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Effect of Science-Technology-Society Approaches to The Science Process Skills Elementary School Students

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***Abstract*—The first observation at some schools indicated learning process of Natural Sciences just concept-oriented without observation or applied on the real nature. That was cause students Science process skills did not increased. This study aims to find out effect of Science-Technology-Society (STS) Approaches to the science process skills. This study used pretest-posttest control group design was conducted at Putat Elementary School involved 74 students 5th grade which was divided into two groups. The first group was experiment class (VB) and the second was control class (VA). The results with calculation the difference of two mean used confidence level 95% show average score of Science process skills between experiment class and control class has different. Experiment class with STS approaches learning indicated better enhancement to Science process skills compared control class with conventional learning. The STS approaches was implemented in one week at water cycle learning. Study instrument used science process skills test, learning outcomes test, and observation classes. The results show that STS approaches could improving students Science process skills and making students more exciting on Natural Sciences learning.**

Keywords—STS approaches, science process skills, learning approaches, learning outcomes.

1. INTRODUCTION

Education is attempt to developing better personal skills and attitudes. Education Another describing education as an stage that has an institutional with the aims to develop skills in knowledge, personal skills, and attitudes [17]. With that goal, learning activities for students should using meaningful learning. That meaning not only making students memorize the theory but also applied that theory in the real life. Learning activities will be more meaningful if knowledge is found by students themselves, not just from teacher informations [12]. Through direct experience, students will be better understanding the concept, especially in Natural Sciences.

Natural Sciences learning not only making students understand the concept, but how the concept can be applied in the daily life of students. That is why natural sciences learning always doing observation or experiments activities. Observation and experiments which students do not only build the concept but also could improve science process skills and scientific attitudes. It is certainly required learning process in accordance with the principles of Natural Sciences study.

But in fact, Natural Sciences learning process in some schools not in ideal conditions for achieving goals. The condition is evidenced by the lack of students science process skills which becomes one of the Natural Sciences learning goals. Things that caused improvements of sciences process skills and scientific attitudes of students not optimal which demonstrated by studies and assessments undertaken by PISA (Program for International Student Assessment) in 2012 that measures students sciences literacy skills. Indonesia was one of country who participated in that study and assessments got an average score of science literacy ability of 382. With that score, Indonesia was only ranked 64 out of 65 countries that participated in the test. The position was only one rank from the last position. These results indicated that the ability of Students Natural Sciences still low in the scope of science literacy. The lack of development science process skills aspects due to less innovative learning. Natural Sciences learning at the schools just give priority to concept-oriented and the teacher only use conventional learning method like discourse and question and answer methods [6]. That was one of some aspects which caused students science process skills does not have better improvements.

Natural Sciences concepts obtained through the sciences process will last long and could be used to overcome problems in the real life [12]. It should be more meaningful if the theory and practice implemented each other in a balanced with the orientation on improvement science process skills and scientific attitudes. Natural Sciences learning objectives at schools on Kurikulum Tingkat Satuan Pendidikan (KTSP) confirms that learnings is expected to instill and develop

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students knowledge, skills, and attitudes and raise awareness to appreciate the natural surrounding (BNSP, 2006). To realize that, teachers need innovative learning which connect theory with environmental problems. It is reinforced with Piaget cognitive theory, elementary students is in the range of 6-12 years old in the pre-operative and formal operational phase. At that phase, students have not been able to think abstractly and still refer to concrete experiences (Piaget in Asy`ari, 2006). Natural Sciences learning for elementary schools should be able to provide hands-on experiences to develop their capabilities, so they can explore and understand nature as a whole [12].

Based on the problem studies above, Science-Technology-Society (STS) approaches become one of solutions in improving science process skills and learning outcomes. Natural Sciences learning connected to daily life through related technology products, will make students feel that Natural Sciences learning is useful to learn [11]. Application of STS approaches could make students applied concept of Natural Sciences at daily life with regard the technology that is growing at their society. The application of STS approaches in Natural Sciences learning is done in several stages. It starting with invitation, exploration, solutions, and applications [1]. Invitation stage begins with giving students the ongoing problems or issues in the environment that could observe by students. Exploration stage giving students the opportunity to understand concepts with teacher guidance through observation and problem analysis. Problem identification from exploration can be taken by students with reading articles from newspapers, listening radio or watching news from television. At the solution stage, students begin to develop the concept they have gained with the new concept that fit with environmental conditions. It becomes the student references to analyzing the cause of the problem and looking for alternative solutions that can be used to solve the problem. After they find alternative solutions, at the application stage, they try to applying the solution as a provision to be applied in the students environment. On this stage also do the stabilization of the concept that students are not mistaken in understanding the new concept.

Based on the above exposure, this study aims to find out the improvement students science process skills and learning outcomes in the water cycle concept with STS approaches learning and conventional learning. This study also observed the correlation between science process skills and students learning outcomes.

II. METHOD

This study used experiment method which have two compared groups selected at random. Research design used pretest-posttest control group design. Following description of the research design. First steps research was divide students into two class and determined control class and experiment class (A), continued with given pretest to both classes (0). After that, experiment class was given treatment that implemented use the STS approaches learning while the control class was not given treatment or implemented use the conventional learning as usual [9].

Research populations was superior groups elementary schools in district Sedong. From six schools belonging to superior groups, conducted a draw to determined the sample and obtained by 5th grade students of Putat Elementary School. After that, 74 students from Putat Elementary School divided into two groups namely the experiment class (VB) and Control class (VA).

Research instruments on this study used quantitative analysis consisted of science process skills and learning outcomes test. Validity, reliability, level of difficulty, and appropriateness of questions tested first to 70 students. Validity and reliability were used to test the feasibility of the questions to be tested measure students abilities.

Calculation of validity used correlation coefficient formula product moment raw score by Pearson. After calculation, correlation coefficient interpreted using validity coefficient by Guilford [13]. Nine questions of science process skills and seven questions of learning outcomes were tested. Test results show 6 of 9 science process skills questions had high validity while 3 other questions had medium validity. 5 of 7 learning outcomes questions had high validity, one question had very high validity and one more question had medium validity.

Calculation of realibility use reliability coefficient by Cronbach Alpha. After calculation, correlation coefficient interpreted using reliability coefficient by Guilford [13]. Test results show reliability of science process skills questions had correlation coefficient reached 0,84 and based on coefficient correlation was in very high category. Reliability of learning outcomes questions had correlation coefficient reached 0,79 and based on coefficient correlation was in high category.

Difficulty level of science process skills and learning outcomes questions calculated by Microsoft Excel for Windows. Test results show 8 of 9 science process skills questions had medium level and one question had difficult level. All of learning outcomes questions had medium level. Appropriateness of science process skills and learning outcomes questions calculated by Microsoft Excel for Windows. Test results show 6 of 9 science process skills questions had good appropriateness, 2 questions had very good appropriateness, and one more question had sufficient appropriateness. All of learning outcomes questions had good appropriateness.

Other research instruments used on this study was teacher performances and students activity observations. Teacher performances which observation was compatibility of planning and implementing STS approaches learning and conventional learning. Students activity observation was done to know response of students during following STS approaches learning and conventional learning.

Research procedure on this study had four stages. The stage starts with preparation, implementation, data processing, and data analysis. Preparation stage start with set problems and topics for learnings, prepared instruments, consulted topics and instruments to experts, validity instruments test, improvement instruments, permit to the school where the research was conducted, and consultation with teacher about technical research implementation. Implementation stage start with pretest to experiment class and control class aims to measure students initial ability from both classes. The next activity was the learning according to the schedule that has been set. Experiment class did the learning with STS approaches and control class did the conventional learning for one week. During the learning process, teacher performance and students activities are observed. In the end of learning, students were given posttest to determined the effect of STS approaches and conventional learnings to the students science process skills and learning outcomes.

After all learning activites were completed and all instruments are filled, data was processed and analyzed. Pretest and posttest data from STS approaches and conventional learning was processed and analyzed by quantitative analysis consisted of normality test, homogeneity test, two mean difference test, and correlation coefficient test. Things that must be considered if one or both groups data were abnormal distribution, it was not followed by homogeneity test but used non-parametic statistical test with Mann-Whitney or U-test. Analysis was also did on teacher performance and students activity observation. After all instruments were analyzed then drawing conclusions from the initial hypothesis whether it was accepted or rejected.

III. RESULTS AND DISCUSSION

Pretest data shows the difference average between the experiment class and the control class. The average pretest of science process skills the experiment class was 20,05 while the control class was 17.83. There was the difference amount 2,22. After the pretest result of both classes, the first step was normality test to that results. Analysis was done by Lilliefors test (Kolmogorov-Smirnov).

As shown in table 1, the results show normality test of the experiment class pretest has P-value (Sig.) 0,046 with Lilliefors test. That point less than α = 0,05. Therefore, pretest data for the experiment class is abnormal distribution. Furthermore, control class pretest has P-value (Sig.) 0,200 with Lilliefors test. That point more than α = 0,05. Therefore, pretest data for the control class is normal distribution. Because one of the data is abnormal distribution, then the next step is two mean difference test with Mann-Whitney or U-test. It is because the data being tested is unrelated data or independent. Table 2 display the results two mean difference test of both classes pretest has P-value (Sig.2-tailed) 0,553 with Mann-Whitney or U-test. That point P-value (Sig.2-tailed) more than α = 0,05. Based on these results, there is no difference in initial ability between the experiment class and the control class.

Table 1. Normality test of pretest and posstest data science process skills

Tests of Normality					Tests of Normality				
	Class	Kolmogorov-Smirnov[a]				Class	Kolmogorov-Smirnov[a]		
		Statistic	df	Sig.			Statistic	df	Sig.
Pretest	Experiment	.144	38	.046	Posttest	Experiment	.190	38	.001
	Control	.121	36	.200*		Control	.155	36	.029
a. Lilliefors Significance Correction					a. Lilliefors Significance Correction				
*. This is a lower bound of the true significance.									

Table 2. Two mean difference test of pretest and posttest data science process skills

Test Statistics[b]		Test Statistics[b]	
	Pretest		Posttest
Mann-Whitney U	629.500	Mann-Whitney U	200.500
Wilcoxon W	1.296E3	Wilcoxon W	866.500
Z	-.594	Z	-5.238
Asymp. Sig. (2-tailed)	.553	Asymp. Sig. (2-tailed)	.000
a. Based on 10000 sampled tables with starting seed 1314643744.		a. Based on 10000 sampled tables with starting seed 743671174.	
b. Grouping Variable: Class		b. Grouping Variable: Class	

Posttest data shows the difference average between both classes. The average pretest of science process skills the experiment class was 61,61 while the control class was 35.50. There was the difference amount 26,11. After the posttest result of both classes, the next step was normality test by Lilliefors test (Kolmogorov-Smirnov). On table 1, normality test of the experiment class posttest has P-value (Sig.) 0,001 with Lilliefors test. That point less than α = 0,05. Therefore, posttest data for the experiment class is abnormal distribution. Furthermore, control class posttest has P-value (Sig.) 0,029 with Lilliefors test. That point less than α = 0,05. Therefore, posttest data for the control class is abnormal distribution. Because both of the data is abnormal distribution, then the next step is two mean difference test with Mann-Whitney or U-test. Table 2 display the results two mean difference test of both classes pretest has P-value (Sig.2-tailed) 0,000 with Mann-Whitney or U-test. That point P-value (Sig.2-tailed) less than α = 0,05. Based on these results, there is difference in final ability between the experiment class and the control class.

To see the effect of STS approaches and conventional learning to the science process skills, Wilcoxon test was conducted on both classes. Data processing and analyzing to answer the hypothesis is done with the SPSS for Windows.

Table 3 show two mean difference pretest and posttest experiment class with Wilcoxon test. The results display points of P-value (Sig.1-tailed) = 0,000 or less than α = 0,05. Based on these results, there is difference between initial ability and final ability of science process skills at experiment class. Table III also show two mean difference pretest and posttest control class with Wilcoxon test. The results display points of P-value (Sig.1-tailed) = 0,000 or less than α = 0,05. Based on these results, there is difference between initial ability and final ability of science process skills at control class.

Table 3. Wilcoxon test results of data pretest and posttest science process skills experiment and control class

Test Statistics Experiment Class[b,c]		Test Statistics Control Class[b,c]	
	Posttest – Pretest		Posttest – Pretest
Z	-5.375[a]	Z	-4.940[a]
Asymp. Sig. (2-tailed)	.000	Asymp. Sig. (2-tailed)	.000
a. Based on negative ranks.		a. Based on negative ranks.	
b. Wilcoxon Signed Ranks Test		b. Wilcoxon Signed Ranks Test	
c. Based on 10000 sampled tables with starting seed 2000000.		c. Based on 10000 sampled tables with starting seed 299883525.	

Analysis data learning outcomes

The average pretest of learning outcomes the experiment class was 30,66 while control class was 30,89. There was the difference amount 0,23. After the pretest result of both classes, the first step was normality test to that results. Analysis was done by Lilliefors test (Kolmogorov-Smirnov).

Table 4. Normality test of pretest and posttest data learning outcomes

Tests of Normality					Tests of Normality				
	Class	Kolmogorov-Smirnov[a]				Class	Kolmogorov-Smirnov[a]		
		Statistic	df	Sig.			Statistic	df	Sig.
Pretest	Experiment	.136	38	.074	Posttest	Experiment	.202	38	.000
	Control	.179	36	.005		Control	.083	36	.200*
a. Lilliefors Significance Correction					a. Lilliefors Significance Correction				
					*. This is a lower bound of the true significance.				

Table 5. Two mean difference test of pretest and posttest data learning outcomes

Test Statistics[b]		Test Statistics[b]	
	Pretest		Posttest
Mann-Whitney U	671.500	Mann-Whitney U	213.500
Wilcoxon W	1.412E3	Wilcoxon W	879.500
Z	-.136	Z	-5.103
Asymp. Sig. (2-tailed)	.892	Asymp. Sig. (2-tailed)	.000
a. Based on 10000 sampled tables with starting seed 334431365.		a. Based on 10000 sampled tables with starting seed 299883525.	
b. Grouping Variable: Class		b. Grouping Variable: Class	

As shown in table 4, the results show normality test of the experiment class pretest has P-value (Sig.) 0,074 with Lilliefors test. That point more than α = 0,05. Therefore, pretest data for the experiment class is normal distribution. Furthermore, control class pretest has P-value (Sig.) 0,005 with Lilliefors test. That point less than α = 0,05. Therefore, pretest data for the control class is abnormal distribution. Because one of the data is abnormal distribution, then the next step is two mean difference test with Mann-Whitney or U-test. Table 5 display the results two mean difference test of both classes pretest has P-value (Sig.2-tailed) 0,892 with Mann-Whitney or U-test. That point P-value (Sig.2-tailed) more than α = 0,05. Based on these results, there is no difference in initial ability between the experiment class and the control class.

Posttest data shows the difference average between both classes. The average pretest of learning outcomes the experiment class was 73,13 while the control class was 50.56. There was the difference amount 22,57. After the posttest result of both classes, the next step was normality test by Lilliefors test (Kolmogorov-Smirnov). On table 4, normality test of the experiment class posttest has P-value (Sig.) 0,000 with Lilliefors test. That point less than α = 0,05. Therefore, posttest data for the experiment class is abnormal distribution. Furthermore, control class posttest has P-value (Sig.) 0,200 with Lilliefors test. That point more than α = 0,05. Therefore, posttest data for the control class is normal distribution. Because one of the data is abnormal distribution, then the next step is two mean difference test with Mann-Whitney or U-test. Table 5 also display the results two mean difference test of both classes posttest has P-value (Sig.2-tailed) 0,000 with Mann-Whitney or U-test. That point P-value (Sig.2-tailed) less than α = 0,05. Based on these results, there is difference in final ability between the experiment class and the control class.

To see the effect of STS approaches and conventional learning to the learning outcomes, Wilcoxon test was conducted on both classes just like science process skills data analysis.

Table 6. Wilcoxon test results of data pretest and posttest learning outcomes experiment and control class

Test Statistics Experiment Class[b,c]		Test Statistics Control Class[b,c]	
	Posttest – Pretest		Posttest – Pretest
Z	-5.382[a]	Z	-4.942[a]
Asymp. Sig. (2-tailed)	.000	Asymp. Sig. (2-tailed)	.000
a. Based on negative ranks.		a. Based on negative ranks.	
b. Wilcoxon Signed Ranks Test		b. Wilcoxon Signed Ranks Test	
c. Based on 10000 sampled tables with starting seed 2000000.		c. Based on 10000 sampled tables with starting seed 299883525.	

Table 6 show two mean difference pretest and posttest experiment class with Wilcoxon test. The results display points of P-value (Sig.1-tailed) = 0,000 or less than α = 0,05. Based on these results, there is difference between initial ability and final ability of learning outcomes at experiment class. Table 6 also show two mean difference pretest and posttest control class with Wilcoxon test. The results display points of P-value (Sig.1-tailed) = 0,000 or less than α = 0,05. Based on these results, there is difference between initial ability and final ability of learning outcomes at control class.

Analysis data observation

Table 7. Teacher performance observation results

Class	Learning 1	Learning 2	Learning 3	Averages	Inter pretation
Experiment Class					
Planning	90%	95%	95%	93%	Very good
Implementing	90%	93%	95%	93%	Very good
Control Class					
Planning	95%	95%	95%	95%	Very good
Implementing	90%	93%	95%	93%	Very good

Teacher performance observation was measured used observation format. But, there was difference between the observation format experiment class and the observation format control class. The experiment class uses the observation format in planned and implemented STS approaches learning while the control class uses the observation format in planned and implemented conventional learning. Based on table 7, teacher performance averages in planning on control class is 95% better than experiment class with 93%, nevertheless teacher performance averages in implementation on both classes is equal with 93%.

Table 8. Students activity observations results

Experiment Class				
Activities	Participation	Motivation	Cooperation	Friction
Learning 1				
Total	59	54	60	74
%	52%	47%	53%	65%
Averages	54%			
Interpretation	C			
Learning 2				
Total	67	64	70	89
%	59%	56%	61%	78%
Averages	64%			
Interpretation	B			
Learning 3				
Total	78	70	71	96
%	68%	61%	62%	84%
Averages	69%			
Interpretation	B			

Control Class				
Activities	Participation	Motivation	Cooperation	Friction
Learning 1				
Total	48	47	52	65
%	44%	44%	48%	60%
Averages	49%			
Interpretation	C			
Learning 2				
Total	50	55	58	74
%	46%	51%	54%	69%
Averages	55%			
Interpretation	C			
Learning 3				
Total	55	68	59	86
%	51%	63%	55%	80%
Averages	62%			
Interpretation	B			

Students activites observation was measured used observation format. The goal is to measure students responses to the learning process. Aspects measured in the observation are students participation, motivation, cooperation, and friction. Based on table VIII, students activites averages experiment class on the meeting 1 is 54% better than control class with 49%. It is also seen at the final meeting, students activites averages experiment class on the meeting 3 is 69% better than control class with 62%. However, students activities averages from both classes have an increase at each meeting.

This study to find out a better effect for improvements of students science process ability and learning outcomes by using STS approaches learning and conventional learning. Learning process was done on the concept of water cycle in 5th grade conducted in one week. The study invoved 74 students who were divided into two groups. First group was experiment class (VB) which did the STS approaches learning and second group was control class (VA) which did the conventional learning. Analysis data start with initial ability of students science process skills and learning outomes in both classes. That was done by analyzing pretest data from both classes with Mann-Whitney test which level of trust reach 95%. Based on the test, there was no difference in science process skills between experiment class and control class. Similar results were also obtained on students learning outcomes after being tested using Mann-Whitney test. It shows both classes have the same ability.

After doing each learning for one week, all students from both classes were tested again used Wilcoxon test on pretest and posttest. The results obtained there was a difference between initial ability and final ability from both classes in science process skills and learning outcomes. These results indicate that there was an improvement in science process skills and learning outcomes from both classes. That was supported by an increase in averages scores of the science process skills and learning outcomes. Science process skills averages scores of experiment class increase from 20,05 to 61,61 while learning outcomes averages scores increase from 30,66 to 73,13. In the control class, science process skills averages scores increase from 17,83 to 35,50 while learning outcomes averages scores increase from 30,89 to 50,56. These results also show that water cycle concept learning with STS approaches better than conventional learning in improving students science process skills and learning outcomes though intial ability score of learning outcomes control class was better than experiment class by the difference point 0,23.

The next analysis examines the related between science process skills and learning outcomes. Correlation test used coefficient correlation test (Pearson Correlation) on science process skills posttest data and learning outcomes posttest data. If Pearson correlation was positive then there was positive correlation between science process skills and learning outcomes. Moreover, the higher of Pearson values also the higher correlation. Based on Pearson correlation results, obtained positive results with 0,676 points in the experiment class, and positive results with 0,575 points in the control class. These results show that improved in science process skills will be followed also by improved learning outcomes.

IV. CONCLUSION

Based on the exposure of the research results, it can be concluded that STS approaches learning and conventional learning has an effect to students science process skills and learning outcomes at water cycle concept in 5th grade elementary schools. Both learning can improve science process skills. But STS approaches learning improve students science process skills better than conventional learning. Similar results were also found on learing outcomes analysis data. Both learning can improve learning outcomes. But STS approaches learning improve students learning outcomes better than conventional learning.

The results also indicated a correlation between science process skills and learning outcomes. It was reinforced by Pearson correlation between science process skills and learning outcomes with positive results. These results show that improved in science process skills will be followed also by improved learning outcomes.

Research results show that Natural Sciences learning at water cycle concept with STS approaches better than conventional learning in improving students science process skills and learning outcomes. It was because STS approaches learning not only concept-oriented, but also giving students direct experience though the atual problems that occur in their environment. With problem identification can improve students ability to observe the surrounding environment. Moreover, STS approaches could make Natural Science learning more meaningful and improve students ability to applied concept, process skills, creativity, and scientific attitudes on appreciate technology product and responsible for the problems that arise in the environments [1]. The use of continuous and diverse evaluation method could encourage students to be serious in following the learning because the value is not only about cognitive, but also participation and creativity.

REFERENCES

[1] Asy'ari, M. 2006. Penerapan Pendekatan Sains-Teknologi-Masyarakat dalam Pembelajaran Sains di Sekolah Dasar. Universitas Sanata Dharma: Yogyakarta.

[2] Badan Standar Nasional Pendidikan. 2006. Panduan Penyusunan Kurikulum Tingkat Satuan Pendidikan Jenjang Pendidikan Dasar dan Menengah. BP Dharma Bakti: Jakarta.

[3] Bundu, P. 2006. Penilaian Keterampilan Proses dan Sikap Ilmiah dalam Pembelajaran Sains-SD, Depdiknas: Jakarta.

[4] Departemen Pendidikan Nasional. 2007. Kajian Kebijakan Kurikulum Mata Pelajaran IPA. Depdiknas: Jakarta.

[5] Kariadinata, R. dan Abdurahman, M. 2012. Dasar-dasar Statistik Pendidikan. CV Pustaka Setia: Bandung.

[6] Lestari, Ni. Md. E., dkk. 2013. Pengaruh Pendekatan Sains Teknologi Masyarakat (STM) terhadap Hasil Belajar IPA Siswa Class IV SD di Gugus III Kecamatan Tegallalang. Mimbar PGSD: E-Journal Universitas Pendidikan Ganesha. 1(1).

[7] Maryanto dan Purwanto. 2009. Ilmu Pengetahuan Alam 5 untuk SD/MI Class 5. Depdiknas: Jakarta.

[8] Maulana. 2008b. Konsep Dasar dan Aplikasi Statistika serta Teori Distribusi Peluang. Royyan Press: Subang.

[9] Maulana. 2009. Memahami Hakikat, Variabel, dan Instrumen Penelitian Pendidikan dengan Benar. Learn2live 'n Live2learn: Bandung.

[10] OECD-PISA. 2013. PISA 2012 Results in Focus: What 15-years-old Know and What They Can Do with What They Know Volume VII. Not Published.

[11] Poedjiadi, A. 2005). Sains Teknologi Masyarakat Model Pembelajaran Kontekstual Bermuatan Nilai. PT. Remaja Rosdakarya: Bandung.

[12] Sujana, A. 2012. Pendidikan IPA Teori dan Praktik. Rizqi Press: Bandung.

[13] Suherman, E. dan Sukjaya, Y. 1990. Petunjuk Praktis untuk Melaksanakan Evaluasi Pendidikan Matematika. Wijayakusumah 157: Bandung.

[14] Sukardi. 2005. Metodologi Penelitian Pendidikan Kompetensi dan Praktiknya. PT Bumi Aksara: Jakarta.

[15] Surapranata, S. 2009. Analisis, Validitas, Reliabilitas dan Interpretasi Hasil Tes Implementasi Kurikulum 2004. PT. Remaja Rosdakarya: Bandung.

[16] Suwintara, I Pt., dkk. 2013. Pengaruh Pendekatan STM terhadap Sikap Ilmiah dan Hasil Belajar pada Pembelajaran IPA Siswa Class IV SD Gugus V Kecamatan Sawan. Mimbar PGSD: E-Journal Universitas Pendidikan Ganesha. 1(2).

[17] Syah, M. 2010. Psikologi Pendidikan. PT. Remaja Rosdakarya: Bandung.

[18] Undang-undang Republik Indonesia Nomor 20 Tahun 2003. Sistem Pendidikan Nasional (SISDIKNAS). Fokus Media: Bandung.

[19] Wardana, I. K., dkk. 2013. Pengaruh Model Kontekstual terhadap Keterampilan Proses Sains dan Hasil Belajar Sains pada Siswa Class IV SD Gugus V Dr. Soetomo. Mimbar PGSD: E-Journal Universitas Pendidikan Ganesha. 1(3).