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SCIENCE PROCESS SKILLS AND CRITICAL THINKING IN SCIENCE: URBAN AND RURAL DISPARITY

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ABSTRACT

The study focuses on the relationship between process skills and critical thinking in junior high school students in learning science. Besides, an interrelation between process skill and critical thinking skills was also investigated. The study used a mixed-method. A sample of this study is 689 students of total sampling technique. Quantitative data were analyzed by SPSS 21 to find descriptive statistics in terms of mean, min, max while qualitative were analyzed in-depth interviews. The finding shows that the science process skill of students in learning science whether urban and rural areas are good categories. The independent sample t-test shows that students' science process skills in learning science in urban tend to be higher than in rural schools ($p<0.01$). Students' critical thinking in learning science for urban areas is high but for rural areas is a fair category, with significance $p<0.001$. The regression showed the level of contribution of students' science process skill influence as much as 51.5% for critical thinking. The other research result was found that students' science process skill affects critical thinking in learning science. Moreover, a comparison between students' science process skills and critical thinking based on their school location showed that urban is higher than rural.

Keywords: critical thinking; Junior High School; urban; rural; science processing skill

INTRODUCTION

Critical thinking becomes a pattern of thinking that must be possessed by learners. Critical thinking is the use of cognitive skills to improve learning outcomes, such as: to analyze thoughts, arguments, solve problems carefully (Saputra & Kuswanto, 2019). It is expected that students can think about the ideal. In general, students can solve problems and phenomena in their activities in social life (Akcay & Yager, 2016; Tiruneh & Cock, 2017). Critical thinking has five indicators, namely: providing simple explanations, building basic skills, making conclusions, making further explanations, and setting strategies and tactics (Aminudin et al., 2019). However, not all students can think critically. This is caused by a lack of mastering the concepts and learning material (Rahdar et al., 2018). Therefore, it is important to know students' critical thinking skills in each learning material. It is the science that is closely related to daily life (Astuti et al., 2020).

In addition to critical thinking, the topic of science process skills is also an important link to student success as learners. The purpose of this skill is to solve problems and find practical solutions (Darmaji et al., 2018), which are basic science process skills and integration (Duda et al., 2019; Fitriani, & Fibriana, 2020). Basic process skills will be the basis for the development of integrated skills (Darmaji et al., 2018). Both of these science process skills will affect students to solve problems in the environment practically.

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One of the lessons which are closely related to environmental problems in science (Harahap et al., 2019).

Students' science process skills and critical thinking are important aspects that must be possessed in learning science. Both are skills that involve scientific inquiry and problem solving about the concepts of science that exist in life. This research will provide a description that provides knowledge of science process skills based on demographic differences. Critical thinking of students based on demographic differences will provide new knowledge and provide useful information for teachers. Learning that directs to solve life problems is meaningful learning (Alkharusi et al., 2019; Basri, 2019; Widodo & Budijastuti, 2020). Process skills are easily observed when students carry out practical or experimental activities (Aldahmash et al., 2019; Ismail et al., 2019). Whereas critical thinking skills can be observed by the way students solve complex problems with the concepts they learn (Mahanal et al., 2019; Susetyarini & Fauzi, 2020). Science process skills and critical thinking have the same thinking path so that both are possible to have a connection.

In previous studies, identifying science process skills at various levels of education shows good things. But in reality, what makes it interesting is the regional disparity because it is possible to have unique findings. Schools in rural areas tend to have different facilities, teachers, and environments from urban areas (Sun et al., 2019; Astalini et al., 2020). Differences in conditions and environment can affect learning activities (Barrett, et al. 2019). Studies to find out the differences or similarities in critical thinking between urban and rural will be a unique study. This is a research gap that has not been found in previous studies.

This conceptual framework for research was caused by a sense of curiosity. Critical thinking skills and process skills have a good impact on education. However, what about the influence of differences in learning locations. Rural and urban will have an impact on learning processes and activities. Researchers will provide an interesting picture of the findings of this study. The purposes of the study are: (1) to describe the students' science process skills of junior high school in learning science in urban and rural areas; (2) to describe the students' critical thinking of junior high school in learning science in urban and rural areas; (3) to describe the differences of science process skills and critical thinking in learning science in urban and rural areas; (4) to find the relationships between science process skill and critical thinking in learning science.

METHODS

This study used a mixed method-explanatory approach (Creswell & Creswell, 2017). Qualitative data are taken after quantitative data. Qualitative data support quantitative data (the research procedure is stated in Figure 1). The research sample was taken using a total sampling technique. This sample was taken from eighth-grade students of junior high school who were studying fluid. The total number of sampling was 689 students, 376 from urban, and 313 students from rural.

This study consists of observation instruments for science process skills by the researcher with validity (0.74) and reliability (0.90). Multiple choices were used for critical thinking by Aminudin (2019). An interview guide was used for strengthening the data for science process skills and critical thinking by the researcher. The process skills observation sheet consists of 44 items: to measure 7 items; 5 item prediction; 4 item communication; summing up 4 items; compile data table 6 items; graph 4 items; obtain and process data 6 items; make a hypothesis 8 items. All items use a scale of 1-4. While critical thinking consists of 7 questions for each indicator with 1 for the correct score and 0 for the incorrect score.

SPSS was used to analyze descriptive, regression, and independent sample t-tests. Descriptive statistics describe the conditions of the data and present it in the form of tables. Tables make data easy to read (Field et al., 2017). Descriptive statistical data used are frequency, mean, min, max, and percentage. Moreover, regression was used to recognize the relationship between science process skills and critical thinking of junior high school students. Independent sample t-test determined differences in attitudes, science process skills, and critical thinking of junior high school students between urban and rural areas.

The categories of observation of science process skills, and multiple choices to assess the critical thinking of students include very good, good, fair, and poor, as shown in table 1.

Table 1. Categories of Students' Basic and Integrated Science Process Skill in Learning Science

	Science Process Skills	Category			
		Poor	Fair	Good	Very good
Basic	Observation	7.0 – 12.2	12.3 – 17.5	17.6 – 22.7	22.8 – 28 .0
	classification	5.0 – 8.7	8.8 – 12.5	12.6 – 16.2	16.3 – 20
	Prediction	4.0 – 7.0	7.1 – 10.0	10.1 – 13.0	13.1 – 16.0
	Measure	4.0 – 7.0	7.1 – 10.0	10.1 – 13.0	13.1 – 16.0
Integrated	Identification variable	6.0 – 10.5	10.6 – 15.0	15.1 – 19.5	19.6 – 24
	arrange table data	4.0 – 7.0	7.1 – 10.0	10.1 – 13.0	13.1 – 16.0
	Make a hypothesis	6.0 – 10.5	10.6 – 15.0	15.1 – 19.5	19.6 – 24
	Make a graph	8.0 – 14.0	14.1 – 20.0	20.1 – 28.0	28.1 – 36.0

To explain the categories of critical thinking, it can be seen in table 2. Explanation of the categories of each indicator: Elementary clarification; The basis for the decision; Inference; Advanced clarification; Strategy and tactics.

Table 2. Categories of Students' Critical Thinking in Science

Category	Critical thinking				
	Elementary clarification	The basis for decision	Inference	Advanced clarification	Strategy and tactics
Very low	0.0 – 1.4	0.0 – 1.4	0.0 – 1.4	0.0 – 1.4	0.0 – 1.4
Low	1.5 – 2.8	1.5 – 2.8	1.5 – 2.8	1.5 – 2.8	1.5 – 2.8
Fair	2.9 – 4.2	2.9 – 4.2	2.9 – 4.2	2.9 – 4.2	2.9 – 4.2
High	4.3 – 5.6	4.3 – 5.6	4.3 – 5.6	4.3 – 5.6	4.3 – 5.6
Very High	5.7 – 7.0	5.7 – 7.0	5.7 – 7.0	5.7 – 7.0	5.7 – 7.0

Furthermore, the data collection procedure in this study is shown in Figure 1 below.

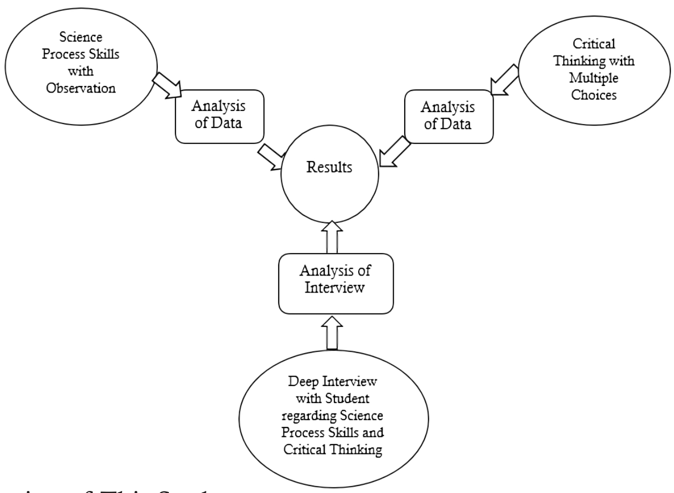

Figure 1. Data Collection of This Study

Figure 1 explains the data retrieval stage. During data collection, the first activity undertaken is to select a sample of students. Furthermore, Observation of science process skills in learning science in fluid topics, and assess the critical thinking of students in fluid topic with multiple choices. Along with those, interviews were also conducted. Furthermore, after all, questionnaire data were obtained, the data were analyzed using SPSS 25, as well as interview data which were further analyzed to help the statistical data obtained (Cohen, 2013).

RESULTS AND DISCUSSION

The novelty of this study explores the science processing skills and critical thinking of students' junior high schools, also, to know the difference between the skill process skills and critical thinking in urban and rural areas.

Science Process Skills of Students in Urban and Rural Schools

The result of students' basic and integration science process skills in science subject of fluid in urban and rural junior high schools showed by table 3.

Table 3. Science Process Skill of Students in Learning Science for Urban and Rural Junior High Schools

	Science process skill	Region	Category (f, %)				Total	Mean	Min	Max
			Poor	Fair	Good	Very Good				
Basic	Observation	Urban	35 (9.3)	87 (23.1)	189 (50.3)	65 (17.3)	376	18.04	8	24
		Rural	73 (23.3)	109 (34.8)	91 (29.1)	40 (12.8)	313	12.39	7	24
	Classification	Urban	12 (3.2)	88 (23.4)	199 (52.9)	77 (20.5)	376	21.32	9	28
		Rural	88 (28.1)	99 (31.6)	89 (28.4)	37 (11.8)	313	14.29	7	28
	Prediction	Urban	24 (6.4)	98 (26.1)	191 (50.8)	64 (17.0)	376	15.00	6	20
		Rural	78 (24.9)	101 (32.3)	91 (29.1)	43 (13.7)	313	7.60	5	20
	Measure	Urban	9 (2.4)	77 (20.5)	178 (47.3)	80 (21.3)	376	12.06	5	16
		Rural	78 (24.9)	101 (32.3)	91 (29.1)	43 (13.7)	313	8.28	4	16
Integrated	Variable identification	Urban	15 (4.0)	98 (26.1)	187 (49.7)	76 (20.2)	376	18.16	6	24
		Rural	81 (25.9)	98 (31.3)	101 (32.3)	33(10.2)	313	13.07	6	24
	Compile data tables	Urban	30 (8.0)	66 (17.6)	202 (53.7)	78 (20.7)	376	12.23	4	16
		Rural	67 (21.4)	121 (38.7)	89 (28.4)	37 (11.8)	313	8.21	4	16
	Make a hypothesis	Urban	22 (5.9)	95 (25.3)	189 (50.3)	70 (18.6)	376	18.10	7	24
		Rural	77 (24.6)	89 (28.4)	108 (34.5)	39 (12.5)	313	16.12	6	24
	Make a graph	Urban	25 (6.6)	89 (23.7)	197 (52.4)	65 (17.3)	376	24.20	10	36
		Rural	75 (24.0)	91 (29.1)	105 (33.5)	42 (13.4)	313	16.82	8	36

Table 3 shows that students' science process skills in science subject of fluid junior high school area as much as 376 students for urban and 313 for rural. Indicator of observation is dominated by good category 189 (50.33%) students for urban and fair category 109 (34.8%) students for rural. Classification is dominated by good category 199 (52.9%) students for urban and fair category 99 (31.6%) students for rural. Prediction is dominated by good category 191(50.8%) students for urban and fair category 101(32.3%) students for rural. Indicator of measure is dominated by good category 178 (47.3%) students for urban and fair category 101 (32.3%) students for rural. Variable identification is dominated by good category 187 (49.7%) students for urban and good category 101 (32.3%) students for rural. Compile data tables is dominated by good category 202(53.7%) students for urban and fair category 121(38.7%) students for rural. Make a hypothesis is dominated by good category 189(50.3%) students for urban and good category 108(34.5%) students for rural. Make a graph is dominated by good category 197(52.4%) students for urban and good category 105(33.5%) students for rural.

From the results of the statistical analysis, it can be concluded that the science process skills of students are good for urban areas, but for rural areas, it is still fair. This indicates that there is a gap between urban and rural. A very possible cause is the quality and facilities of learning support. This was revealed by several students related responses in the interview, as follows;

"... if I can observe the tool, but for use it. I can't. This is my first experience using this tool ..."

"…correct. I only put numbers in the table ... "

"... I made the graph according to the example, for viscosity there was no example so I had difficulty ..."

From the interview, it can be seen that students in the area have lack practical experience. This experience is very supportive in conducting practical work and science process skills. Furthermore, for urban, students have a fairly good ability to respond to problems and have to predict, as follows;

"... it is predicted that the viscosity will be large if the mass is large ..., I just estimate it from the formula ..."

Answers like this indicate that students have critical thinking, use their knowledge to predict. This is part of the success of the learning process. The success of learning science was seen as the cognitive, psychomotor, and affective aspects (Duran & Dökme, 2016). Process skills are part of the psychomotor skills students must have (Puspita et al., 2017). Process skills are acquired skills and basic skills. Where these basic skills will develop higher skills. However, to increase this skill requires experience to do the practicum (El Islami & Nuangchalerm, 2020). Science process skills can be used by students to solve science problems in everyday life (Darmaji et al., 2018; Wibawa et al., 2020).

Some things that must be considered in improving students' science process skills, namely the selection of learning models, curriculum suitability, and students' skills. Learning models can influence students' science process skills (Limatahu & Prahani, 2018). If the learning model is following the students' interests, then students' interest in learning will be high and can improve skills, especially in practical learning models (Can et al., 2017). This certainly must be adjusted to the provisions contained in the curriculum. Moreover, the curriculum used is process-based. The process-based curriculum will benefit for improving science process skills (Soobard et al., 2018). Even so, it must be supported by teachers who have a good experience (Danday & Monterola, 2019).

Critical Thinking of Students in Urban and Rural Schools

The result of students' critical thinking includes; elementary clarification, basic for the decision, inference, advanced clarification, strategy and tactics in science for urban and rural junior schools showed in table 4.

Table 4. Critical Thinking of Students in Learning Science for Urban and Rural Junior High School

Critical thinking		Category (f, %)					Total	Mean	Min	Max
		Very low	Low	Fair	High	Very High				
Elementary clarification	Urban	12 (3.2)	78 (20.7)	88 (23.4)	174 (46.3)	24 (6.4)	376	5.04	1	7
	Rural	19 (6.1)	77 (24.6)	115 (36.7)	89 (28.4)	17 (5.4)	313	3.48	0	7
Basic for decision	Urban	4 (1.1)	74 (19.7)	88 (23.4)	182 (48.4)	28 (7.4)	376	5.08	1	7
	Rural	20 (6.4)	82 (26.2)	121 (38.7)	81 (25.9)	9 (2.9)	313	3.42	0	7
Inference	Urban	11 (2.9)	78 (20.7)	87 (23.1)	176 (46.8)	24 (6.4)	376	5.04	0	7
	Rural	25 (8.0)	76 (24.3)	120 (38.3)	81 (25.9)	11 (3.5)	313	3.43	0	7
Advanced clarification	Urban	13 (3.5)	67 (17.8)	84 (22.3)	170 (45.2)	42 (11.2)	376	5.08	1	7
	Rural	31 (9.9)	83 (26.5)	101 (32.3)	83 (26.5)	15 (4.8)	313	3.42	0	7
Strategy and tactics	Urban	4 (1.1)	78 (20.7)	98 (26.1)	156 (41.5)	40 (10.6)	376	5.05	1	7
	Rural	24 (7.7)	81 (25.9)	114 (36.4)	73 (23.3)	21 (6.70)	313	3.43	0	7

Table 4 shows that students' critical thinking for rural junior high schools' area as much as 376 respondents. Students' critical thinking includes; elementary clarification is the high category, as much as 174 (46.3%) students for the urban and fair category, as much as 115 (36.7%) students for the rural. Basic for decision is high category, as much as 182 (48.4%) students for the urban and fair category, as much as 121 (38.7%) students for the rural. Inference is high category, as much as 176 (46.8%) students for the urban and fair category, as much as 120 (38.3%) students for the rural. Advanced clarification is high category as much as 170 (45.2%) students for the urban and fair category, as much 101 (32.3%) students for the rural. Strategy and tactics is high category, as much as 156 (41.5%) students for the urban and fair category, as much 114 (36.4%) students for the rural.

For critical thinking skills are not much different from science process skills. Students in urban areas tend to be better than rural in terms of critical thinking. However, when viewed from the results of interviews, students in rural areas also have critical thinking skills but in different contexts. Following are the results of interviews that illustrate, students in rural areas have critical thinking.

"... I try to understand by looking at my father when measuring rice fields ..."

"... yes. I try to apply to flow through my rice field related vessel concepts ... "

Students in rural areas tend to utilize knowledge with the environment they experience. This is very useful and very impressive learning. Because the principle of learning knows what is not known by students, starting from phenomena and concepts (Tiruneh & Cock, 2017). Students must understand the concepts to improve critical thinking (Nurdin & Damayanti, 2020). If students have critical thinking skills, students can look at the situation from all sides, able to think ideally (Al-Mahrooqi & Denman, 2020).

Critical thinking is the main capital to be a problem solver (Olaniyan & Govender, 2018). To produce students who can become problem solvers, a strong understanding of concepts is needed (Utomo & Narulita, 2018). Even natural science subjects that have various concepts will help in solving problems in the environment (Sener & Tas, 2017). Some experts claim that: critical thinking skills can be created by giving students treatments. The treatments used to adjust to students' potential, such as learning by playing roles (Ong et al., 2020).

If students have critical thinking skills, students will tend to have good learning outcomes. Learning achievement can be in the form of critical thinking and have good process skills or a good attitude towards natural science (Gurcay & Ferah, 2017). Furthermore, students will be able to face challenges in the future (Broks, 2016). The method that can be used is to give students problems that require critical thinking (Zenda & Ferreira, 2016; Chikiwa & Schäfer, 2018).

The Regression between Students' Science Process Skills and Critical Thinking

The results of the effect of students' science process skills and critical thinking can be seen in Table 5 and 6 below.

Table 5. Results of Regression

Variable	Unstandardized Coefficients		Standardized Coefficients	t	sig.
	B	Std. Error	Beta		
Constant	17.445	3.216		7.120	.000
Science process skill	3.267	.731	.717	2.134	.016

From table 5, it can be seen the results of a simple regression test found that the regression equation is Y = 17.445 + 3.267X, where it is found that students' attitudes influence students' critical thinking ($p<0.001$).

Table 6. Contribution from Attitude on Self-confidence

Model	R	R square	Adjust R Square	Std. Error of the Estimate
1	.624	.515	.509	1.719

The results of simple regression analysis based on Table 5 showed that the value of the coefficient of determination was (R^2) 0.515, which means that the contribution of students' attitude to students' critical thinking is 51.5%, while the remaining 48.5% is influenced by other variables.

Table 5 and 6 found that the effect of science process skills on critical thinking is quite significant. There are student responses that illustrate the effect of process skills on critical thinking, as follows;

"... at school, I never did that, so when I can't pump water, I think it's a problem because there is a leak. The same principle is Boyle's law. Water will go in all directions; this is my answer related to related concepts in my life ... "

From the responses above it is known that students have critical thinking by relating concepts to the problems being faced. From statistical analysis and in-depth interviews, it is concluded that there is an influence of science process skills on students' critical thinking skills (Ješková et al., 2016; Jatmiko et al., 2018). Students who have high skills will tend to have the ability to think highly or critical thinking. A science process skill indicator, there is an indicator of the ability to think critically. The science process skills have a strong relationship with critical thinking, students with low science process skills have moderate or low critical thinking skills (Diani et al., 2020).

The Disparity of Students' Science Process Skills and Critical Thinking based on Urban and Rural Area

To find out whether there is a difference between the teacher's socio-cultural competence based on urban and rural schools' area, an independent sample t-test was used. Table 7 shows students' science processing skills in learning science subjects, meanwhile, Table 8 shows students' critical thinking in learning science subjects.

Table 7. Independent Sample t-test for Science Process Skill

	School Area	Mean	Std. Deviation	T	Sig.	95% confidence interval	
						Lower	Upper
Science Process Skill	Urban	3.175	.17825	18.224	0.001	14.330	.6250
	Rural	2.482	.18190	18.224		11.335	.7125

Based on Table 7, the result shows if that there are differences among students' science process skills in learning science based on their schools' area ($t(687) = 18.224$, $p<0.01$), where students who are schooling in urban schools' area ($M=3.175$, $SD = 0.17825$) tent to provide higher attitudes than students who are schooling in rural schools' area ($M=2.482$, $SD = 0.18190$).

If we look, urban and rural science process skills are different but not significant. This value illustrates the difference in the ability of students in urban and rural areas. This impact will have a significant effect on critical thinking, as in Table 7.

Table 8. Independent Sample t-test for Critical Thinking

	School Area	Mean	Std. Deviation	T	Sig.	95% confidence interval	
						Lower	Upper
Critical Thinking	Urban	5.058	.16330	17.224	0.000	11.115	.5560
	Rural	3.436	.15220	17.221		12.120	.6265

Furthermore, based on Table 8, the result shows if that there are differences among students' critical thinking in learning science based on their schools' area ($t(687) = 17.224$, $p<0.001$)), where students who are schooling in urban schools' area ($M=5.058$, $SD = 0.16330$) tent to provide higher self-confidence than students who are schooling in rural schools' area ($M=3.436$, $SD = 0.15220$).

Critical thinking between urban and rural has a significant difference. The difference in the critical thinking skills of secondary school students can be influenced by many factors. One of them is with the facilities and quality of learning. As stated by Asrial et al. (2019) "Education to acquire knowledge, skills, and habits in life". Education can be said as a conscious effort to shape human potential as the participants do by teaching and facilitating student learning activities (Alneyadi, 2019; Alemu, 2020). Important activities in the learning process are parts of education. Natural science is not only mastery of a collection of knowledge in the form of facts, concepts, or principles, but also is a process of discovery (Susetyarini & Fauzi, 2020). In general, to understand natural phenomena (Leasa et al., 2020).

The importance of the science process skills for junior high school students is that students learn meaningfully by knowing and being actively involved in discovering concepts from existing phenomena in the environment. Meaningful learning is learning that involves students directly and learning will be easy to remember (Puspita et al., 2017). Students who can form science process skills will help students master further skills. Students who have the science process skills will think critically. The ability to think critically is needed to understand the concept well (Zeidan & Jayosi, 2015). One model of learning that can be done by teachers is by practicum (Phonna et al., 2020) or using technology to provide new nuances in learning (Chen et al., 2018).

On the other hand, other factors can influence the science process skills and critical thinking, which is the region. This region problem is divided into two namely urban and rural (Mupezeni & Kriek, 2018). Besides, the level of student age or grade level will affect science process skills and critical thinking (Prayitno et al., 2017) which means that students who already have a lot of knowledge will be more critical and have science process skills. All problems or inhibiting factors can be minimized by the ability of good teachers, by how the teacher cheers students with their shortcomings and needs (Zhan et al., 2019). So, it is expected that students equally have high critical thinking skills, and can answer future challenges (Çetin & Özdemir, 2018; Lin, et al., 2019)

The novel of this study was students in urban areas who have higher process skills when compared with rural areas. As well as critical thinking, students in urban areas are higher than those in rural areas. Another finding is that science process skills affect critical thinking skills. These findings are in line with some previous research (Inayah et al., 2020; Tarchi & Mason, 2020)

This novel provides benefits for teachers. Utilization in the realm of knowledge that science process skills will have an impact on critical thinking. So to foster students' critical thinking, teachers must fight for the learning process involving science process skills. This is supported by the findings of previous studies (Astuti et al., 2020).

CONCLUSION

The conclusion of the study is the science process skill of students in learning science whether urban and rural areas are good. But when comparing that results, the independent sample t-shows that students' science process skills in the urban tend to be highest than in rural schools ($p < 0.01$). Critical thinking of students in learning science whether the urban is high than the rural area ($p < 0.001$). Lastly, the regression shows the level of contribution of students' science process skill interest as much as 51.5% for critical thinking. Moreover, by study, it was found that student science process skill affects the critical thinking in learning science. The students' science process skills and critical thinking are based on their school location whether the urban is highest than the rural area.

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