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The Development of SSP by Utilizing Nusakambangan Biodiversity based on SETS to Enhance Soft Security and Practical Skills

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ABSTRACT

The purposes of this research are (1) to produce Subject Specific Pedagogic (SSP) for Natural Sciences course by utilizing Nusakambangan biodiversity based on the valid and practical SETS (Science Environment Technology and Society) approach, and (2) to determine the effectiveness of the developed product to improve the students' soft security and practical skills. This research can be categorized as development research adapting the 4-D model from Thiagarajan. The research procedures consisted of four stages, namely: (1) define (2) design (3) develop, and (4) disseminate. This research was conducted in two classes, the experimental class, and the control class, among the seventh grade students of State Junior High School in the school year of 2018/2019. The instruments for data collection were questionnaire, observation sheets, and pretest-posttest. The qualitative data consisted of input and suggestions from validator, students' responses, and observations results, while the quantitative data were in the form of soft security questionnaire results and practical skills test scores. The data analysis techniques were in the form of normality test, homogeneity test, gain score and Manova test. The results showed that: (1) The SSP by utilizing Nusakambangan biodiversity based on SETS was declared valid to be used in the learning process that can be categorized as "very feasible", (3) The developed SSP was effective in enhancing the students' soft security and practical skills with p value of 0,000 <α 0.05.

Keywords: SSP, Nusakambangan, SETS, soft security, practical skills

INTRODUCTION

The common issues to standardize the education quality in Indonesia is the equitable access due to its wide range of geographical condition that is bordered by oceans, rivers, mountains, and wilderness. This condition directly impacts the low school quality in rural areas which have limited human resources, infrastructures, and low financial support. This circumstance should be a concern from the whole nation not only the government, especially those who work in the field of education. One of the most appropriate solutions is utilizing the potential local biodiversity to develop Subject Specific Pedagogy (SSP) of Natural Science to enhance soft security and practical skills among the students of rural schools, particularly in Nusakambangan Cilacap, Central Java. Based on interview results with the science teachers at State Junior High regarding the teaching materials in the learning process, it is found that the teachers only use the textbooks in the library that is general, not based on the specific conditions of surrounding potential. It makes the students

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rarely use the SSP as independent learning materials that can promote student-centered learning. In fact, material content is very crucial to facilitate the students to learn a basic competency in systematic procedure. Moreover, the learning process must be contextual and appropriate to students' experience, so the use of the potential learning resources in the surrounding environment should be emphasized. In fact, only a few teachers that are able to use the potential resources in their area within their learning activities.

The utilization of local potential is in accordance with the Law No. 30 the Year 2003 concerning the National Education System and The regulation from the Minister of Education and Culture of the Republic of Indonesia No. 81A Year 2013 in which the government demands that the learning process be incorporated with the local potential. Indonesia has a plentiful local richness with the diversity of ethnicity, race, language, customs and culture that symbolizes the characteristics of each island or region (Atmojo, 2015).

Nusakambangan is an island located on the Indonesian border within Cilacap region, Central Java. It is one of the Indonesian outer areas which is directly bordered with the other countries' ocean. Threats on the frontier islands of Indonesia need serious attention since it prones to conflicts of interests, security problems, and various illegal activities. There are several incidents that have occured in these areas, such as cross border issues, illegal logging, and illegal fishing. Nusakambangan actually provides abundant biodiversity due to the existance of tropical forests with dozens of vegetation and endangered species that are still preserved. The diversity of plant species on Nusakambangan Island is reported to be more than 530 species of flowering plants and many types of ferns. Moreover, several types of flora in Nusakambangan are listed as endemic and rare as well as their unique fauna. The Nature Reserve of Nusakambangan is one of the remnants of the Pama forest in Java known for its distinctive features due to the existance of limestone hills. However, the distribution of flora in Nusakambangan is getting imbalanced, only the natural reserves of the west and east still survive (Setyowaty & Rahayu, 2005).

The utilization of local potential as teaching material has the opportunity to improve students' soft security and this aspect is really needed, especially in the border areas. The concept of soft security does not only understood as an effort to form the physical but in a broad sense it drives good relationship among fellow citizens into common needs to counteract various threats both from internal or external that may hinder the nation sovereignty. In addition, this soft security concept cannot be separated from the national resilience.

Since states' territorial integrity has been all over human history subjected to external threats, it urges the development of soft security in accordance with the Constitution to drive the people awareness to participate in the defending country from all kinds of disturbances or challenges. The implementation of soft security is also based on citizens' awareness on the rights and obligations as well as belief in one's own strength (Wahyudi, 2017).

Soft security consists of several indicators including the love of motherland, sense of belonging to the nation and self-protection. In fact, the low soft security can be reflected from the territorial claims by another country and the degradation of nationalism attitude among border communities. As mentioned by Minister of Defense, Ryamizard Ryacudu, at the opening of the IX National Communication Forum for the Retired Officers of Indonesian National Armed Forces and Police that Indonesia ranks 85th according to the national insight a survey conducted in 105 countries (Suyitno, 2015). The research results from Gerungan and Sendow (2017) and Jauhari (2015) also show that the soft security awareness has decreased sharply due to the globalization effect which is eroding the national identity.

As explained earlier that the regional potentials can be used as a source of learning and laboratory materials to enhance students' knowledge, skills and behavior. The goal is to provide students with a real insight of their local richness in order to maintain state integrity. The long-term goal of this concept is that future generations in the certain region can recognize and manage their local potential independently, creatively and productively to avoid the claims from another country (Winaryati, Handarsari, & Fathurohman, 2013).

The soft security may also be promoted in science learning since the purpose of science is to enable students' scientific practical skills to define problems around them (Aktamis & Ergin, 2008). In line with this view, Aydogdu, Erkol, and Erten (2014) claims that practical skills are not only used in education but are also needed in daily life to solve problems in society. It means teachers should not only pay attention to the aspects of students' knowledge but also encourage their students to train and develop their practical skills. Tawil and Liliasari (2014) highlight that science learning is not just discussing the concept of knowledge but also fostering the process of scientific activities, attitudes, and character among students.

Unfortunately, classroom learning activities are dominated by lecturing methods using power point media and worksheets with material explanations and exercises. It is more on teacher-centered learning that makes students lack ability to explore and possess their own practical skills. Most teachers are still oriented to knowledge aspects than practical skills. Based on the initial observations and interviews results with science teachers, they admitted that students do not optimally master practical skills since it only limits to observing and measuring aspects. Similar findings are also exposed by Suhanda and Suryanto (2018) and Hamadi, Priyayi, and Astuti (2018) that students' practical skills in several aspects are still low such as concept application, experiments, questions, and communication. On the other hand, the basic practical skills should be established based on process skills and integrated process skills

Haryono (2005) emphasizes that practical skills are crucial in an educational context to develop scientific attitudes and problem solving skills among students in order to make them creative, critical, open-minded, innovative, and competitive. Thus, the students' environment is expected to support their practical skills development since therein is embedded the true of science that is beneficial for their lives. The science education can be useful for students themselves and for the wider community if they are able to apply properly in their lives. It needs the utilization of environment to encourage students to grasp their own knowledge related to their local potentials.

The efforts to improve students' soft security and practical skills can be realized by the learning design based on the SETS (Science, Environment, Technology, and Society) approach to present contextual understanding of science and technology as well as provide students with an intellectual foundation for being responsible citizenship (Mansour, 2010). This is similar to Chowdhury (2015) idea that the application of SETS is able to expand students' pedagogical knowledge and epistemological views, as well as to promote scientific knowledge, practical skills, citizenship behavior, and decision making.

Based on the above description, this study proposes the development of Subject Specific Pedagogy (SSP) for natural sciences by utilizing Nusakambangan biodiversity based on SETS approach to enhance soft security and practical skills. The novelty of this study regarding the relationship between biodiversity in certain an area to improve soft security since there are only a few studies that address the relevance of these two things. In truth, the local potential is part of our obligation as citizens to maintain soft security from all kinds of challenges and threats.

METHOD

This research can be categorized as development research adapting the 4-D model from Thiagarajan. It developed teaching materials on science courses for the seventh grade of junior high school in the form of SSP by utilizing Nusakambangan biodiversity to improve the students' soft security and practical skills. The material covered the interaction of living things with the environment.

The development procedure in this study consisted of four stages, namely define, design, develop and disseminate. The procedure to develop their science teaching materials in the form of the SSP by utilizing Nusakambangan biodiversity can be seen in **Figure 1**.

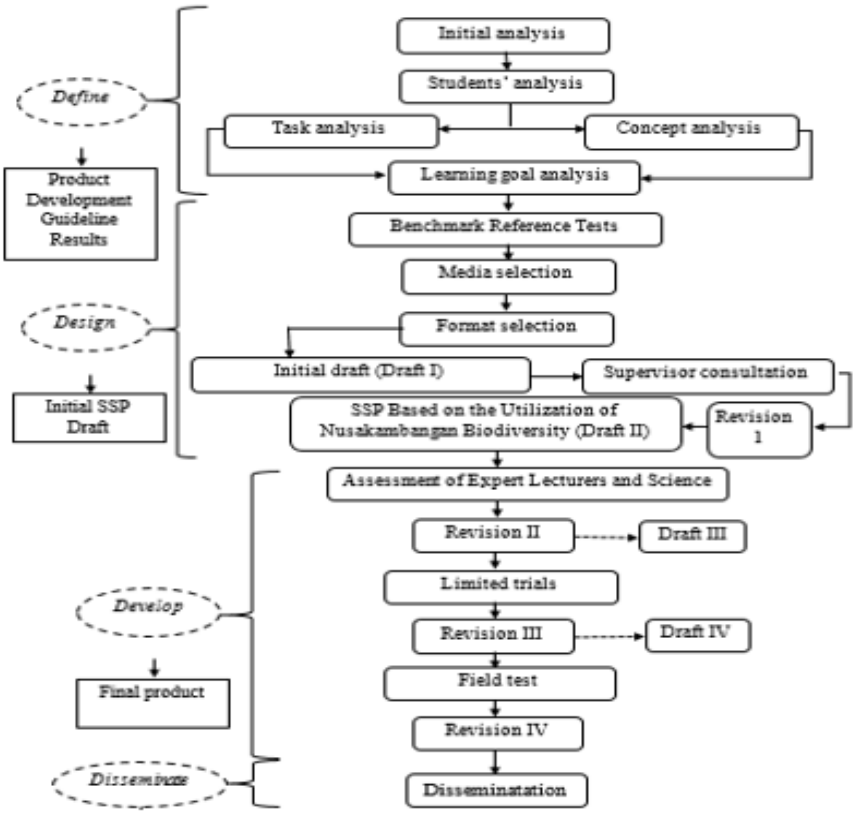

Figure 1. Research Procedure of SSP by utilizing Nusakambangan Biodiversity (modified from Thiagarajan, et al. 1874, p. 5-8)

There were several trials to improve the SSP products that consist of two stages, namely:

a. Limited Trials

This trial was conducted on a small group of 8 students in seventh grade class of State Junior High . It was conducted in non-sample classes to determine the response of teachers and students to the developed SSP. The class determination was done randomly, while the students were selected based on the results of the Natural Sciences score level including 3 students in the upper group, 3 students in the middle group and 3 students in the lower group. The nine students were given the SSP draft to provide input on the readability aspect of the developed SSP product.

b. Main Field Test

The main field trials used the quasi-experimental method with the pretest and posttest control group models (Creswell, 2008). In this experiment, group A was as an experimental class and group B as a randomly selected control class. The experimental class was given treatment using the developed SSP teaching materials by utilizing Nusakambangan Biodiversity. Meanwhile, the control class was not given treatment but used the common materials from teachers. The experimental class and the control class had been through pretest and posttest as presented in **Figure 2**.

A R....O.....X.....O
B R....O.....O

Figure 2. Design of pretest and posttest control group (Creswell, 2008)

Explanation:

A = experiment group

B = control group

R = assessment

X = treatment

O = pretest and posttests

To measure to the extent to which the feasibility of the developed SSP both from material experts, media experts, science teachers, and students, the obtained score from the field trials was converted into four scale interval data. The four scale criteria can be seen in **Table 1**.

Table 1. Criteria of mean score categorization

Score Range	Score	Category
X > $\bar{Xi}$ + 1,50 Sbi	A	Very Good
$\bar{Xi}$ + 1,50 Sbi > X ≥ $\bar{Xi}$	B	Good
$\bar{Xi}$ > X ≥ $\bar{Xi}$ - 1,50 Sbi	C	Moderate
X < $\bar{Xi}$ - 1,50 Sbi	D	Low

Explanation:

X = mean scores

Xi = ideal mean scores

$$Xi = \frac{1}{3}(ideal\ high\ score + ideal\ low\ score)$$

Sbi = Ideal standard deviation

$$Xi = \frac{1}{3}(ideal\ high\ score - ideal\ low\ score)$$

RESULTS AND DISCUSSION

The discussion of the reserach results is focused on develop and disseminate stages which aim at producing the final product of the SSP. In the initial stage, the feasibility test was performed by material and media experts. The feasibility of the product is important to measure the extent to which the media used is in accordance with the research objectives. The validation of the developed SSP was done with the product assessment instruments.

The material validation was conducted by one expert lecturer and science teacher. The material expert lecturer who assessed the feasibility of the science learning SSP was from the Biology Department of Universitas Negeri Yogyakarta. The aspects assessed by the material experts consisted of the content, presentation and media characteristics. The suggestion from material experts was on the improvement of images in the SSP for both animals and plants, the additional illustrations in the form of photos of animals and plants in Nusakambangan to strangthen the interactions among ecosystem components. The SSP test results are shown in **Table 2**.

Table 2. The Feasibility Assessment from the Material expert

No	**Aspects**	**Mean scores**	**Category**
1	Content	3.81	Very Feasible
3	Presentation	3.82	Very Feasible
3	Characteristic	3.76	Very Feasible
	Mean	3.79	Very Feasible

Based on **Table 2**, it can be seen that the SSP of natural science by utilizing Nusakambangan local potential obtained high assessment results from the material experts with an average score of 3.79. This assessment was obtained by converting the scores through a 4-scale conversion. Moreover, the feasibility testing of SSP science learning was also carried out by the media experts consisting of one expert lecturer and one science teacher. The aspects assessed by the media experts involved the aspects of language, graphics and media characteristics. The assessment results by the media experts were suggesting for completing some images (scientist figures) with its sources. The validation results of the developed SSP according to media experts are presented in **Table 3**.

Table 3. The Feasibility Assessment from the Media Expert

No	Aspects	Mean scores	Category
1	Language	3.82	Very Feasible
3	Graphics	3.79	Very Feasible
3	Characteristics	3.84	Very Feasible
	Mean	3.85	Very Feasible

The results of the product feasibility test of material experts and media experts are presented in **Table 4**.

Table 4. Recapitulation of the Feasibility Test Results

Learning materials	Score		Mean	Category
	Material expert	Media expert		
SSP Pemanfaatan Biodiversitas Nusakambangan	3.79	3.83	3.82	Very Feasible

According to media experts, the result of the feasibility testing of the SSP based on local potential was very high with an average score of 3.83. This assessment was obtained by converting the obtained scores using the 4-scale score conversion. Based on the assessment results, the developed SSP of Natural Science learning can be considered as feasible to be used after some revision was made based on the input and suggestions from the validator. After the feasibility test was carried out, the next stage was the limited trial in the classroom.

The limited trial phase was done by implementing the developed SSP. The product was printed for the students and the soft file was used by the teacher to direct the learning process. The trial was conducted on the seventh grade students of junior high school in Nusakambangan. This trial was done in two classes, the experimental with the developed SSP for its learning activities, and the control class using the worksheet that was commonly used in the schools. The process of science learning was investigated by the observers to assess the learning process as presented in **Table 5**.

Table 5. The observation result on the learning implementation

No	Meeting	The implemented item	% implementation	Average	Criteria
1	I	30	82.46	84.58	Good
2	II	31	87.62		
3	III	29	83.66		

The results showed that SSP of science learning based on local potential can assist students to understand the material on the interaction between living things and the environment, as well as to know more about their local potential. Based on **Table 5**, it can be seen that the learning using the SETS approach resulted in a good category with an average implementation percentage of 84.58%.

The learning activities began with the pretest questions about process skills and soft security questionnaires for students. In the first meeting, students learned the environment material where they observed biotic and abiotic components in the surrounding schools. In the second meeting, the students discussed the interaction between components and their environment. Meanwhile, the third meeting regarding human activities affected ecosystems. At the end of the learning process, the students were given a posttest about process skills and a soft security questionnaire.

The results of the pretest and posttest were analyzed for its standard score gain. The data analysis was performed with prerequisite tests and inferential tests that consisted of multivariate normality tests and homogeneity tests. After the prerequisite tests had been fulfilled, the inferential tests were conducted with Manova test and the t-test. The purpose of Manova test was to determine to find the significance of difference on the use of the developed SSP, while t-test was to determine the significance of difference in the mean score of soft security and practical skills between the experimental class and the control class. The recapitulation of soft security values is presented in **Table 6**.

Table 6. Recapitulation of Soft security Measurement

No	Components	Experimental class			Control class		
		Pretest	Posttest	<g>	Pretest	Posttest	<g>
1	Subject number	38	38	38	38	38	38
3	Highest score	86.30	88.50	0.18	83.30	88.80	0.32
3	Lowest score	55.60	75.30	0.23	54.00	74.40	0.37
4	Mean	75.58	84.85	0.38	72.51	78.57	0.36
5	Standard deviation	7.53	3.77	0.50	5.35	3.37	0.37

Based on the average score of the pretest and posttest of soft security, it was shown that the experimental class obtained a higher score than the control class. This was indicated by the higher average gain score in the experimental class with 0.36 which belonged to the moderate category and 0.32 for the control class categorized as the low category. The comparison graph of the average soft security score can be seen in **Figure 3**.

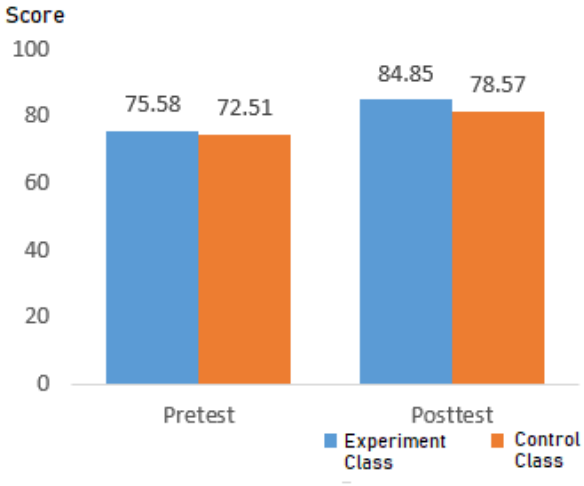

Figure 3. The Comparative Histogram of Soft Security

The scores results of the pretest and postest on the students' practical skills in the experimental class and the control class are presented in **Table 7**.

Table 7. Recapitulation of Practical skills Measurement Results on Experiment and Control Classes

No	Components	experimental class			control class		
		Pretest	Posttest	<g>	Pretest	Posttest	<g>
1	Subject number	38	38	38	38	38	38
3	Highest score	82.34	83.44	0.56	76.79	87.92	0.50
3	Lowest score	44.42	73.33	0.51	50.00	51.11	0.33
4	Mean	66.12	73.52	0.49	66.18	81.16	0.32
5	Standard deviation	10.88	5.55	0.50	8.35	7.58	0.18

Based on the average score of the pretest and posttest on practical skills, it was shown that the experimental class obtained a higher score than the control class. This is indicated by the higher average gain score in the experimental class with 0.49 which belonged to the moderate category and 0.32 for the control class that categorized as a low category. The comparison graph of the average soft security score can be seen in **Figure 4**.

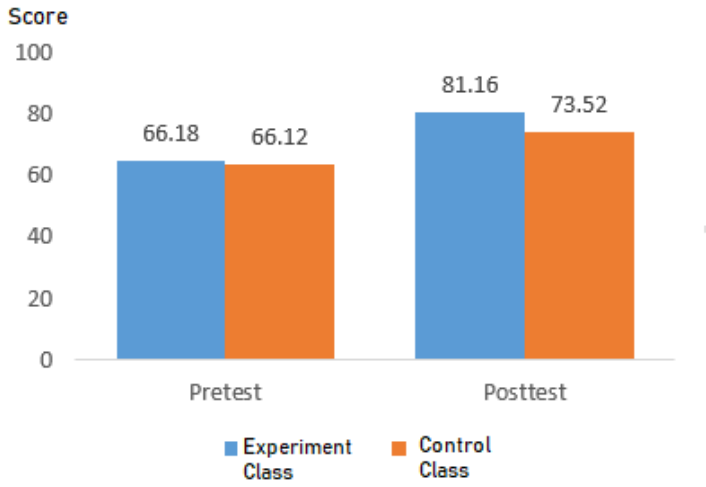

Figure 4. The Comparative Histogram of Practical skills

Based on the data recapitulation on soft security and practical skills in junior high schools, it can be seen that there was a higher increase in the experimental class (using the developed SSP of Nusakambangan Biodiversity utilization) compared to the control class (using the worksheet). Manova test was conducted to determine the differences in the average score of soft security scores and practical skills. The requirements that had been fulfilled in conducting this Manova test were multivariate normality and multivariate homogeneity tests. The decision of Manova test results is shown by the analysis of Pillai's Trace, Wilk's Trace, Hotelling's Trace, and Roy's Largest Root as presented in **Table 8**.

Table 8. Manova Test Recapitulation

No.	*Effect*	Score	F	Sig.	Conclusion
1.	*Pillai's Trace*	0,373	10,785	0,001	H_0 is rejected
3.	*Wilk's Trace*	0,713	9,587	0,003	H_0 is rejected
3.	*Hotelling's Trace*	0,503	10,685	0,000	H_0 is rejected
4	*Roy's Largest Root*	0,603	10,585	0,001	H_0 is rejected

Based on **Table 7**, it can be seen the significance value from the analysis of Pillai's Trace, Wilk's Trace, Hotelling's Trace, and Roy's Largest Root were 0,000 <0.05. so it can be concluded that H_0 are rejected. This means that there are differences in the average of students' soft security and practical skills between those who are using SSP products by utilizing Nusakambangan Biodiversity based on SETS approach and those who do not.

Manova testing based on Hotteling's Trace analysis showed the sig. value of 0,000 with a significance level of 0.05. The decision making based on the obtained significance value was less than 0.05, so H_0 is rejected. This means that the use of the developed SSP by utilizing Nusakambangan Biodiversity based on SETS really helps students in improving soft security and practical skills.

The soft security variable was measured using a questionnaire before and after learning. This questionnaire consisted of 35 positive and negative statements. The measured aspects consisted of the love of motherland, nation and state awareness, as well as willingness to sacrifice for defending country. The escalation of soft security was measured using a gain score. The average gain score in the experimental class was 0.38 which can be categorized in the moderate category, while and the average gain score of the control class was 0.36 as the low category.

The results of the gain score analysis as a preliminary test were then analyzed using a multivariate test. The purpose of this test is to determine the escalation of soft security in the experimental class caused by the use of SSP of Nusakambangan Biodiversity. Multivariate test results were indicated by the value of sig. from the test of between-subjects effects i.e. 0.043. The significance level was 0.05, so the sig. value obtained should be less than 0.05. It can be concluded that there was an improvement in students' soft security caused by the developed SSP by utilizing Nusakambangan Biodiversity based on SETS.

The use of local wisdom within education is very important to form and strengthen national identity and character. According to Alfian (2013), local wisdom is vital to shape the citizens' attitudes and behavior reflecting the nation's personality as well as enhancing the soft security among individuals and certain groups. Similarly, Asriati (2013) proposes that the integration of local content in learning will be suitable for the existing environment experienced by students. It will make students more motivated to learn and instill the values of local wisdom to build their nationalism spirit.

Another opinion from Zoller (1883) that the SETS approach emphasizes the social, cultural, environmental, political aspects of technological progress, and the consequences of uncontrolled technological development. The purpose of SETS application is to involve and arise the students' responsibility in decision making and behavior that they make.

The practical skills were measured using pretest and posttest in the form of multiple choice questions. The measured aspects of practical skills consisted of observing, predicting, experimenting, interpreting, concluding and communicating. Those were measured using gain scores from the results of the pretest and posttest. The average gain score of the experimental class was 0.48 which can be categorized as moderate, while the average gain score of the control class was 0.38 in the low category.

The results of the gain score analysis showed that the experimental class got better results than the control class. After that, Multivariate test was done to determine the escalation of practical skills in the experimental class caused by the developed SSP. The results of the multivariate test of between-subjects effects were indicated by the value of sig. 0,000. It can be concluded If the significance level was 0.05, the sig value obtained should be lower than 0.05.

Through the utilization of Nusakambangan local biodiversity in SSP of natural science, the students can gain meaningful experience to enhance their practical skills and soft security. The students found it easier to carry out meaningful activities, such as practicum and outdoor activity. Moreover, the learning with the developed SSP raises biodiversity awareness with the escalation on several aspects, especially the love of motherland, environment care, and problem soving skills. It is in line with the study from Cahyaningtyas, RN et. al. (2017) which reveals that integrated science learning with local potential can improve students' process skills, one of which was practical skills among seventh grade students of junior high school.

Another supporting study from Izzaturrohmah et al. (2017) show that the SETS-based worksheets are having a positive and significant influence on students' process skills. The stages of SETS can help students to explore and discover learning experiences that lead to the science process that involves their practical skills. It is supported by Hairida (2017) who mentions that SETS which is integrated with local wisdom will encourage students to collect, analyze and apply concepts to solve problems based on local wisdom values.

CONCLUSION

Through the implementation of integrated SSP science of Nusakambangan local biodiversity based on SETS, students can gain meaningful experience to improve their practical skills and soft security. The students found it easier to carry out meaningful activities, such as practicum and outdoor activity. Also, the learning with the developed SSP raises biodiversity awareness with the escalation on several aspects, especially the love of motherland, environment care, and problem solving. It indicates an improvement on students' practical skills and soft security caused by the developed SSP for natural sciences by utilizing Nusakambangan biodiversity based on sets approach.

RECOMMENDATIONS

The results of this study recommend that policy makers and schools in national border regions combine learning with efforts to strengthen soft security. Biodiversity in border areas can be used as effective teaching material to improve science process skills.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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