In line with research conducted by Haruna in 2021 that argumentation can be used to explore students' reasoning skills. This is because argumentation encourages each individual to externalize and reflect on the results of their own reasoning / thinking. The ability to argue can be trained by the teacher through the learning process both individually and in groups so

that students gain new knowledge. Students will gain new knowledge through the internalization process, namely students are forced and trained to think logically first about existing concepts and try to describe them and communicate through opinions (Minin, 2022). To be able to train reasoning skills, students are usually faced with problems related to everyday life but still integrated with learning materials. Thus, in the problem solving process students will use their argumentation skills to communicate what steps can be taken and used as a solution. Therefore, by arguing students can practice thinking using logic or reasoning according to the ability of each individual (Arifin, 2021; Rahman, 2018).

Indicator 3: drawing a conclusion

Based on the results of interviews in learning, students are faced with problems that contain solving a problem. The questions given are related to problems in everyday life, so they are easily analyzed by students. In the process of solving problems, students are required to think rationally or reason so that they can determine the right steps to be the solution to the root of the problem. The solution that has been found by students is inseparable from the process of identifying and communicating arguments that students have gone through in the previous stage. Thus the solution found has contained scientific facts and evidence so that it is in accordance with existing facts. The problems presented by the teacher are usually still closely related to the material previously learned. For example, students are faced with a problem related to the technique of breeding flower plants by mengenten, what if in the process of mengenten plants are not successful and what is the right solution. AL.WD.RH answered:

"Go back again sis and choose flower stems that are probably the same age"

So that in solving a problem students must first identify the root of the problem, as for AR.GB.SYH answered :

"Find out the cause first, then we will repeat the wrong part"

Drawing conclusions is the ability to choose a way out for solving a problem. At this stage students have obtained a solution to the problem that has not been resolved. The solution that has been obtained has been carefully mapped, so it is clear how the flow will be carried out. Through solutions that are packaged coherently can complete what was the previous problem (Rahayu, 2017; Bahri, 2018). Based on the results of the interview that in the learning process the teacher has also trained students in the process of finding a solution to the problem. Teachers can train students through questions that can be given individually or in groups so that they can be done together. However, based on interviews that have been conducted, some students still have difficulty in analyzing problems based on making conclusions. Some students know the root of the problem and have several alternative solutions, but they still have difficulty choosing which alternative solution is the right one to use.

In line with research conducted by Fuadina in 2022 that the ability to draw conclusions can be used as a means to form students' logical thinking or reasoning skills. In learning that is faced with problem-based questions, students will be more active in thinking. Thus, their reasoning skills will be honed in finding and solving a problem. With the ability to draw conclusions, students' knowledge will develop and be organized (Faradina, 2020; Martini, 2017). However, students' reasoning abilities will vary from each individual, so that later it will produce various solution answers. Thus it can be seen that how students' reasoning patterns can be formed through problem-based questions given by the teacher. Through the material of plant and animal breeding systems, students will find it easier to develop their scientific reasoning patterns. The ability to draw conclusions is very important because it provides students with skills in selecting and sorting out the right solutions to use, helping students to explore their arguments and add new knowledge. This new knowledge can make students challenged to solve other problem-based problems (Yusuf, 2022).

The three indicators that are often used in learning can improve students' reasoning patterns (Handayani, 2020). Through the ability to think according to reason, a person can combine two or even more thoughts in being able to criticize events in his life. So that someone

who has the ability to think logically can integrate science and thoughts based on facts that occur. With the ability to think logically or reasoning students will find it easier to process answers, find the root of the problem and find a solution to any existing problems. The ability to think logically can be trained by the teacher in the learning process both individually and in groups. Thus students will be actively involved in the course of learning. Students will have broader knowledge and can develop into scientific arguments and according to facts and logic (Prihatin, 2021).

Analysis of N-Vivo coding results

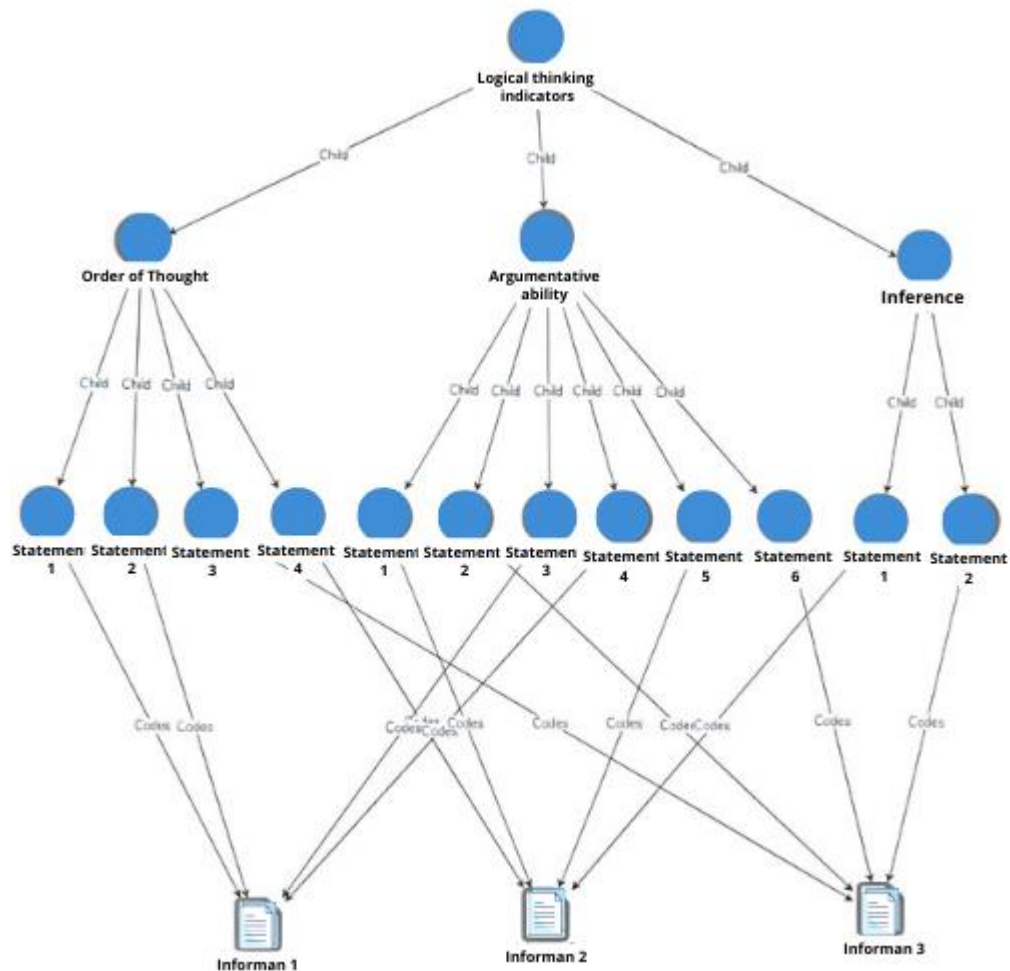


Figure 1 : Project Map Resulting from Student Interviews Based on Logical Thinking Ability Indicators which was Processed Using N-Vivo Software

First sample analysis

Based on the results of coding by N-Vivo software on logical thinking indicators, the ability of students' reasoning patterns in classroom learning varies. In line with research conducted by Chatarina (2017), it is suggested that with different reasoning problems and problems also have various solutions or answers. In line with international research Fang (2019), it is argued that in his research comparing the scientific reasoning of students from two countries in science learning. From the results of his research, it was found that there were differences in reasoning put forward. From both countries, only a few students can identify the problems presented. Therefore, differences in reasoning not only occur in each individual with individuals but also in different countries. There is a difference between this research and previous research, namely that it can explore the reasoning of each student so that teachers get various kinds of answers to the questions given. Through this exploration of reasoning, teachers

can find out to what extent students can use their reasoning in learning. Apart from that, interviews were also conducted with students to explore their reasoning orally. So with interviews students not only make arguments expressed in written form but also directly based on their reasoning. In the figure can be seen, from the first sample of students who have been taken and conducted semi-structured interviews, it is found that in the teaching and learning process, students can use reasoning patterns in solving problem-based problems given by the teacher based on logical thinking indicators. The first learner can use reasoning patterns in the sequence of thinking, meaning that they can answer questions that contain identification of the root of the problem. At this stage, it is the first step that must be done by students by following the existing flow, concepts, and rules. The argument contains information related to the initial steps and is a solution plan to solve a problem (Rola, 2020).

At this stage students have several alternative solutions and how they flow into it. Thus, through argumentative skills, students can describe in detail what steps can be taken as a way out for the solution of a problem (Chun, 2015). However, in the context of inference, the first learner has not been able to answer questions. This can be influenced by several factors, including students not understanding the problems given by the teacher, and the questions given being considered difficult by the first students. Therefore, students have different reasoning patterns in the learning process. So the logical thinking ability of the first learners needs to be developed again to train reasoning patterns in scientific thinking. This will also have an impact on the daily lives of students. In line with research conducted by Fauzan (2020), the ability to think logically is needed by students during class learning, group discussions, and solving problems that require the ability to connect something in the surrounding environment. In addition, it can be understood by reason, so that it can be implemented as logic to solve a problem. Based on this research, new knowledge is gained that each individual's reasoning is different. So, the exploration of reasoning can make it easier for teachers to determine the learning strategies to be used. For students, reasoning plays a very important role in learning, one of which is used to answer or solve problem-based questions. Apart from that, by training teachers to think logically in learning, students will get used to using reasoning in everyday life. So, with reasoning, students will have high-level thinking abilities.

Second sample analysis

Based on the results of interviews that have been transcribed and coded through N-Vivo software, as in the figure, it is known that students can only answer questions in the context of the sequence of thinking. This means that students have not maximally used their reasoning patterns to identify the root of the problem. So, at this stage, these students still have difficulties in identifying and understanding the characteristics of the problem. However, it is different in that questions in the context of arguing can answer as many as two questions just like the first learner. This means that they can express their opinions reasonably. The arguments expressed contain several alternative steps that can be taken to solve the problem in the problem (Permorten, 2011). Meanwhile, the question in the context of concluding can answer one problem, meaning that the second learner has been able to choose a way out for solving a problem. At this stage, students have obtained a solution to the problem that has not been resolved. The solution that has been obtained has been carefully mapped out, so it is clear how the flow will be carried out. Solutions that are packaged coherently can resolve what was the previous problem. In line with research conducted by McNeill (2008) thinking coherently can develop a strong student understanding of knowledge content. Thus, students can build explanations to find solutions to a problem.

For this reason, the second participant sample needs to develop logical thinking skills in scientific reasoning, especially in the context of orderly thinking and inference. However, in the context of argumentation, participants have begun to explore themselves to convey their opinions. Arguing is easier than finding a root cause and drawing conclusions. Because arguing will appear when a person's reasoning or thinking patterns have developed, so it is easy to

convey what is in the contents of his mind (Jialan, 2015). Different from n looking for a root cause. Therefore, in class learning, students will be more active in presenting their arguments through presentations made after group discussions or in question-and-answer discussion sessions. In line with research conducted by Ida (2014) suggests that with argumentation students get the opportunity to find explanations from their reasoning. This can be done by discussing the results of discoveries, science experiments, or problem-solving that has been done in the form of presentations in front of the class. So that arguments can be expressed Lisa and train students to speak scientifically. In addition, through argumentation, students can explore opinions through their reasoning patterns.

Third sample analysis

Based on the results of coding by N-Vivo software on logical thinking indicators in semi-structured interviews that have been transcribed in word form, it is known that the third learner can only answer one question in the context of the sequence of thinking. This means that students have not maximized using their reasoning patterns to identify the root of the problem in the problem that has been given by the teacher (Ying, 2011). Thus, at this stage, these students still have difficulties in identifying and understanding the characteristics of the problem. However, it is different in the question in the context of arguing that students can answer the question as much as two just like the second student, which means that they can convey the opinions they get through their scientific thinking patterns. The arguments put forward contain several solutions that can be used as alternatives to solve a problem presented in the problem (LaKeisha, 2011). While in the question in the context of the conclusion can answer one question, meaning that the third learner has been able to choose the last alternative solution to solving a problem. The solution or answer that has been obtained has been carefully thought out, so it is easy to apply it in answering the problem. In addition, using a coherent solution flow can make it easier for students to solve what was the problem in the previous problem. In line with research conducted by Hafnidar (2016), it is suggested that with the sequence of thinking, student reasoning will develop coherently and can analyze problems logically.

So, based on the results of the analysis in samples one to three students have different reasoning patterns. From the results, some participants have been able to use their reasoning patterns in answering questions in the context of the order of thinking, arguing, and inference. However, based on these results some students have not and still have difficulty answering questions in the context of order of thinking and inference. However, the three samples of students who conducted semi-structured interviews have been able to answer questions in the context of argumentation. Therefore, it is necessary to develop students' reasoning patterns, so that they can answer problem-based questions, especially in the material of plant and animal breeding systems as well as in other fields and subjects. In line with research conducted by Edhita (2015), reasoning can improve and be able to build and construct student knowledge through deep understanding. Meanwhile, the ability to argue can be utilized by students in screening and expressing opinions not only when inside but in public. In line with research conducted by Ariana (2023), reasoning is an ability that can integrate and connect learning with an event in everyday life. In addition, using logical reasoning is also used as an ability to reach a conclusion or decision in solving problems.

CONCLUSION

Based on the results of research through semi-structured interviews, the teacher's strategy in developing students' reasoning skills is to provide problembased problem exercises based on three indicators of logical thinking skills. Students can use different reasoning patterns in solving the problems given by the teacher. In addition, with the indicators of logical thinking, students can think using their reasoning, so that they are able to argue without being fixated on the material contained in the book or teaching.

Through this research, it is hoped that it can increase knowledge, especially prospective educators, that students' reasoning abilities must continue to be developed because of the demands of the 21st century, future generations can have the ability to think scientifically. Scientific thinking is very important in the world of education, especially in science learning and is useful in solving problems in everyday life. Therefore, there is a need for innovation and new strategies that can help in developing students' reasoning skills. To further explore the reasoning of students, further research can be carried out on different materials.

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