Urban and Rural School, who is better? Student's Critical Thinking Skills and Science Processing Skills based on Gender

Critical thinking and science processing skill is important in 21st Century. The purpose of this study is to determine the science process skills and critical thinking skills of students in rural and urban areas and to see if there are differences between the two in terms of gender. In addition, the purpose of this study was also to determine the effect between the variables of science process skills and students' critical thinking skills. This type of research is quantitative research with experimental research design. The population of this research is public junior high school students who are in rural and urban areas. The sample used in this study was 534 students with details of 281 female students and 253 male students. The sample selection technique used is purposive sampling technique. The instruments used are science process skills observation sheets and critical thinking ability test sheets. The data analysis technique used is descriptive statistics and inferential statistics with Anova test and Simple Linear Regression Test. The results of this study indicate that the science process skills and critical thinking skills of students in rural and urban areas are in the good category. Where for science process skills in rural and urban areas which are in the very good category, namely the observing and experimenting indicators and there are significant differences regarding critical thinking skills and science process skills in rural and urban schools. In addition, there is a significant influence between the variables of science process skills and students' critical thinking skills.

Keywords: *Science Process Skills, Critical Thinking, Cognitive, Gender*

Introduction

Education is one of the important factors in a country that plays a role in building the future. One of the important roles of education is to help build students' beliefs, understanding, attitudes and thinking skills to develop their potential(Siswanto et al., 2019; Hanh et al., 2021; Palinussa et al., 2021). In addition, students are asked to be more productive, creative, innovative and become an effective generation through knowledge and life skills(Nugraha and Eliyawati, 2019; Ndayabaje et al., 2020; Zhou, 2021). Education can be used as a benchmark in improving human resources to create superior human beings(Abate et al., 2021; Darmaji et al., 2019; Yarychev & Mentsiev, 2020). Therefore, it is necessary to have a good quality of education. One of the important subjects to learn is science learning.

Science learning is a branch of science that focuses on providing direct experience in everyday life because it is the basis for the development of science(Nida, Mustikasari and Eilks, 2021; Sæleset and Friedrichsen, 2021; Torres, Paiva and Mouraz, 2021). Science learning consists of a set of concepts, facts and laws of physics found with scientific concepts. One branch

of science that requires direct understanding is physics. Physics is a learning with science that discusses natural phenomena and the nature of objects in the universe which contains a collection of knowledge in the form of concepts, facts and principles.(Dasilva et al., 2019; Fenditasari et al., 2020; Sajidan et al., 2020). Physics is able to direct students in improving process skills to produce good cognitive(Tanti, Maison, et al., 2020; Daher, Alfahel and Anabousy, 2021; Krumphals and Haagen-Schutzenhofer, 2021). One way to help students understand physics is by doing practical work.

Practicum is an activity to test and apply the theory that has been obtained during the learning process (Arista and Kuswanto, 2018; Kurniawan et al., 2019; Tiandho, 2021). Practicum activities require students to observe, experiment and test existing concepts both inside and outside the laboratory(Akcay & Yager, 2016; Firmansyah & Suhandi, 2021; Zhan et al., 2019). Practical activities can actively involve students during the practicum process to develop scientific attitudes so that they can train cognitive, affective and psychomotor aspects(Wang, 2018; Hariwangsa Panuluh et al., 2020; Yang & Lim, 2021). In practice, students can be involved in the process of observing, comparing, and formulating hypotheses so that students get experience and real case examples from the material being taught(Seung, Choi and Pestel, 2016; Mustari et al., 2020; Zezekwa and Nkopodi, 2020). Through practical activities students can improve science process skills that require critical thinking skills in making problem - solving decisions .

One of the potentials that must be developed by students to understand science is science process skills. This science process skill is a skill that every student must have(Akcay and Yager, 2016; Indri, Sarwanto and Nurosyid, 2020; Nurhayati et al., 2021). Important science process skills are mastered as the basis for using the scientific method in developing knowledge(Gunawan et al., 2019; Tanti, Maison, et al., 2020; Restiana and Djukri, 2021). Students are trained to develop sensitivity to scientific attitudes which are expected to gain hands-on experience (Suryawati and Osman, 2018; Setiawan and Sugiyanto, 2020; Apaivatin, Srikoon and Munggam, 2021). Science process skills that students have supports scientific thinking to support further abilities. One of the important things with developing students' process skills is to improve students' critical thinking.

Thinking skills are important skills that must be mastered by students. One of the thinking skills that students need to develop is the ability to think critically(Fitriani et al., 2020; Lin, Hu and Chiu, 2020; Rumahlatu, Sangur and Lililine, 2020). Critical thinking consists of interpreting and evaluating skills in terms of observation, communication, and also the acquisition of information(Chikiwa and Schäfer, 2018; Supratman et al., 2021).Critical thinking is used for problem solving, analyzing assumptions, evaluating and making decisions. Critical thinking skills are important to be implanted in science to be able to critically examine the information obtained(Rahmawati et al., 2019; Sustekova et al., 2019; Shaw et al., 2019).

One of the characteristics of students who have the ability to think critically is always looking for and explaining the relationship between the

problems discussed and relevant things (Özelçi and alışkan, 2019; Shaw et al., 2019; Verburgh, 2019). Science process skills and students' critical thinking skills are important aspects that students must have. These scientific process skills and critical thinking skills involve scientific inquiry and problem solving about life science concepts(Chikiwa and Schäfer, 2018; Nisa, Nafiah and Wilujeng, 2020; Tanti, dwi agus Kurniawan, et al., 2020). To achieve good process skills and critical thinking requires serious effort from students(Çetin and zdemir, 2018; Sustekova, Kubiatko and Usak, 2019; Darmaji et al., 2020)Achieving good learning outcomes is influenced by process skills and students' critical thinking. One of the things that affect the difference in the ability of science process and critical thinking ability of students is gender.

Gender differences are one of the differences that distinguish aspects of science process skills and critical thinking between men and women. Gender is the difference that appears in women and men when viewed from the values and behavior or differences between men and women socially. Gender can be called a differentiating factor in a person's abilities such as the ability to learn in class(Heeg & Avraamidou, 2021; Ikonen et al., 2019; Sultan et al., 2020). Based on research(Bhagat and Chang, 2018; Gulacar, Milkey and Mclane, 2019; Daher, Alfahel and Anabousy, 2021)that female students are more active than male students. However male students are more talented in science than female students(Lee and Kung, 2018; Ikonen et al., 2019; Bustami et al., 2020). Therefore, gender differences have an influence on students' science process skills and critical thinking.

Based on the description above, the purpose of this research is to find out how the science process skills and critical thinking skills of students in rural and urban areas, whether there is a difference between the two and whether there is an influence between the two science process skills on critical thinking skills in terms of gender.

Methods

The research design in this study was descriptive qualitative with an experimental approach. The type of research used by the researchers in this study was a quasi-research with a posttest only control design. Data collection was carried out in April 2021. The population is the generalization area of the research results(Jaya, 2010). The population in this study consisted of several schools that had accredited A criteria, the population in this study consisted of two areas, namely the Jambi city area and the village area. For the population of this study can be seen in table 1 below.

Table 1. Research Population

Urban	**Rural**
SMPN 17 Jambi City	SMPN 2 Batang Hari
SMPN 17 Jambi City	SMPN 8 Batang Hari
SMPN 22 Jambi City	SMPN 5 Batang Hari

From the population used by the researcher, the sample selection in this study used a purpose sampling technique. This technique was chosen in this study to determine the sample. The sample selection has criteria that students have studied the measurement material. So that later a sample will be obtained in accordance with the objectives of the research, so that in this study the sample used was 534 students, with details of 126 female students and 115 male students in the urban area, while in the village area there were 155 female students and 138 male students. male students.

In this study, the quantitative data used were data on students' science process skills and students' critical thinking skills. To get these data, students are asked to conduct experiments or practicum, while when students do practicum, researchers are assisted by a team to assess science process skills with indicators of science process skills, which are presented in table 2 below.

Table 2. Student's Science Process Skills Assessment Grid

Types of Science Process Skills	**Indicator Science Process Skills**	Many Statements
Basic science process skills	Observation	6
	Classification	5
	Measure	5
	Conclude	4
Integrated science process skills	Variable identification	3
	Doing an experiment	5
	Arrange table	4
	Designing experiments	3

The assessment of students' science process skills uses a Likert scale of 1 to 4, namely: a score of 4 (Very Good), 3 (Good), 2 (Not Good), and 1 (Very Bad).

When students do practicum, researchers assess students' science process skills using observation sheets. Students' science process skills are tested based on indicators of basic and integrated science process skills. In this study, the researchers adjusted the indicators on the science syllabus in junior high school so that the researchers only took 4 indicators of basic science process skills and 4 integrated science process skills, so for the interval class for each indicator it can be seen in table 3 below

Table 3. The range of scores for the quantitative criteria of students' science process skills based on each indicator

Types of science process skills	**Indicator Science Process Skills**	**Value Range**			
		Very Not Good	**Not Good**	**Good**	**Very Good**
Skills	Observation	6-10.5	10.6-15	15.1-19.5	19.6-24
Science	Classification	5-8.75	8.76-	12.51-	16.26-

process			12.5	16.25	20
Basic	Measure	5-8.75	8.76-12.5	12.51-16.25	16.26-20
	Conclude	4-7	7.01-10	10.01-13	13.01-16
Skills Science process	Doing an experiment	5-8.75	8.76-12.5	12.51-16.25	16.26-20
	Arrange table	4-7	7.01-10	10.01-13	13.01-16
Integrated	Variable identification	3-5.25	5.26-7.5	7.51-9.75	9.76-12
	Designing experiments	3-5.25	5.26-7.5	7.51-9.75	9.76-12

In addition to scientific process skills, researchers also conduct research on critical thinking skills, for critical thinking skills grids can be seen in table 4 below.

Table 4. Critical thinking skills assessment grid

Indicator Critical thinking skills	Many Statements
Give a simple explanation	2
Building basic skills	2
Conclude	2
Provide further explanation	2
Set strategy and tactics	2

The assessment of students' critical thinking skills uses a Likert scale of 1 to 4, namely: a score of 4 (Very Good), 3 (Good), 2 (Not Good), and 1 (Very Bad).

When the students have done the practicum, the researcher assesses the students' critical thinking skills using an observation sheet. After determining the scale, the researcher categorizes students' critical thinking skills which can be seen in Table 5.

Table 5. The range of scores for the quantitative criteria of students' critical thinking skills

Range	Criteria
0.0 – 10.0	Very Not Good
10.1 – 20.0	Not good
20.1 – 30.0	Good
30.1– 40.0	Very good

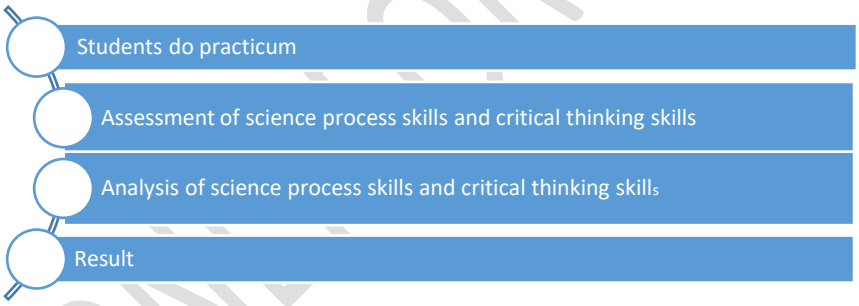
The data processing technique used is descriptive statistics, as described (Nasution, 2016 ; (Leni Masnidar Nasution, 2017)that descriptive statistics are used to describe or provide information on conditions or problems using data. In the descriptive analysis, the mean, median, mode, and standard deviation values are presented(Goos & Maintrup, 2015 ; (George and Mallery, 2019).

The mean is the sum of all scores of the frequency distribution divided by the number of data(Budiwanto, 2017). The median is the number that lies in the middle of a frequency distribution (MUNDIR, 2012). The mode is used to analyze the phenomenon that occurs the most or is used the most.

For inferential statistics consists of hypothesis testing. Before testing the hypothesis, the data obtained were first tested for prerequisites, namely normality and homogeneity tests. The data will be homogeneous if the Sig value obtained is more than 0.05 (Sig > 0.05)(SHESKIN, 2000; (Judge et al., 2020). After the data obtained are homogeneous, the next step the researcher is to test the prerequisites for the normality test, the data obtained so that it is said to be normal, namely if the sig value obtained is more than 0.05 (Sig > 0.05)(Duisembekova, 2021).After doing the prerequisite test, then the data is tested for hypotheses with the Anova test and regression test. The requirements of the regression and ANOVA tests are sig values less than 0.05 (< 0.05)(Salim and Darmayanti, 2020).

The data collection procedure in this study began with the initial activity, namely students doing measurement practicum, when students did research practicum assisted by the team observing students' scientific process skills and critical thinking skills using observation sheets. Next, the researcher analyzed the data using SPSS 23. The quantitative data presented used descriptive statistics and inferential statistics. Data collection procedures briefly can be seen in the diagram below.

Figure 1. Research Flowchart



Results and Discussion

This study contains statistical analysis that explains the mastery of science process skills based on indicators of basic science process skills including observation, classification, measuring, inferring and integrated science process skills including identifying variables, conducting experiments, designing experiments, and compiling data tables. The indicators of critical thinking skills included in this research are:*elementary clarification, basic support, inference, advanced clarification, strategy and tactics.*

The novelty of this research is that researchers explore science process skills and critical thinking skills in junior high schools based on gender differences and based on school locations located in urban and rural areas.

Science process skills of students' in urban and rural schools

Science process skills are skills that students need when learning science. The results of basic science process skills and integrated science process skills in urban junior high schools are shown in table 6 and the results of basic science process skills and integrated science process skills in rural junior high schools are shown in table 6

Table 6. Science Process Skills of Student in Learning Science for Urban Junior High School.

Region	Sps	Gender	Category (%)				mean
	Basic		**Very not good**	**not good**	**good**	**Very good**	
urban	Observation	Male	2(1,3)	26(16.8)	78(50,3)	49(31,6)	18.07
		female	0(0)	43 (31.2)	66(47,8)	29(21,0)	16.94
	Classification	Male	4(2.9)	34 (24.6)	66(47,8)	34(24,6)	14.33
		female	3(1,9)	35 (22.6)	85(54,8)	32(20,6)	14.64
	Measure	Male	3(2,2)	47(34,1)	71(51,4)	17(12,3)	13.44
		female	3(1,9)	43(27.7)	82(52,9)	27(17.4)	14.05
	Concluding	Male	13(9,4)	41(29.7)	63(45,7)	21(15.2)	11.11
		female	4(2,6)	37(23.9)	89(57.4)	25(16,1)	11.52
	Integrated						
	Variableidentification	Male	5(3,6)	9 (6.5)	33(23.9)	91(65.9)	11.11
		female	5(3,2)	7 (4.5)	46(29.7)	97(62,6)	11.59
	Experiment	Male	6(4,3)	42(30,4)	74(53,6)	16(11,6)	13.39
		female	3(1,9)	42(27,1)	85(54,8)	25(16,1)	13.94
	Make a table	Male	12(8,7)	49(35,5)	58(42,0)	19(13,8)	10.81
		female	5(3,2)	27(17.4)	85(54,8)	38(24.5)	11.90
	Design experiment	Male	8(5,8)	26(18,8)	60(43,5)	44(31,9)	8.67
		female	8(5,2)	28(18,1)	66(42,6)	53(34,2)	8.63

Based on table 6 shows that the average results of the basic science process skills and integrated science process skills in urban junior high schools are almost similar. In the basic science process skills of students in urban areas, the highest results were obtained on the observation indicators with a mean value of 18.07 for male gender and 16.94 for female gender. Meanwhile, for integrated science process skills, the highest results were obtained on experimental indicators with an average value of 13.94 for female gender and 13.39 for male gender

Table 7. Science Process Skills of Student in Learning Science for Rural Junior High School

Region	Sps Basic	Gender	Category (%)				mean
			Very not good	not good	good	Very good	
Rural	Observation	Male	2,4(32)	25.4(32)	54.8(69)	17.5(22)	16.93
		female	0	0	48.4(61)	51.6(65)	19.71
	Classification	Male	1.7(2)	37.4(43)	47.8(55)	13.0(15)	13.62
		female	2,4(3)	25.4(32)	54.8(69)	17.5(22)	14,17
	Measure	Male	0.9(1)	40.9(47)	49.6(57)	8.7(10)	13.31
		female	0	11.9(15)	63.5(80)	10.2(13	13.43
	Concluding	Male	4.3(5)	43.5(50)	47.8(55)	4.3(5)	10.63
		female	4(2,6)	37(23.9)	89(57.4)	25(16,1)	11.52
	Integrated Variableidentification	Male	13.0(15)	40.0(46)	30.4(35)	16.5(19)	7.59
		female	4.0(5)	19.8(25)	37.3(47)	38.9(49)	8.77
	Experiment	Male	1.7(2)	36.5(42)	55.7(64)	6.1(7)	13.42
		female	0.0(0)	9.5(12)	74.6(94)	15.9(20)	15.02
	Make a table	Male	6.1(7)	33.0(38)	49.6(57)	11.3(13)	11.03
		female	5,6(7)	17.5(22)	62.7(79)	64.3(18)	11.52
	Design experiment	Male	4.3(5)	20.9(24)	36.5(42)	38.3(44)	8.67
		female	0	11.9(15)	51.6(65)	36.5(46)	9.29

The results obtained in rural junior high schools are shown in table 7. Based on table 7 the results of basic science process skills that have the highest average are in the observation indicators with an average of 16.93 for male gender and 19.71 for female gender. While the integrated science process skills obtained the highest average results on the experimental indicators with an average value of 13.42 for male gender and 15.02 for female gender.

Critical thinking of students in urban and rural schools

Critical thinking ability is a cognitive skill that is used to improve learning outcomes. The results of students' critical thinking skills in urban and rural areas are shown in table 8 and table 9

Table 8. Critical Thinking of student in learning science for urban junior high school

interval	Category	mean	median	Mode	Min	Max	%	Gender
0.0 – 10.0	Very Not Critical						-	
10.1 – 20.0	Not Critical						-	Male
20.1 – 30.0	Critical	14.19	14	14	11	18	61.6	
30.1– 40.0	Very Critical						38.4	
0.0 – 10.0	Very Not Critical						-	
10.1 – 20.0	Not Critical						1.3	female
20.1 – 30.0	Critical	28.74	29,00	26	18	37	68.4	
30.1– 40.0	Very Critical						30.3	

Based on the table. 8 students' critical thinking skills in urban areas are in the good category with a percentage of 61.6 for male gender and good category with a percentage of 68.4 for female gender.

Table 9. Critical Thinking of student in learning science for rural junior high school

interval	Category	mean	median	Mode	Min	Max	%	Gender
0.0 – 10.0	Very Not Critical						-	
10.1 – 20.0	Not Critical						-	Male
20.1 – 30.0	Critical	29.71	30.00	30	21	37	60	
30.1– 40.0	Very Critical						39.7	
0.0 – 10.0	Very Not Critical						-	
10.1 – 20.0	Not Critical						68.3	female
20.1 – 30.0	Critical	28.84	29,00	20	29	37	31.0	
30.1– 40.0	Very Critical						-	

Table 9 is the output of students' critical thinking skills in rural areas. Based on table 9 obtained good results with a percentage of 60% for male gender and good category with a percentage of 68.3 for female gender.

The anova and regression between students' science process skills and critical thinking

After seeing students' science process skills and students' critical thinking skills at junior high schools in cities and villages. Furthermore, the researcher wanted to see whether there was a difference between science process skills and critical thinking skills of students attending rural and urban schools and to see if there was an influence between the two variables. To be able to see whether there is a difference between SPS and CT students in urban and rural schools, the researchers used the Anova test. However, before carrying out the Anova test, the data must be ensured to meet the prerequisite tests which include the normality test and the homogeneity test.

Table 10. The Result of Normality, Homogenity, and Anova Test

		Gender	Rural	urban
SPS	N	Male	115	138
		female	126	155
	Normality(Asymp. Sig. (2-tailed)	Male	0.70	0.091
		female	0.80	0.200
	Homogeneity (Sig.)		0.205	0.141
	One Way Anova (Sig).		0.000	0.000
CT	N	Male	115	138
		female	126	155
	Normality (Asymp. Sig. (2-tailed)	Male	0.78	0.061
		female	0.62	0.097
	Homogeneity (Sig.)		0.525	0.064
	One Way Anova (Sig).		0.034	0.046

Based on table 10 above, the results show that the data on students' science process skills in the city are normally distributed and homogeneous. This is because the results of the normality test of city students on male gender obtained 0.091 results and female gender obtained 0.141 results. Thus, the significance value of the data on science process skills of students, both male

and female in the city, can be said to be normally distributed because it is greater than the normality test requirement (0.05). For the results of the homogeneity test of students in the city, the result is 0.141, which means the significance value is greater than the homogeneity test requirement (0.05) so that the data can be said to be homogeneous or the same. Meanwhile, student data in rural areas is also normally distributed, namely for male gender the results are 0.70 and female gender is 0.080. In addition, the homogeneity test value of students in the village obtained the result of 0.205. The data obtained can be said to be normally distributed and homogeneous if the significance value of the data is greater than the requirements of the normality test and homogeneity test of 0.05.

For students' critical thinking skills, both in urban and rural areas, the results are also normally distributed and homogeneous. This is because the significance value obtained is greater than the requirements of the normality test and homogeny test (0.05). Where for students in the city, the results of male gender were 0.061 for the normality test and 0.064 for the homogeneity test for male students and female students. While female students in the city got a score of 0.097 for the normality test and 0.097 for the homogeneity test. For students in rural areas, the result is 0.78 for the normality test for male students. As for female students, the result was 0.62 for the normality test. To test the homogeneity of male and female students in rural areas, the results obtained were 0.525.

Based on the ANOVA test, it was found that there was a significant difference between science process skills in urban and rural schools. This is because the significance value of science process skills is 0.000, which is greater than 0.05. As for the variable of critical thinking ability of students in urban areas, the result is 0.046 and in rural areas the result is 0.034, which means that there is a difference between the critical thinking ability of students in urban and rural areas because it is less than 0.05.

After knowing that the data obtained are normally distributed and homogeneous, then the data is tested using the linearity test. The following table shows the linearity test between the variables of science process skills and students' critical thinking skills.

Table 11. The Result of Linearity Test

		Sum of Square	Mean Square	F	Sig.
CT*SPS	Deviation from Linearity	4843,522	66,350	0.928	0.645

The linearity test is a test used to see a linear relationship between the variables of science process skills and students' critical thinking skills.

The results obtained indicate that there is a linear relationship between the variables of science process skills and students' critical thinking skills because the significance value obtained is 0.645, which means it is greater than the value of the linearity test requirement (0.05).

Then, the hypothesis was tested using a simple linear regression test and the ANOVA test. The following is a table of 12 simple linear regression tests and ANOVA tests.

Table 12. The Result of the Variance test

Model	Sum of Square	Mean Square	F	Sig.
Regression	36980.546	36980.546	26457,978	0.000b
Residual	743,581	1.398		
Total	37724,127			

Table 12 shows that there is an influence between the variables of science process skills and students' critical thinking skills. This is because the significance value obtained is 0.000, which means it is smaller than the requirements for a simple linear regression test (0.05).

Table 13. The Result of Coefficient Determination

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.990a	0.980	0.980	1.182

Table 13 shows that the value of the coefficient of determination or R square of the variables of science process skills and critical thinking skills. The value obtained is 0.980. The magnitude of the coefficient of determination is 0.980 x 100% = 98.0%. So that means that the variables of science skills and students' critical thinking skills simultaneously have an effect of 98.0%.

Table 14. The Result of Simple Linear Regression Coefficient

Model	B	Std. Error	Beta	T	Sig.
(Constant)	26,992	0.618		43,711	0.000
Science Processing Skills	1.398	0.009	0.990	162,659	0.000

Based on table 14, the regression equation for science process skills and critical thinking skills is Y= 26,992 + 1,398X. For p-value obtained 0.000 which means it is smaller than 0.05. So it is said that science process skills and students' critical thinking skills have an influence.

Science process skills and critical thinking skills are very important aspects in facing the 21st century (Almulla, 2018; Shaw et al., 2019; Malik and Ubaidillah, 2020). Science process skills are science process skills and critical thinking skills can be developed through the stages contained in practicum activities(Maison, Darmaji, Astalini, *et al.*, 2019; Maison, Darmaji, Kurniawan, *et al.*, 2019; Malik and Ubaidillah, 2020). Therefore, researchers look at science process skills and critical thinking skills through practical activities. And the percentage of mastery of science process skills is obtained as in Tables 6 and 7.

Table 6 explains that the basic science process skills and integrated science process skills of students in both urban and rural schools are quite good and almost similar. The highest mastery score on the basic science process skill indicators of students in urban schools is the observation indicator with 18.07

for male gender and 16.94 for female gender and the percentage of mastery of observation on male students is 78% and female students is 60 % good category. Meanwhile, integrated science process skills are experimental indicators with an average of 13.39 for male gender and 13.94 for female gender and the percentage of experimental mastery for male students is 74% and 84% female students.

The mastery of basic science process skills and integrated science process skills of students in rural schools is shown in table 7. Where, the highest averagegi is in the observation indicator with an average of 16.93 for male gender and 19.71 for female gender. While the integrated science process skills obtained the highest average results on the experimental indicators with an average value of 13.42 for male gender and 15.02 for female gender.

Based on these results, it can be seen that basic science process skills and integrated science process skills are in the good category, both in urban and rural areas, namely in the observation indicators and experimental indicators. Observation is a basic skill that underlies the understanding of nature and is a skill that influences other scientific process skills(Kurniawan et al., 2019; Yurumezoglu & Oztas Cin, 2019; Klofutar et al., 2020). Experimentation is the most important indicator in integrated skills where students conduct experiments directly on the material topic. Experimentation is an integrated science process skill that includes an observation process that tests ideas that come from facts, concepts, and principles of science.(Ozgelen, 2012; Hernawati et al., 2018). When viewed by gender, both urban and rural schools show that female students are more skilled and have better science process skills than male students. Based on the observations of the observers in the field, this is because female students are more enthusiastic in carrying out practical activities from the initial step to the end of the practicum activities.

After students carry out practical work and also complete critical thinking test questions, it can be seen in table 8 which shows that students' critical thinking skills in urban schools are in the good category with a percentage of 61.6% for male gender and 68.4% for female gender. Likewise, if seen in table 9, it shows that the critical thinking skills of students in rural schools are in the good category with a percentage of 60% for male gender and good category with a percentage of 68.3% for female gender. Based on the two regions, it shows that there are differences in the critical thinking abilities of students in urban and rural areas, where the CT of urban students is better than the critical thinking abilities of rural students. However, these results indicate that the difference between the two is not significant. Then, when viewed based on the gender of students in both regions, it shows that the dominant critical thinking ability is found in the ability of female students. This finding is also reinforced by previous research which says that female students have divergent thinking skills and excel in thought processes, perception, pronunciation and processing of reference sources, while male students have analytical thinking skills and excel in problem solving.(Lin *et al.*, 2012; Abraham *et al.*, 2014; Malik and Ubaidillah, 2020).

When looking at the results of science process skills and critical thinking skills in table 10, it shows that there is a significant difference betweenscience process skills and critical thinking skills in urban and rural schools. Urban schools have students with better critical thinking skills and science process skills than rural schools. Based on the findings of the observers in the field, this is influenced by the facilities of several village. schools that are not adequate enough, most of the laboratory equipment tends to be damaged and cannot be used, the unskilled teachers in rural areas in carrying out several experiments, and the ability of students who are not honed during the pandemic.

Then, researchers are also interested in conducting research on the effect of the two variables studied. Table 12 explains that there is an influence between the variables of science process skills and students' critical thinking skills. Table 13, shows that the value of the coefficient of determination or R square of the variables of science process skills and critical thinking skills obtained is 98.0%. So that means that the variables of science skills and students' critical thinking skills simultaneously have an effect of 98.0%. And 2% of it is influenced by other variables or factors that are not detected outside of this test. The output of simple linear regression testing and the resulting equation in table 14 has shown that there is a significant influence between science process skills and students' critical thinking skills. The results of this study are strengthened by previous research which also says that science process skills affect students' critical thinking skills(Darmaji, Astalini, *et al.*, 2020).

Therefore, if students' science process skills are in the low category, it will cause students' critical thinking skills to be low and vice versa. This is because the results of this study indicate that science process skills affect students' critical thinking skills. In addition, the low science process skills and students' critical thinking skills have an impact on the low student learning outcomes. This is in accordance with research which states that the result of the low science process skills of students is that students' learning outcomes are less than optimal(Syafriansyah, Suyanto & Nyeneng, 2013; Kurniawati et al., 2016). In addition, students' science process skills can also increase the knowledge that exists in students through activities that involve cognitive knowledge(Siswono, 2017). So that by developing science process skills, you can get a fun learning experience and improve cognitive abilities, such as the ability to think critically(Nurqolbi, Riyanto and Lestari, 2019).

So to improve science process skills, meaningful learning must be carried out through direct experience or practicum-based learning(Ekene, 2011; Murni, 2018; Wahyuni, Suhendar and Setiono, 2020). Practicum is a learning process based on direct experience and a learning process that uses certain skills. The advantage of practicum activities is that students. can develop a scientific way of thinking. So that practicum is a very important activity in improving science process skills and students' critical thinking skills.

The impact of science process skills and students' critical thinking skills is that it can improve student learning outcomes, can improve rational thinking and can solve problems in everyday life, and can improve cognitive, affective

and psychomotor aspects. This research also complements the research conducted by(D. Darmaji et al., 2020; Darmaji et al., 2020; Tanti, DA Kurniawan, et al., 2020). Where, there are indicators of basic science process skills or integration that have not been covered and this research also adds research innovation with a gender review.

Conclusion

Based on the results obtained, it can be concluded that the science process skills and students' thinking abilities are categorized as good. Then, the most prominent basic science process skills of urban students are observing indicators with an average (male & female) of 17.50 and the most prominent integrated science process skills, namely the skills of conducting experiments or experiments with an average (male and female). & female) 13.66. Meanwhile, in rural students, basic science process skills are more prominent, with an average observing indicator (male & female) of 18.32 and integrated skills with indicators of conducting experiments with an average of (male & female) 14.22. In addition, students' critical thinking skills in urban areas are in the good category with a percentage of 65% (male & female). female). While in rural areas, good results were obtained with a percentage of 64.15% (male & female). In addition, there are significant differences between the variables of science process skills and students' critical thinking skills.

References

Abate, T., Michael, K. and Angell, C. (2021) 'Upper Primary Students ' Views Vis-à-Vis Scientific Reasoning Progress Levels in Physics', *EURASIA Journal of Mathematics, Science and Technology Education*, 17(5).

Abraham, A. *et al.* (2014) 'Gender differences in creative thinking: behavioral and fMRI findings', *Brain imaging and behavior*, 8(1), pp. 39–51. doi: https://doi. org/10.1007/ s11682-013-9241-4.

Akcay, H. and Yager, R. E. (2016) 'Students Learning to Use the Skills Used by Practicing Scientists', *Eurasia Journal of Mathematics, Science & Technology Education*, 12(3), pp. 513–525. doi: 10.12973/eurasia.2015.1395a.

Almulla, M. (2018) 'Investigating teachers' perceptions of their own practices to improve students' critical thinking in secondary schools in Saudi Arabia', *International Journal of Cognitive Research in Science, Engineering and Education*, 6(3), pp. 15–27. doi: 10.5937/IJCRSEE1803015A.

Apaivatin, R., Srikoon, S. and Mungngam, P. (2021) 'Research synthesis of STEM Education effected on science process skills in Thailand', *Journal of Physics: Conference Series*, 1835(1). doi: 10.1088/1742-6596/1835/1/012087.

Arista, F. S. and Kuswanto, H. (2018) 'Virtual physics laboratory application based on the android smartphone to improve learning independence and conceptual understanding', *International Journal of Instruction*, 11(1), pp. 1–16. doi:10.12973/ iji.2018.1111a.

Bhagat, K. K. and Chang, C. Y. (2018) 'A cross-cultural comparison on students' perceptions towards online learning', *Eurasia Journal of Mathematics, Science and Technology Education*, 14(3), pp. 987–995. doi: 10.12973/ejmste/81151.

Budiwanto (2017) *Mertode Penelitian Dalam Keolahragaan*. malang: universitas Negeri malang.

Bustami, Y. *et al.* (2020) 'JiRQA Learning Model of Based Gender: Cognitive Learning Students in Environmental Pollution Material', *International Journal of Instruction*, 14(1), pp. 17–28. doi: 10.29333/IJI.2021.1412A.

Çetin, A. and Özdemir, Ö. F. (2018) 'Mode-method interaction: The role of teaching methods on the effect of instructional modes on achievements, science process skills, and attitudes towards physics', *Eurasia Journal of Mathematics, Science and Technology Education*, 14(5), pp. 1815–1826. doi: 10.29333/EJMSTE/852 17.

Chikiwa, C. and Schäfer, M. (2018) 'Promoting critical thinking in multilingual mathematics classes through questioning', *Eurasia Journal of Mathematics, Science and Technology Education*, 14(8). doi: 10.29333/ejmste/91832.

Daher, W., Alfahel, E. and Anabousy, A. (2021) 'Moderating the Relationship Between Student's Gender and Science Motivation', *Eurasia Journal of Mathematics, Science and Technology Education*, 17(5).

Darmaji *et al.* (2020) 'Do a science process skills affect on critical thinking in science? Differences in urban and rural', *International Journal of Evaluation and Research in Education*, 9(4), pp. 874–880. doi: 10.11591/ijere.v9i4.20687.

Darmaji, D. *et al.* (2020) 'Regression of Science Process Skills On Critical Thinking Skills In Two Junior High Schools In Jambi City', *JIPF (Jurnal Ilmu Pendidikan Fisika)*, 5(3), p. 177. doi: 10.26737/jipf.v5i3.1788.

Darmaji, D., Kurniawan, D. A. and Irdianti, I. (2019) 'Physics education s tudents ' s cience process skills', *International Journal of Evaluation and Research in Education (IJERE)*, 8(2), pp. 293–298. doi: 10.11591/ijere.v8i2.16401.

Darna, N. and Herlina, E. (2018) 'Memilih Metode Penelitian Yang Tepat: Bagi Penelitian Bidang Ilmu Manajemen', *Jurnal Ilmu Manajemen*, 5(1), pp. 287–292. doi: 10.2827/jeim.v5i1.1359.

Dasilva, B. E. *et al.* (2019) 'SSP Development with a Scaffolding Approach Assisted by PhET Simulation on Light Refraction to Improve Students' Critical Thinking Skills and Achievement of Science Process Skills', *Journal of Physics: Conference Series*, 1233(1). doi: 10.1088/1742-6596/1233/1/012044.

Duisembekova, Z. (2021) 'Beliefs about Intercultural Communicative Competence: The Development and Validation of a New Instrument', *International Journal of Instruction*, 14(2), pp. 103–116. doi: 10.29333/iji.2021.1427a.

Ekene, I. (2011) 'Effects Of Co-Operative Learning Strategy And Demonstration Method On Acquisition Of Science Process Skills By Chemistry Students Of Different Levels Of Scientific Literacy', *Journal of research and Development*, 3(1), pp. 204–212.

Fenditasari, K. *et al.* (2020) 'Identification of misconceptions on heat and temperature among physics education students using four-tier diagnostic test', *Journal of Physics: Conference Series*, 1470(1). doi: 10.1088/1742-6596/1470/1/012055.

Firmansyah, J. and Suhandi, A. (2021) 'Critical thinking skills and science process skills in physics practicum', *Journal of Physics: Conference Series*, 1806(1). doi: 10.1088/1742-6596/1806/1/012047.

Fitriani, A. *et al.* (2020) 'PBLPOE : A Learning Model to Enhance Students ' Critical Thinking Skills and Scientific Attitudes', *International Journal of Instruction*, 13(2), pp. 89–106.

George, D. and Mallery, P. (2019) *IBM SPSS Statistics 26 Step by Step*. New York: Routledge.

Goos, P. and Maintrup, S. (2015) *Statistics with JMP: Hypothesis Tests, ANOVA and Regression*. jerman: fraktur book fair.

Gulacar, O., Milkey, A. and Mclane, S. (2019) 'Exploring the effect of prior knowledge and gender on undergraduate students' knowledge structures in chemistry', *Eurasia Journal of Mathematics, Science and Technology Education*, 15(8). doi: 10.29333/ejmste/106231.

Gunawan *et al.* (2019) 'Guided inquiry model through virtual laboratory to enhance students' science process skills on heat concept', *Cakrawala Pendidikan*, 38(2), pp. 259–268. doi: 10.21831/cp.v38i2.23345.

Hakim, L. *et al.* (2020) 'Integrating sharia economics into the high school economics curriculum', *International Journal of Instruction*, 13(4), pp. 117–132. doi: 10.29333/iji.2020.1348a.

Hanh, H. T. M. *et al.* (2021) 'Awareness of education university's preschool students about the impact of 4.0 industrial revolution in education and role of STEM education in teaching', *Journal of Physics: Conference Series*, 1835(1), pp. 0–10. doi: 10.1088/1742-6596/1835/1/012098.

Heeg, D. and Avraamidou, L. (2021) 'Life-Experiences of Female Students in Physics: The Outsiders Within', *Eurasia Journal of Mathematics, Science and Technology Education*, 17(7), p. em1983. doi: 10.29333/ejmste/10991.

Hernawati, D. *et al.* (2018) 'The effectiveness of scientific approach using encyclopedia as learning materials in improving students' science process skills in science', *Jurnal Pendidikan IPA Indonesia*, 7(3), pp. 266–272. doi: 10.15294/jpii.v7i3.14459.

Ikonen, K. *et al.* (2019) 'Finnish ninth graders' gender appropriateness of occupations', *Eurasia Journal of Mathematics, Science and Technology Education*, 15(12). doi: 10.29333/ejmste/111995.

Indri, O. W., Sarwanto and Nurosyid, F. (2020) 'Analysis of high school students' science process skills', *Journal of Physics: Conference Series*, 1567(3). doi: 10.1088/1742-6596/1567/3/032098.

Jaya, I. (2010) *statistik penelitian untuk penelitian*. bandung: citapustaka media perintis.

Klofutar, Š., Jerman, J. and Torkar, G. (2020) 'Direct versus vicarious experiences for developing children's skills of observation in early science education', *International Journal of Early Years Education*, 0(0), pp. 1–18. doi: 10.1080/09669760.2020.1814214.

Krumphals, I. and Haagen-Schutzenhofer, C. (2021) 'Development of a Learning Environment to Enhance Preservice Physics Teachers' Diagnostic Competence in Terms of Students' Conceptions', *Eurasia Journal of Mathematics, Science and Technology Education*, 17(6), pp. 1–18. doi: 10.29333/ejmste/10898.

Kurniawan, W. *et al.* (2019) 'Multimedia physics practicum reflective material based on problem solving for science process skills', *International Journal of Evaluation and Research in Education*, 8(4), pp. 590–595. doi: 10.11591/ijere.v8i4.20258.

Kurniawati, D., Masykuri, M. and Saputro, S. (2016) 'Penerapan Model Pembelajaran Inkuiri Terbimbing Dilengkapi Lks Untuk Meningkatkan Keterampilan Proses Sains Dan Prestasi Belajar Pada Materi Pokok Hukum Dasar Kimia Siswa Kelas X Mia 4 Sma N 1 Karanganyar Tahun Pelajaran 2014/2015', *Jurnal Pendidikan Kimia Universitas Sebelas Maret*, 5(1), pp. 88–95.

Laksono, E. W., Suyanta and Rizky, I. (2018) 'Problem-based learning implementation to develop critical thinking and science process skills of madrasah Aliyah students in yogyakarta', *Journal of Physics: Conference Series*, 1097(1). doi: 10.1088/1742-6596/1097/1/012059.

Lee, C. Y. and Kung, H. Y. (2018) 'Math self-concept and mathematics achievement: Examining gender variation and reciprocal relations among junior high school

students in Taiwan', *Eurasia Journal of Mathematics, Science and Technology Education*, 14(4), pp. 1239–1252. doi: 10.29333/ejmste/82535.

Lin, S., Hu, H. C. and Chiu, C. K. (2020) 'Training Practices of Self-efficacy on Critical Thinking Skills and Literacy: Importance-Performance Matrix Analysis', *Eurasia Journal of Mathematics, Science and Technology Education*, 16(1), pp. 1–10. doi: 10.29333/ejmste/112202.

Lin, W. L. *et al.* (2012) 'The relations of gender and personality traits on different creativities: A dual-process theory account', *Psychology of Aesthetics, Creativity, and the Arts*, 6(2), pp. 112–123. doi: https://doi.org/10.1037/a002624.

Maison, Darmaji, Kurniawan, D. A., *et al.* (2019) 'Analysis Of Science Process Skills In Physics Education Students', *Jurnal Penelitian dan Evaluasi Pendidikan*, 23(2), pp. 197–205. doi: http://dx.doi.org/10.21831/pep.v23i2.28123.

Maison, Darmaji, Astalini, *et al.* (2019) 'Science process skills and motivation', *Humanities and Social Sciences Reviews*, 7(5), pp. 48–56. doi: 10.18510/hssr.2019.756.

Malik, A. and Ubaidillah, M. (2020a) 'Students critical-creative thinking skill: A multivariate analysis of experiments and gender', *International Journal of Cognitive Research in Science, Engineering and Education*, 8(Special Issue 1), pp. 49–58. doi: 10.23947/2334-8496-2020-8-SI-49-58.

Malik, A. and Ubaidillah, M. (2020b) 'tudents critical-creative thinking skill: A multivariate analysis of experiments and gender', *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)*, (8), pp. 49–58.

MUNDIR, M. (2012) *Statistik pendidikan; Pengatar analisis data untuk penulisan skripsi dan tesis*. Jember: IAIN JEMBER.

Murni (2018) 'PROFIL KETERAMPILAN PROSES SAINS SISWA DAN', 6(1), pp. 118–129.

Mustari, M. *et al.* (2020) 'Development of physics practicum module based on collaborative teamwork learning model', *Journal of Physics: Conference Series*, pp. 1–9. doi: 10.1088/1742-6596/1572/1/012018.

Nasution, L. Masnidar (2017) 'Statistik Deskriptif', *Jurnal Hikmah*, 14(1), pp. 49–55.

Nasution, Leni Masnidar (2017) 'STATISTIK DESKRIPTIF', *Jurnal Hikmah*, 14(1), pp. 49–55.

Ndayabaje, E. *et al.* (2020) 'MARITAL STATUS AND SUBJECTIVE WELL-BEING: DOES EDUCATION LEVEL TAKE', *Cakrawala Pendidikan*, 39(1), pp. 120–132. doi: 10.21831/cp.v39i1.29620.

Nida, S., Mustikasari, V. R. and Eilks, I. (2021) 'Indonesian Pre-Service Science Teachers ' Views on Socio-Scientific Issues- Based Science Learning', *Eurasia Journal of Mathematics, Science and Technology Education*, 17(1), pp. 1–11.

Nisa, W. M., Nafiah, Z. and Wilujeng, I. (2020) 'Profile of critical thinking skills in student's SMPN 1 Kalipare at topic of substance and its characteristics', *Journal of Physics: Conference Series*, 1440(1), pp. 1–5. doi: 10.1088/1742-6596/1440/1/012081.

Nugraha, I. and Eliyawati, E. (2019) 'The use of video laboratory report to develop presentation skills in science teacher education students', *Journal of Physics: Conference Series*, 1157(2). doi: 10.1088/1742-6596/1157/2/022031.

Nurhayati *et al.* (2021) 'The impact of problem-based learning and inquiry models toward students' science process skills on the vibrations and waves chapter', *Journal of Physics: Conference Series*, 1760(1). doi: 10.1088/1742-6596/1760/1/012017.

Nurqolbi, R. I., Riyanto, A. A. and Lestari, R. H. (2019) 'PENGARUH KETERAMPILAN PROSES SAINS', *Jurnal CERIA*, 2(5).

Özelçi, S. Y. and Çalışkan, G. (2019) 'What is critical thinking? A longitudinal study with teacher candidates', *International Journal of Evaluation and Research in Education*, 8(3), pp. 495–509. doi: 10.11591/ijere.v8i3.20254.

Ozgelen, S. (2012) 'Students ' Science Process Skills within a Cognitive Domain', *Eurasia Journal of Mathematics, Science & Technology Education*, 8(4), pp. 263–292. doi: 10.12973/eurasia.2012.846a.

Palinussa, A. L. *et al.* (2021) 'Realistic mathematics education : Mathematical reasoning and communication skills in rural contexts', 10(2), pp. 522–534. doi: 10.11591/ijere.v10i2.20640.

Panuluh, A. H., Atmajati, E. D. and Kristanto, Y. D. (2020) 'Physics education students' perception on the use of motion detector in linear motion practicum', *Journal of Physics: Conference Series*, 1470(1). doi: 10.1088/1742-6596/1470/1/012087.

Rahmawati, L., Subanji and Septi Nur Afifah, D. (2019) 'Analysis of Critical Thinking from Student with Quantive Approach', *Journal of Physics: Conference Series*, 1339(1). doi: 10.1088/1742-6596/1339/1/012084.

Restiana and Djukri (2021) 'Effectiveness of learning models for improving science process skills: A review study', *Journal of Physics: Conference Series*, 1788(1). doi: 10.1088/1742-6596/1788/1/012046.

Rumahlatu, D., Sangur, K. and Liline, S. (2020) 'The Effect of Complex Instruction Team Product (CITP) Learning Model on Increase Student ' s Skills', *intenational journal of instruction*, 13(1), pp. 587–606.

Sæleset, J. and Friedrichsen, P. (2021) 'Pre-service Science Teachers' Pedagogical Content Knowledge Integration of Students' Understanding in Science and Instructional Strategies', *Eurasia Journal of Mathematics, Science and Technology Education*, 17(5), pp. 1–18. doi: 10.29333/ejmste/10859.

Sajidan, S. *et al.* (2020) 'Development of Science Learning Model towards Society 5.0: A Conceptual Model', *Journal of Physics: Conference Series*, 1511(1), pp. 0–9. doi: 10.1088/1742-6596/1511/1/012124.

Salim, R. M. A. and Darmayanti, K. K. H. (2020) 'Striving for the brighter future: An experience of high school students as earthquake victims', *International Journal of Evaluation and Research in Education*, 9(4), pp. 887–895. doi: 10.11591/ijere.v9i4.20709.

Setiawan, A. M. and Sugiyanto (2020) 'Science process skills analysis of science teacher on professional teacher program in Indonesia', *Jurnal Pendidikan IPA Indonesia*, 9(2), pp. 241–247. doi: 10.15294/jpii.v9i2.23817.

Seung, E., Choi, A. and Pestel, B. (2016) 'University Students ' Understanding of Chemistry Processes and the Quality of Evidence in their Written Arguments', *Eurasia Journal of Mathematics, Science & Technology Education*, 12(4), pp. 991–1008. doi: 10.12973/eurasia.2016.1248a.

Shaw, A. *et al.* (2019) 'Studies in Higher Education Thinking critically about critical thinking : validating the Russian HEIghten ® critical thinking assessment Thinking critically about critical thinking : validating the Russian', *Studies in Higher Education*, 5079. doi: 10.1080/03075079.2019.1672640.

SHESKIN, D. (2000) *Parametric and nonparametric statistical procedures*. CRC: BOCA RATON.

Siswanto *et al.* (2019) 'ENVIRONMENTAL CULTURED EDUCATION AND ITS IMPLICATION ON THE STUDENT'S COMPETENCIES', *CAKRAWALA PENDIDIKAN*, 38(3), pp. 552–564. doi: 10.21831/cp.v38i3.23154.

Siswono, H. (2017) 'Analisis Pengaruh Keterampilan Proses Sains Terhadap Penguasaan Konsep Fisika Siswa', *Momentum: Physics Education Journal*, 1(2), p. 83. doi: 10.21067/mpej.v1i2.1967.

Sultan *et al.* (2020) 'Textbook discourse readability: Gender, reading interest, and socio-economic status of students with poor reading ability', *Cakrawala Pendidikan*, 39(3), pp. 583–596. doi: 10.21831/cp.v39i3.32326.

Supratman *et al.* (2021) 'The Effect Size of Different Learning on Critical and Creative Thinking Skills of Biology Students', *International Journal of Instruction*, 14(3), pp. 187–206.

Suryawati, E. and Osman, K. (2018) 'Contextual learning: Innovative approach towards the development of students' scientific attitude and natural science performance', *Eurasia Journal of Mathematics, Science and Technology Education*, 14(1), pp. 61–76. doi: 10.12973/ejmste/79329.

Sustekova, E., Kubiatko, M. and Usak, M. (2019) 'Validation of critical thinking test on Slovak conditions', *Eurasia Journal of Mathematics, Science and Technology Education*, 15(12). doi: 10.29333/ejmste/112295.

Tanti, Kurniawan, dwi agus, *et al.* (2020) 'SCIENCE PROCESS SKILLS AND CRITICAL THINKING IN SCIENCE ':, *Jurnal Pendidikan IPA Indonesia*, 9(4), pp. 489–498. doi: 10.15294/jpii.v9i4.24139.

Tanti, Kurniawan, D. A., *et al.* (2020) 'Science process skills and critical thinking in science: Urban and rural disparity', *Jurnal Pendidikan IPA Indonesia*, 9(4), pp. 489–498. doi: 10.15294/jpii.v9i4.24139.

Tanti, Maison, *et al.* (2020) 'Students' self-regulation and motivation in learning science', *International Journal of Evaluation and Research in Education*, 9(4), pp. 865–873. doi: 10.11591/ijere.v9i4.20657.

Tiandho, Y. (2021) 'Practicum implementation for kinematics using tracker: Solutions for practicum implementation during the COVID-19 pandemic', *Journal of Physics: Conference Series*, 1816(1). doi: 10.1088/1742-6596/1816/1/012104.

Torres, A. C., Paiva, J. and Mouraz, A. (2021) 'High School Students ' Questions About Science and Religion in School Debates with Scientists', *EURASIA Journal of Mathematics, Science and Technology Education*, 17(6).

Verburgh, A. (2019) 'Studies in Higher Education Effectiveness of approaches to stimulate critical thinking in social work curricula', *Studies in Higher Education*, 0(0), pp. 1–12. doi: 10.1080/03075079.2019.1586336.

Wahyuni, S., Suhendar, S. and Setiono, S. (2020) 'Profil Keterampilan Proses Sains Siswa Kelas X Sma', *Jurnal Pelita Pendidikan*, 8(1), pp. 41–45. doi: 10.24114/jpp.v8i1.17246.

Wang, T. H. (2018) 'Developing a web-based assessment system for evaluating examinee's understanding of the procedure of scientific experiments', *Eurasia Journal of Mathematics, Science and Technology Education*, 14(5), pp. 1791–1801. doi: 10.29333/ejmste/85170.

Yang, I. and Lim, S. (2021) 'The Satisfaction and Needs of Teachers on the Earth Science Model Experiments in Science Textbooks Used in Primary Schools', *EURASIA Journal of Mathematics, Science and Technology Education*, 17(5).

Yarychev, N. U. and Mentsiev, A. U. (2020) 'Impact of digital education on traditional education', *Journal of Physics: Conference Series*, 1691(1). doi: 10.1088/1742-6596/1691/1/012132.

Yurumezoglu, K. and Oztas Cin, M. (2019) 'Developing Children's Observation Skills Using a Fractal Pattern from Nature', *Science Activities: Projects and Curriculum Ideas in STEM Classrooms*, 56(2), pp. 63–73. doi: 10.1080/00368121.2019.1696734.

Zezekwa, N. and Nkopodi, N. (2020) 'Physics teachers' views and practices on the assessment of students' practical work skills', *Eurasia Journal of Mathematics, Science and Technology Education*, 16(8). doi: 10.29333/EJMSTE/8289.

Zhan, X. *et al.* (2019) 'Propensity score analysis of the impacts of junior secondary students' participation in engineering practices on their attitudes toward engineering', *Eurasia Journal of Mathematics, Science and Technology Education*, 15(11). doi: 10.29333/ejmste/106761.

Zhang, X. *et al.* (2018) 'Exploring the effect of transformational leadership on individual creativity in e-learning: a perspective of social exchange theory', *Studies in Higher Education*, 43(11), pp. 1964–1978. doi: 10.1080/03075079.2017.1296824.

Zhou, F. (2021) 'The Exploration and Countermeasures of University Education Management Model Based on Big Data Technology', *Journal of Physics: Conference Series*, 1881(2), pp. 0–7. doi: 10.1088/1742-6596/1881/2/022099.