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Analysis of Students' Scientific Reasoning Ability towards Integrated Science Classroom on Karapan Sapi Topic in Schoology

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Abstract. The aims of the research were to know the percentage and level of students' Scientific Reasoning Ability (SRA) in solving essay question of karapan sapi topic towards integrated science classroom in schoology. The research design uses a mix design. The sampling technique in this study used nonprobability sampling type purposive sampling with samples class VI A as many as 31 students in the academic year of 2019/2020 in Department of Natural Science, Trunojoyo University of Madura. Data collection using 3 essay question test adjusted for the SRA indicators and interviews with schoology. The results showed that the type question SRA of students in Correlational Reasoning indicator is Intutive 32,25%, No Relationship 12,9%, and One Cell 54,8%. In Probabilistic Reasoning is no question 9,7% and Intutive 90,3%. In Proportional Reasoning is no question 48,4% and Intutive 51,6%. The percentage ability of each SRA indicator is Correlational Reasoning 61% (good), Probabilistic Reasoning 24,8% (less), dan Proportional Reasoning 14,2% (extreme less). From these results it can be concluded that the SRA of students is classified still at the low level. The influencing factors of SRA student low are students have not been able to regulate themselves to learn, difficulty integrating cow racing topics with science, and less use of time in working on problems description on schoology.

Keywords: scientific reasoning ability, integrated science, karapan sapi, schoology

1. Introduction

Natural science (or in Indonesian known as "IPA") as one of the basic sciences that have an important role in life and in the advancement of science and technology in general. Therefore, natural science is one of the main subject in the school either in elementary school, secondary school up to high level of education (university). One of the considerations is that natural science serves as a means of reason student's arrangement, which means that in science there is the process of using the rules, making the relationship, reasoning, communicating ideas of natural science, check the correctness of the results obtained. If the system has run cascading line of reasoning in accordance with the steps and the applicable rules, the purpose of school science education will be achieved (Clough, 2015).

Students will study various natural phenomena by studying the natural science. Natural phenomena are observed through scientific activity. Scientific activities performed seek rational answers to natural and physical phenomena. Look for rational answers using existing

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evidence and facts from research, experiments, and conclusions drawn. From this scientific process concepts, laws, and theories are obtained to solve various problems as products of natural science. Problem solving based on natural phenomena requiring a comprehension of different thinking abilities.

The ability to reason scientifically is one of the thinking skills used in solving problems based on natural phenomena. The ability to reason scientifically is the ability to ask questions or give concrete arguments on the basis of existing evidence and facts to test causal knowledge (Ates & Cataloglu 2007; Bao, et. al, 2009). The ability to reason scientifically is related to thinking strategies, processing, selecting, sorting and selecting suitable information so that existing phenomena can be proved with justified reasons (Perkins & Salomon 1989). For students in the 21st century, the era of industrial revolution 4.0 and society 5.0 based on the world of digital computing, this ability is significant. This is necessary to keep you from getting carried away with the hoaxes.

During the last few decades, various factors affecting the learning outcomes of physics were investigated. Results showed that thinking abilities were one of the main factors influencing the outcome of science learning (Lawson et al., 2000, 2004, 2007; Cavallo, 1996; Enyeart et al., 1980; Cohen et al., 1978). It can be said that reasoning skills are a significant aspect to be developed in science learning. Duschl (2008) explains that science learning has focused on what needs to be known (known) in order to do (do) science, but this focus has shifted in recent years to what students need to do (to do) in order to learn (to know). In addition, Dushl (2008) states that building knowledge can be a dialogical process that includes the acquisition and use of principles and evidence to explain and predict nature reasoning.

While reasoning abilities are important skills in learning physics, the results of several studies indicate that the reasoning abilities of the students are still in the unsatisfactory category. The results of the 2015 PISA study show that Indonesian students are included in the category of having limited scientific knowledge and can only be applied to certain general situations, can only provide scientific explanations if there is explicit and clear evidence, and are not yet able to reason scientifically and compile evidence-based and argument-based explanations using critical analysis (OECD, 2015). Results from Sadler's (2004) study show that students often find it difficult to articulate their proposed claims and justify them. Results from McNeill's (2011) study show that students rarely connect arguments with evidence and rarely use data when answering a question to support evidence.

The description of the above problems indicates the need to train and develop scientific reasoning (SRA) skills, especially in the learning of sciences. SRA is the goal of an inquiry process that leads to understanding, articulating and convincing others about that understanding of a natural phenomenon based on scientific knowledge (Sandoval & Reiser, 2004). Students are expected to be able to construct and give evidence-based interpretations of natural phenomena in learning science, and to show the link between the evidence and the explanation given. Not only does SRA provide descriptions of natural phenomena, but there are also demands to give reasoning and answer the 'why' question (Chang et al., 2016; Berland & Reiser, 2009; Osborne & Patterson, 2011).

Student involvement in scientific discovery activities and building evidence-based explanations can change the views of science among students (McNeill et al., 2006). Developing the ability of the students to build evidence-based reasoning is a complex demand and involves cognitive processes. To build evidence-based reasoning, students need to have a good knowledge of science, know the important components of what will be explained, and know how to explain the connections between the parts (Wang, 2015). Research aimed at analyzing the scientific reasoning skills of integrated science learning using the subject of cow

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breeds is therefore necessary in the LMS Schoology. This is important to do because karapan sapi can be preserved as a characteristic of local Madurese wisdom which distinguishes other types of cow breeds. The preservation of local wisdom in Madurese is through its integration into integrated science learning using LMS Schoology as an online learning media. From this research, the percentage and level of the Scientific Reasoning Ability (SRA) of students can be seen in solving karapan sapi topic essay question toward an integrated science classroom in schoology.

2. Methodology

This research is a mix approach that aims to evaluate the percentage and level of student SRA in schoology in order to solve the definition of cow breeds in an integrated science class. All Madura science teacher candidates for the 6th semester of the 2019/2020 academic year who studied in the Trunojoyo University Natural Science Education Study Program were the population in this study, totaling 90 people. The sampling technique was performed by taking samples based on certain considerations using purposive nonprobability sampling type technique. The samples taken were 31 science teacher candidates for class VI A. Scientific reasoning ability (SRA) data collection was performed through the provision of test descriptions and sample interviews. The description test instrument (SRA) consists of 3 items which include indicators of correlational reasoning, probabilistic reasoning, and proportional reasoning, while interviews are conducted with the sample which obtains the highest and lowest scores based on the calculation of the standard deviation value to determine the factors influencing SRA. The technique of data analysis used quantitative descriptive statistics in the form of percentages on description test results and qualitative data on interview through the Miles and Huberman model.

3. Result and Discussion

Student-categorization tests based on standard deviation

The questions that were given to the students were made dependent on the Scientific Reasoning Skill indicator with the cow racing stuff. Problem number 1 is a problem with the Correlational Reasoning (CR) type of Scientific Reasoning Ability Indicator. Problem number 2 is a problem with the Probabilistic Reasoning type (PbR) Scientific Reasoning Ability Indicator. Problem number 3 is a question relating to the Proportional Reasoning (PR) type Scientific Reasoning Ability Indicator. The students chosen as interviewers came from 8 high scoring students and 2 lowest scoring students, respectively. Some interviews were conducted in the medium group as this study decided to show that the students' Scientific Reasoning Capacity was still poor and this was adequate to show it by supporting evidence from the results of interviews with high and low score students.

Based on these students, the selection of the 8 students in the high score category had the highest score and had the same score. Then the low-category selection was made on 2 students who had the lowest ratings. The classification of student value group can be seen from standard deviation value measurement. **Table 1**. indicates the following description of the student interest groups.

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Table 1. Student-value classification groups

SD Value	**Criteria**	**Value of Categories**	**Number of Samples**	**Percentage**
S≥(M + SD)	S≥4.8	Tinggi	8	25,8%
(M-1 SD)<S <(M + 1 SD)	2.4< S <4.8	Sedang	18	58,1%
S≤(M-1 SD)	S≤2.4	Rendah	5	16,1%

Based on **Table 1.** using the standard deviation formula above, it can be shown that 25.8 percent of students earn the high grade, which indicates that 8 students have a higher Scientific Reasoning Skill than other students in solving problems with the Scientific Reasoning Ability indicator on the karapan sapi content. Then there are 58.1 percent of medium grade students, which means that 18 students have Scientific Reasoning Ability that solves problems with the Scientific Reasoning Ability indicator in the cow racing content. The group of students with low Scientific Reasoning Ability to solve problems with the Scientific Reasoning Skill predictor was 5 students or 16.1 percent of the 31 students in the cow race data. From these results the number of students to be interviewed was 10, each consisting of 8 high-score students and 2 lowest score students.

Analysis of the Percentage of Each Type of Answer on Each Scientific Reasoning Ability Indicator Question

a. Correlational Reasoning (CR)

Table 2. shows the percentage of the response provided by each type of student to the Scientific Reasoning Ability indicator for the types of Correlational Reasoning (CR) questions obtained by the class VI A students.

Table 2. Percentage of types of answers on types of Correlational Reasoning (CR) questions

Question	Type of Answer						Number of Students
	TM (0)	I (1)	NR (2)	OC (3)	TC (4)	C (5)	
1	0	10	4	17	0	0	31
Percentage	0%	32,25%	12,9%	54,8%	0%	0%	100%

Based on **Table 2.** above, it can be seen that students answered CR type questions with TM type answers or not answering 0% meaning that all students answered question number 1. The questions with the Correlational Reasoning indicator were in question number 1. So the students answered questions on the CR type with the answer category I (Intuitive) as much as 32.25 percent indicates that as many as 10 students worked on question number 1 by randomly predicting the answer with an illogical answer using a method or formula and getting 1 point. Then the students answered the CR type with the NR (No Relationship) type of answer as much as 12.9 percent, which means that 4 students answered question number 1 by providing reasons and explanations but they were not related and earned 2 points. Students answered questions of the CR type with OC (One Cell) students answering as much as 54.8%, meaning that 17 students answered question number 1 by giving reasons for a problem, or students answered only one problem in question number 1 and received 3 points. In addition, the students answered the CR form with the response type TC (two cells) as much as 0 percent, which implies that there were no students who answered question number 1 by offering reasons and explanations for the two problems. Finally, the students replied to the CR form with the response type C (Correlation) as much as 0 percent, which means that there were no

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students who answered question number 1 by providing reasons and detailed explanations for all the problems explaining the relationship between the issue and the cause. **Figure 1**. presents the results of the percentage of each form of answer to the types of correlation questions.

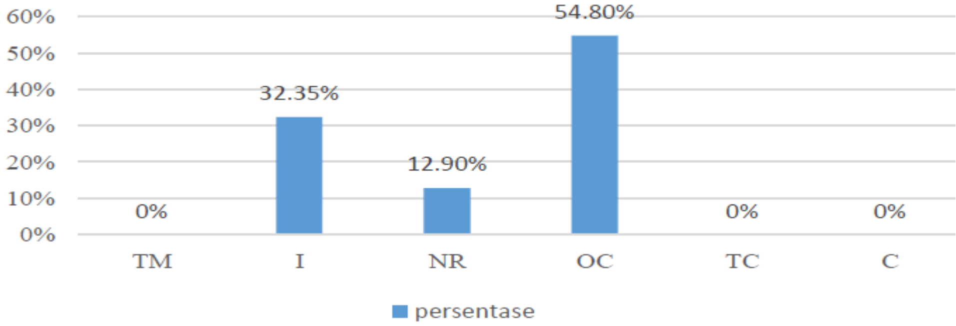

Figure 1. Percentage diagram of answer types on CR question types

Figure 1. explains that many students answered question number 1 with the type of answer OC or One Cell, which was 54.80 percent, which means that 17 students answered question number 1 by giving reasons for a problem or students only answered one problem in question number 1 and received 3 points.

Students ' ability to provide answers in the form of reasons and explanations for this question is consistent with Landa's theory of learning, namely the heuristic and algorithmic theory of learning. The processes of algorithmic learning are linear and clear processes in understanding concepts. Whereas, in knowing many principles the heuristic reasoning process is said to be a systematic learning process (Dewi, 2018). Therefore, issue number 1 also refers to Jean Piaget's philosophy of learning, specifically the cognitive development philosophy. In the theory of cognitive development students are able to think abstractly and more complexly at the formal organizational level (Dahar, 2017).

Other than that, David Ausubel claims in concrete theory of learning that students equate new knowledge that has been acquired with knowledge that already exists in previous students (Tarmidzi, 2018; Ding & Xin, 2014). However, in question number 1 students were unable to think thoroughly about understanding the concept and focus only on one problem that is linked to one concept obtained by students from the results of examination the material associated with previous student knowledge. Therefore, students also can not think more complexly about understanding the problems in the questions as there are still responses to question number 1 which cannot clarify the whole problem. It is also reflected in research (Dewi & Riandi, 2016) by simple and complex ability assessments that the skills of students are only at a basic level and are not yet complex. The explanation for this is that classroom instruction appears to be monotonous and only teacher-centric. Teachers do not provide students with prompts and students appear to be passive and the reasoning skills of students do not turn up. Thus it can be seen that the teacher's method of learning affects the ability of students to think in specific ways.

b. Probabilistic Reasoning (PbR)

The percentage of each type of student's answer to the Scientific Reasoning Ability indicator for the types of Probabilistic Reasoning (PbR) questions obtained by class VI A students can be seen in **Table 3.**

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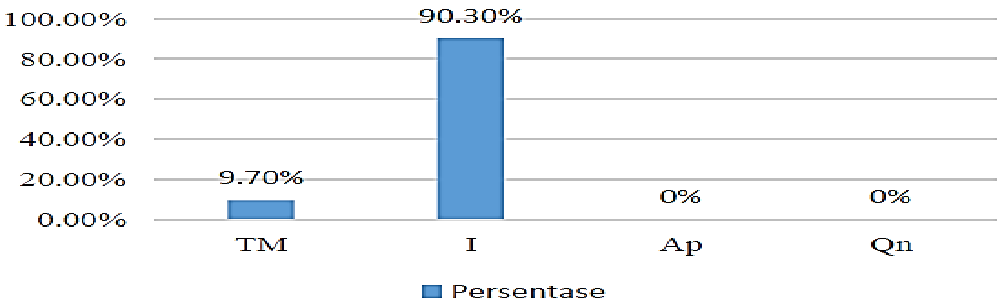
Table 3. Percentage of types of answers on types of Correlational Reasoning (CR) questions

Question	Type of Answer				Number of Students
	TM (0)	I (1)	Ap (2)	Qn (3)	
2	3	28	0	0	31
Percentage	9,7%	90,3%	0%	0%	100%

Based on **Table 3**, it can be shown that 9.7 percent of students are or do not respond to the TM form response. That means 3 students did not answer question number 2 and did not get points or 0. Then there were 90.3 percent of students in type I (Intutive), meaning that 28 students responded to question number 2 by arbitrarily conjecturing or using formulas and numbers with an illogical response. Students with the form of Intuitive Answer get 1 point. In addition, there were no students (0 percent) in the Ap response form (Approximate) who answered question number 2 by offering a qualitative summary of the interpretation and reasons. Qn (Quantitative) is the last answer type on question number 2. There are also no students who answer question number 2 using quantitative methods to provide detailed explanations and reasons (0 percent). **Figure 2** displays the following percentage results for each Probabilistic Reasoning Indicator rubric.

Figure 2. Diagram of the Percentage of Answers to the Types of PbR Questions



There are also no students who answer question number 2 using quantitative methods to provide detailed explanations and reasons (0 percent). **Figure 2**. displays the following percentage results for each Probabilistic Reasoning Indicator rubric.

Problem number 2 is about Landa's theory of algorithmic processes of thought. Nevertheless, the calculation process in question number 2 could not be completed correctly by the students. Students were unable to perceive the information collected on the questions, which resulted in errors in selecting the completion strategy. Students were also unable to associate already acquired knowledge with newly acquired knowledge. This is also shown in research (Nurhayati et al., 2016; Lee & She, 2010), that students appear to be random in problem solving. The explanation is due to the prior experience and mistakes of the students when interpreting information. The initial knowledge possessed by students influences the answers provided by students and the sense of incorrect information causes errors in students when problem solving.

c. Proportional Reasoning (PR)

The percentage of each type of answer given by students to the Scientific Reasoning Ability indicator for the types of Proportional Reasoning (PR) questions obtained by class VI A students can be seen in **Table 4.**

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Table 4. Percentage of types of answers on types of Correlational Reasoning (CR) questions

Question	Type of Answer					Number of Student
	TM (0)	I (1)	A (2)	Tr (3)	R (4)	
3	15	16	0	0	0	31
Persentase	48,4%	51,6%	0%	0%	0%	100%

Based on **Table 4**, as many as 48.4%, namely 15 students did not answer question number 3, which means that the form of answer given was TM (Not Answering) and did not earn points (0). Instead, in the intuitive (I) response category, 51.6 percent of students, i.e. 16 students, responded to question number 3 by calculating and using methods or formulas and random numbers with illogical answers and 1 point. There were no students in the Aditive (Ad) form of reply who answered question number 3 by using a mediation approach even though it centered on different issues. There were also no students in the Transitional (Tr) response form who answered question number 3 using the ratio equation strategy, although the answers given were incorrect. There were also no students in the last form of answer, namely Ratio (R), who answered question number 3 by applying the strategy of equation ratio and having the score correctly. The following is the percentage of response forms for proportional justification questions, as shown in **Figure 3.**

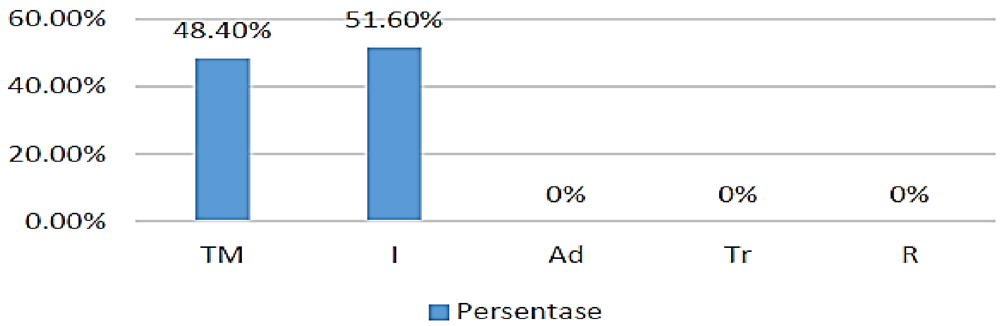

Figure 3. Percentage diagram of types of answers to types of PR questions

Figure 3 shows that many students answered with the Intuitive (I) type of response to question number 3, namely 51.6 percent of students or 16 students by guessing and using techniques or formulas and random numbers with illogical answers and getting 1 point. Students answered more questions number 3 based on the data collected by guessing and using the wrong strategy. We can see this in **Figure 3**. The formula used to solve problem number 3 is wrong. Students were unable to grasp the context that the questions presented, and what the questions asked. But students are offering the wrong answer to that. It is also clarified in research Alfathy et al. (2018) and Shofiyah, et al. (2013) that students are not inspired to develop certain scientific behaviors and have trouble interpreting concepts. The explanation for this is that learning appears to be monotonous in the form of teacher lectures while students only listen and take notes.

Percentage Value Analysis on Every Theoretical Basis Skill Predictor Question

The consequence of the percentage value for each Scientific Reasoning Ability indicator element can also be said to be the product of the total score for each Scientific Reasoning Skill indicator received by the students in one class. **Table 5** displays the percentage for every element of the Logical Reasoning Skill indicator**.**

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Table 5. Percentage of Value on Each Scientific Reasoning Ability Indicator Problem

No Soal	Indicator	Percentage
1	*Correlational Reasoning* (CR)	61%
2	*Probabilistic Reasoning* (PbR)	24,8%
3	*Proportional Reasoning* (PR)	14,2%
Jumlah		100%

Based on **Table 5.** above, it can be seen that students obtain 61 percent of question number 1 interest, namely questions with the Correlational Reasoning indicator. Problems with the Correlational Reasoning method are concerns about the ability to relate the variables under analysis. Then it can also be seen from table 4.5 that students get 24.8 percent of the value of question number 2, namely the Probabilistic Reasoning question. Probabilistic reasoning is a problem with the ability to use facts in order to figure out a conclusion's true. Instead, students got a score of 14.2 percent in question form number 3 or third. Question number 3 is the Proportional Reasoning Indicator problem. The problem with the Proportional Reasoning predictor is a matter requiring students to define two variables, namely the independent variable and the dependent variable by means of the ability to provide answers to the questions which make comparisons.

From these results, it shows that students get the most scores on question number 1, namely questions with the Correlational Reasoning indicator, which indicates that the students' Scientific Reasoning Ability of student is higher when it comes to questions with the Correlational Reasoning type. Based on the results of the analysis of student response study, it is known that the category of answers provided by students is still in the low category, indicating that means that the Scientific Reasoning Ability of students with regard to cow karapan in the integrated science learning class in schoology is still low. The explanation for this is that students do not understand the meaning of the presented content and therefore encounter uncertainty when they state explanations based on current scientific evidence and truth. Students were unable to coordinate for learning, have trouble integrating the subject of cow racing with science and do not take enough time to work on problem details in schoology.

In addition to the causal factors from students, factors that influence the students ' low level of reasoning and comprehension of concepts are learning that is conducted in class (Aeniah et al., 2018; Weld, Stier, McNew-Birren, 2011). This refers to the teachers' methodes used in teaching. The material of cow races is a material that tends to apply a lot of science, technology, engineering, art, and mathematical reviews so that it requires students to study these reviews and integrate them with learning science concepts through literature studies and experiments. Based on observations made at the beginning of the research, the teacher explained that the learning performed in the classroom using schoology is still traditional or instructor-centered and the debate is less comprehensive based on the analysis of STEAM (Science, Technology, Engineering, Art, and Mathematics) with a emphasis on indigenous knowledge and scientific knowledge from the results of literature studies and experiments.

As a result, students are less involved to explore and share ideas using LMS Schoology in classroom. Students lack evidence to explain the reasons behind the claims. Learning will be ideally designed to promote high-level thought, comprehension, and reasoning abilities of the students. Teachers must be able to include scientific learning material as well as relevant investigative processes (Aini et al., 2018; Fisher, et al., 2014; Berland & McNeil, 2010). The learning disadvantages above are complemented by integrating the STEAM approach. STEAM invites students to become integrated problem solvers from various disciplinary reviews (Messier, 2015; Yakman & Lee, 2012; Idin, 2018; Colucci, et.al, 2017).

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4. Conclusions

From these results it can be concluded that the SRA of students is classified still at the low level. The influencing factors of SRA student low are students have not been able to regulate themselves to learn, difficulty integrating cow racing topics with science, and less use of time in working on problems description on schoology.

5. Suggestions

Based on the results of this study, recommendations can be given to teachers, parents, and policy makers, which are expected to take steps to improve scientific reasoning skills so that they can foster critical and creative students which in turn will have an impact on effective and efficient problem solving. Finally, it is hoped that in the next research the writer / researcher will choose other variables as internal-external factors that are thought to affect the ability of scientific reasoning, both direct and indirect influence on the ability of scientific reasoning.

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