The effectiveness of physics subject-specific pedagogy based on indigenous knowledge to improve students' patriotism

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Article Info	ABSTRACT
	Indigenous knowledge can develop ways of thinking, creativity, and dynamics of indigenous peoples in an area. This study aimed to know the effectiveness of Physics Subject-specific Pedagogy (SSP) based on indigenous knowledge to improve students' patriotic character. This study focused on SSP product implementation through an experimental method, i.e., one group pretest-posttest design. The Physics SSP adopted the 4D research by Thiagarajan. This product consisted of a syllabus, lesson plans, worksheets, questionnaires, and observation sheets. This research was conducted at Senior High School 1 Turen, Malang, with two different treatments on sixty-six eleventh-grade students in the academic year of 2019/2020. The analyses performed were descriptive and analytical test analysis. Based on the homogeneity and normality test results, all pretest and posttest scores in both classes had homogeneous data. However, the data were not normally distributed. Based on the regression coefficient and the effect size value, the Physics SSP, based on indigenous knowledge, obtained an effect size value of 14.12%. However, the obtained value indicated that the effect of Physics SSP was in a low category.

INTRODUCTION

This current era requires modernization to affect every aspect of human life (Ramadani, 2017; UNESCO, 2017). It produces heterogeneity development on the data information flows that can abridge foreign cultures' entry (Ramadani, 2017). It can slowly erode the indigenous knowledge system and lessen the love toward Indonesia as a nation and state (Ramadani, 2017; UNESCO, 2017).

In this era of modernization, moral education is needed by the young generation at an early age to cultivate many positive characters. This moral education can enrich character education (Yusoff & Hamzah, 2015), especially love for the country and patriotic values.

Character education can imply and grasp students' ethical abilities in enhancing rational and righteous desire toward humanity (Yusoff & Hamzah, 2015). In society, an emotional attachment and deep feeling toward the nation enables someone to help and protect the country against the enemy. Individual's sensitivity toward a nation consciously promotes sensitivity toward the world or country's problem (Bas, 2016; Göksu & Kayalar, 2018). This kind of national-awareness character can be called a patriotic character.

Patriotism as a citizenship value is an essential component for social studies education (Jin & Song, 2019; Öztürk et al., 2016), especially in Civic subjects. The patriotic character can be implemented in all

learning activities (Nurdin, 2017; Ramadani, 2017; Wardhani et al., 2020). The patriotic character can be developed by linking indigenous education and local wisdom. Local wisdom comes from varied indigenous knowledge developed by interactions between communities and the environment (Khusniati et al., 2017; Rosana et al., 2019; UNESCO, 2017).

Indigenous knowledge can develop ways of thinking, creativity, and dynamics of indigenous peoples in an area. It has similarities with traditional knowledge because indigenous knowledge is developed by individual communities (Ezeanya-Esiobu, 2019; Mawere, 2015; Zidny & Eilks, 2018). Indigenous knowledge has a special meaning for the learning process because it is related to the students' daily life. Thus, enculturation learning using local culture (indigenous knowledge) can influence students' scientific thinking and character (Dewi et al., 2017; Handayani et al., 2018) because the science learned is related to the daily lives (Langtang & Mataubenu, 2020; Parmin et al., 2017; Utami et al., 2017).

Indigenous knowledge-based learning provides useful and straightforward learning innovations to develop students' competencies in physics learning (Khusniati et al., 2017; Sukma et al., 2019). Besides, indigenous knowledge-based learning enables educators to develop self-awareness that influences their actions toward the community (Khusniati et al., 2017; Subali et al., 2015). The synergy between indigenous knowledge and science can quickly develop an innovative learning approach (UNESCO, 2017).

Several research has been carried out by integrating local wisdom with indigenous knowledge to improve problem-solving skills (Dewi et al., 2017), science literacy (Sya`ban & Wilujeng, 2016), and various positive characters (Khusniati et al., 2017; Mannan, 2016).

One of the indigenous knowledge in Malang, East Java, is patrol music art. Patrol music as a product of cultural locality in the Bandulan area, Malang, comes from the villagers' habit of waking up people for *sahoor* by going around the village. At the same time, they hit a bamboo *kentongan* (Maftuchin, 2019). The people's habit of hitting *kentongan* acts as a patrol music art. This change cannot be separated from rhythm modification. This rhythm modification produces some excellent sound, and it has become the characteristic of patrol music art.

The sound of *kentongan* presents some aspects of physics subjects, mostly sound waves. So, this patrol music art as indigenous knowledge that can be integrated into physics subject and Subject-Specific Pedagogy (SSP).

Several previous research showed that SSP could strengthen students' abilities and their characters, for example, students' ecological literacy (Riyadi et al., 2018), problem-solving (Ubaidillah & Wilujeng, 2019), practical skill (Rosana et al., 2019), and some good characters like honesty and care (Haryati, 2016). In this research, indigenous knowledge has been combined with the Subject-Specific Pedagogic to improve students' patriotic character.

Learning innovation in physics education can be expected to develop students' characterS. The development of Physics SSP products emphasized integrating learning activities and local wisdom assisted by student worksheets through the discovery learning model. Students can increase their discovery understanding of the concept with the teacher as a facilitator (Putra et al., 2018).

METHOD

This research was a Research and Development with the 4-D model by Thiagarajan as the development model. This research focused on the implementation of the developed Physics SSP product. This research aimed to know the effectiveness of the developed Physics SSP product to improve students' patriotic character. The

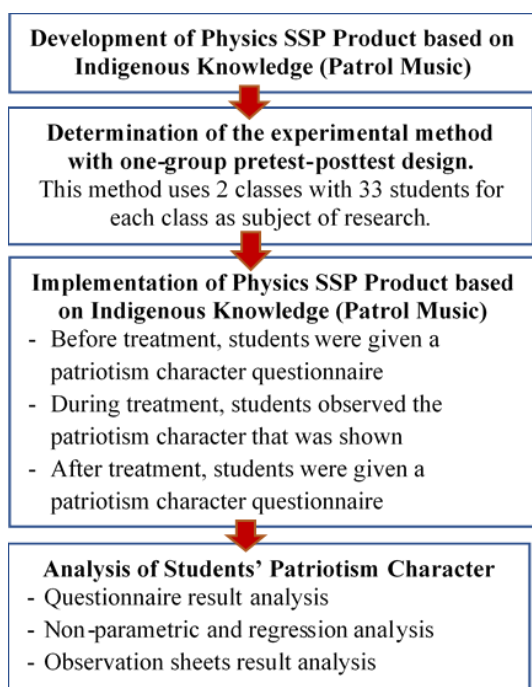flowchart of the research can be seen in Figure 1.

Figure 1. Research's flowchart

This research had been conducted at the State Senior High School 1 Turen, Malang. The subject consisted of two eleventh-grade classes. Both classes had the same number of students. This research sample consisted of thirty-three students in each class determined through a simple random sampling technique. The experimental class had been taught using Physics SSP product based on indigenous knowledge and discovery learning. In contrast, the control class had been taught using direct learning and group presentation assignments. The treatments were performed to the same number of meetings and group division system.

The Physics SSP products consisted of a syllabus, lesson plans, student worksheets, handout, and patriotic character questionnaires. A sound wave concept was integrated into the SSP products as one of the physics sub-subjects in the eleventh grade.

This research had been conducted for three weeks (February 10th-28th, 2020). Before the main research activities, some

observations were carried out to determine the students' character in general.

Before implementing the Physics SSP products, the instruments involved in the research were validated by three expert lecturers and two physics teachers. The syllabus and lesson plan explain discovery learning steps based on indigenous knowledge (Patrol music art). The discovery learning was chosen because it can explain the concept of material clearly. The handout and student worksheets were accompanied by information, illustration, and drawings based on indigenous knowledge (patrol music art).

The research data had been obtained from two instruments, i.e., patriotic character questionnaires and observation sheets. The questionnaires consisted of 24 statements that have been adapted to the indicator of patriotic characters. All data collected from the pre and post questionnaires were transformed into N-gain value (1).

$$< G > = \frac{< X_{post} > - < X_{pre} >}{100 - < X_{pre} >} \qquad (1)$$

Gain score $< G >$ presents students' patriotic character before treatment (X_{pre}) and after treatment (X_{post}). The N-gain results were analyzed descriptively and analytically. First, the improvement of students' patriotic character can be interpreted with N-gain value. The N-gain criteria can be seen in Table 2.

Table 2. Category of n-gain score

Interval	Category
$0.7 \leq G < 1$	High
$0,3 \leq G < 0.7$	Moderate
$G < 0.3$	Low

Source: Meltzer, 2002

The data analysis process was assisted by Ms. Excel 2013 and SPSS 21.0 (descriptive test, homogeneity test, normality test, linearity test, Wilcoxon test, and simple linear regression tests).

The hypothesis stated that if the significance value was less than 0.05, then

the initial hypothesis (H_0) was rejected. On the other hand, the hypothesis (H_1) can be accepted as a conclusion. The basis for this decision was the Asymp significance value limit. Sig. (2-tailed) of 0.05.

RESULTS AND DISCUSSION

This research's final results were Physics Subject-specific Pedagogy products integrated with indigenous knowledge from a rural area (i.e., Patrol music art). Before the implementation, the Physics SSP products had been validated by three expert lecturers. The validation results showed that the obtained mean value was 3.38 in the excellent category. Thus, the Physics SSP products were declared feasible to be implemented in the classroom. Figures 2 and 3 present the cover book of Physics SSP product and students' worksheet. Table 3 presents a description of the Physics SSP product.

Table 3. The description of physics subject-specific pedagogy based on indigenous knowledge (patrol music art)

Physics SSP products	Description
Syllabus	It contains basic competence 3.10 and the material and activities of the sound wave. It also contains indicators for the assessment of patriotic characters;
Lesson Plan	The lesson plans are designed for five meetings within two hours duration. The lesson plan has been integrated with patrol music art to achieve basic competency 3.10;
Student Worksheet	The worksheets must be done by students in groups assisted by bamboo *kentongan* and sound wave software;
Questionnaire	It contains twenty-four statements given to respondents to determine their perceptions or habits that reflect their patriotic characters;
Observation sheets	The sheets have been adapted to patriotism to record attitudes that reflect the student's patriotic characters during the learning process.

Figure 2. The cover page of physics SSP products

Figure 3. Patrol music-based learning activities in student worksheet

Based on the data analysis, some information about students' patriotic characters are described as follows:

The Questionnaire Analysis Result

The questionnaire had been given to students in both classes. It contained twenty-four statements that reflected students' patriotic characters in different contexts. It employed a Likert scale with four answers; strongly agree (SA), Agree (A), disagree (D), and strongly disagree (SD). Table 4 presents the conversion of the qualitative value to quantitative value l.

Table 4. Conversion of values

Answer	Value Conversion	
	Positive	Negative
Strongly Agree (SA)	4	1
Agree (A)	3	2
Disagree (D)	2	3
Strongly Disagree (SD)	1	4

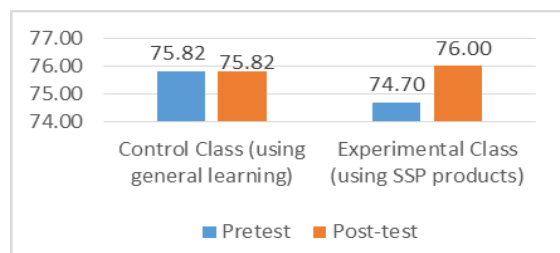The analysis result is shown in Figure 4 below:

Figure 4. The pre-post questionnaire's average value

Based on Figure 4, the pre-post questionnaire's results between the two classes were similar. However, the experimental class obtained a higher posttest value than its pretest value. These average values cannot represent the role of Physics SSP in changing students' patriotic characters.

Through the results of the questionnaire before and after the treatment, the gain value had been normalized. The N-gain value indicated a difference (change) due to different treatments. The N-gain value can be seen in Table 5.

Table 5. The n-gain values of the experimental and control class

Class	N-gain	Patriotic Characters	
		Score	Category
Experimental	Max	0.533	
	Min	-0.330	
	Mean	**0.061**	**Low**
Control	Max	0.269	
	Min	-0.450	
	Mean	**-0.013**	**Low**

Based on Table 5, the experiment class obtained a higher N-gain value. However, both classes' N-gain values belonged to the low category, which indicated that the treatments presented insignificant students' patriotic character changes. A more definite analysis was then continued using the SPSS application to know more about the effect of Physics SSP products on students' patriotic characters.

Before the data were analyzed with parametric/non-parametric tests, the normality and homogeneity test had been performed with the following hypothesis;

H_0: All data are normally distributed and homogeneous

H_1: All data are not normally distributed and homogeneous

Tables 6 and tables 7 present the normality and homogeneity test results.

Table 6. The normality test result

Class	Source	Shapiro-Wilk		
		Score	df	Sig.
Experimental	Pretest	0.978	33	**0.733**
	Post-test	**0.911**	**33**	**0.011**
Control	Pre-test	0.970	33	**0.472**
	Post-test	0.979	33	**0.742**

Table 7. The homogeneity of variance result

Source	Sig.
Pretest	0.792
Post-test	0.446

Based on Table 6, the experiment class's post-test data were not normally distributed. However, based on Table 7, all of the pretest and posttest data were homogeneous. Thus

the test performed test was the non-parametric test, i.e., the Wilcoxon test.

Wilcoxon Test

The Wilcoxon test is a non-parametric test to determine the differences between two paired data groups. The hypothesis used as a decision making in this analysis were;

H_0: There were no differences in two data groups between the pretest and posttest

H_1: There were differences in two data groups between the pretest and posttest,

The results of the Wilcoxon test are presented in Tables 8 and 9.

Table 8. The outputs of the wilcoxon test

	Rank	N	Mean Rank
Pre-post	Negative	26[a]	24.75
	Positive	29[b]	30.91
	Ties	11[c]	
	Total	66	

a. Post < Pre   b. Post > Pre   c. Post = Pre

Table 8 shows that the positive difference (on the positive rank) has a more excellent value than the negative rank and the ties rank had an increased value after the treatment was given. This data analysis required more testing to test the hypothesis. Table 9 presents the difference between the pretest and posttest data on students' patriotic characters.

Table 9. Statistic output of the wilcoxon test

	Pre-Post
Z	-1.063[a]
Asymp. Sig. (2-tailed)	0.288

a. Based on negative ranks

From Table 9, it is known that the significance value of the Wilcoxon test was more significant than 0.05. This value means that there were no differences between the two groups' pretest and posttest scores. It also means that there was no effect of Physics SSP products on students' patriotic characters. Furthermore, the data

were analyzed using the non-parametric effect size (2) (Tomczak & Tomczak, 2014).

$$r = \frac{Z}{\sqrt{n_0}} \qquad (2)$$

Z is a value result in Table 9, and n_0 is the result of the following calculation (3) (Israel, 1992; Yamane, 1967):

$$n_0 = \frac{N}{1 + N(e)^2} \qquad (3)$$

N is the population size (66 participants), and **e** is the level of precision (0.05 or 5%). From equations (2) and (3), the effect values obtained were 0.1412 or 14,12%. The values showed an effect of Physics SSP products based on indigenous knowledge on students' patriotic characters by 14.12%. According to (Cohen, 2013), the effect size value can be categorized as weak.

Simple Linear Regression Test

One way to predict one independent variable's effect on the dependent variable is the simple linear regression test. In this research, the regression test had been used to determine the effects of different treatments in both classes on the students' patriotic character.

Before performing the regression test, a linearity test needed to be done as the regression test requirement. Table 10 presents the linearity test result for both classes' N-gain data.

Table 10. The outputs of the linearity test

Independent*Dependent variable	F	Sig.
Treatment*Patriotism	0.809	0.728

Based on Table 10, the significance value of the linearity test was more significant than 0.05. This value showed that the overall N-gain data had a linear correlation with the different treatments. It means that the use of Physics SSP products in the experimental class had a linear correlation with the variable's patriotic characters. The

regression test results are shown in Table 11.

Table 11. Simple linear regression test result

| Model | Unstandardized Coefficient | | Sig. |
	B	Std. Error	
(Constant)	0.842	0.079	0.000
Gain Patriotism	0.459	0.201	**0.026**

Based on Table 11, the significance value was more significant than 0.05. It shows no effect of the different treatments given to the two classes on students' patriotic characters.

However, when data was observed from the regression coefficient (the B value) in Table 11, there was a positive effect of Physics SSP products on students' patriotic characters.

Based on the Wilcoxon test, the Physics SSP products did not affect experimental class students' patriotism. The Physics SSP products had a weak effect with a value of 14,12%. The patriotic character might have been caused that needs time to develop because this character must be trained through habituation.

However, based on the regression coefficient value in Table 11, the Physics SSP products produced some positive influences on the students' patriotic characters. The positive results were similar to other research (Subali et al., 2015). Subali's research (2015) indicates that local wisdom-based science learning can establish students' lively characters.

Additional information about the positive influences was obtained based on the questionnaire and observation sheets' indicators. The questionnaire analysis is presented in Table 12.

Table 12. The average value of questionnaire's patriotic character in each class

| Indicators of Patriotic Characters | Average Value | | | |
| | Ctrl Class | | Exp Class | |
	Pre	Post	Pre	Post
Defending the state's character for the motherland	3.11	3.12	3.03	3.15
Tolerance	3.04	3.11	2.97	3.15
Obey the society's norms and regulations	3.24	3.26	3.31	3.31
Total average	**3.13**	**3.16**	**3.10**	**3.20**

Information:
Ctrl: control   pre: pre-test
Exp: experimental   post: posttest

Based on Table 12, the control class's average pretest score was greater than the experimental class. However, the control class had a smaller total posttest average score than the experimental class.

Based on the average pretest and posttest scores differences, there was a positive effect of the two classes' treatments.

a. The Analysis Result of Observation Sheets

The observation sheets had been given to three observers to determine students' patriotic character during learning with or without the Physics SSP products. The observations result served as additional information about the effect of different treatments given to the two classes on students' patriotic characters. Table 13 presents the average percentage based on the three indicators of patriotic characters.

Table 13. Patriotic characters' observation sheets result

| Indicators of Patriotic characters | Average value (%) | |
	Ctrl	Exp
Defending the State's Character for the Motherland	59.38	64.16
Tolerance	61.94	71.95
Obey the Society's Norms and Regulations	67.08	77.08
Total average	**62.80**	**71.06**

Information: Ctrl: Control class
              Exp: Experimental class

Table 13 shows that the experimental class obtained a greater value than the control class.

Students showed their patriotic character during learning in the experimental class than the students in the control class. It might be caused by group learning activities using *kentongan* and software applications in explaining sound wave material. These activities were more attractive to students, and the character of patriotism can be shown unconsciously.

Using bamboo *kentongan* in explaining the sound wave made the students more interested during the learning process.

CONCLUSION AND SUGGESTION

The developed Physics SSP products based on indigenous knowledge positively influenced students' patriotic character. Based on the analysis results of the N-gain value in Table 8, both classes' N-gain value was in a low category. Meanwhile, the Wilcoxon test results did not show any effect between the different treatments in both classes on students' patriotic characters. However, the regression coefficients and the effect size value showed positive effects of Physics SSP products on students' patriotic character with the regression coefficient of 0.459 and an effect size value of 14.12%.

The diversity of indigenous knowledge from various places can be integrated with various pedagogical-content-knowledge (PCK). These pedagogic models can be adapted into various learning models. Innovative learning must involve students so that it can attract their interest during the learning process.

Also, the research took a long time because the characters must be trained through habituation. Further research can integrate other subjects with a longer duration so that the impact can be measured over a longer time.

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AUTHOR CONTRIBUTIONS

TD develop the product. DR prepared literature in accordance with research. TD and DR collected and analysed data and wrote the manuscript.

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