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Effectiveness of Causalitic Model Science Learning Device Integrated with Character Value and Local Wisdom to Improve Students' Problem-Solving Ability

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Abstract— This study aims to measure the effectiveness of science learning devices with causalitic model integrated character values and local wisdom to improve students' Problem-Solving Ability (PSA). The study used a mixed method as a modify of the explanatory design and statistical analysis using the Wilcoxon t-test. The analysis results show that the implementation of devices is significantly effective in developing the PSA of students of Public Junior High School (JHS) 3 Labuapi, West Lombok Regency, West Nusa Tenggara Province. The device developed has been proven to have the exact alignment for all learners when developing the PSA. The developed PSA includes six indicators, namely understanding (IPSA-1), selecting (IPSA-2), differentiating (IPSA-3), determining (IPSA-4), applying (IPSA-5), and identifying (IPSA-6). Statistical analysis was also performed on the difference in the final achievement of each indicator of PSA of the students of High-Group (Hi-group) and Low-Group (Lo-group) for each indicator of PSA (IPSA). The results show that the finals of IPSA-1 up to IPSA-4 have no difference for either Group, but for IPSA-5 and IPSA-6, there are significant differences. The average final PSA scores of the Hi-Group in the two indicators, respectively 77 and 75, are higher than those of the Lo-Group, 56 and 52.

Keywords— Effectiveness of Learning Devices; Character Value; Causalitic Model; Local Wisdom; Problem-Solving Ability.
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Introduction

One indicator of educational success at the junior secondary level is the development of problem-solving ability. Problem-solving is one of four abilities emphasized in the 21st century [1]. Problem-based learning can further increase students' motivation and problem-solving ability [2]. Efforts to develop problem-solving ability, among other things, can be made by applying causal learning models. The literacy of nature conservation is done by discussing local wisdom in learning.

Regarding problem-solving ability, the results showed that the percentage of problem-solving ability of junior high school students was 40.3%, which is in the poor category. This research was conducted on Class VIII students of Sukabumi District State Junior High School using ten description questions [3]. Related to preserving the surrounding environment, the Semarang City Environmental Agency provides at least six recommendations to protect the environment in the community and those that must be done from home [4]. These recommendations include farming wisely, using domestic products, protecting flora and fauna, preserving forests, conducting EIA, and reforestation.

Gagas Envirotek Indonesia states that quality human beings are seen in their education, daily behavior, and treatment of their area or place. A well-organized and clean residence always looks comfortable and conducive (safe) if it is balanced with the condition of the surrounding environment, which is also clean and well-organized [5].

Regarding local wisdom, there are at least several related factors. These factors include the development of modern tourism, the absence of specialized local wisdom institutions, unfavorable community living principles [6], and community conflict events [7]. The issue of local wisdom for junior high school students is an essential thing that needs to be given in supporting literacy in preserving the environment around the place of residence and nature in general. The above problems are thought to be triggered because a) learning is not integrated with the development of instruments that facilitate problem-solving ability, b) there is no integration of each subject with the cultivation of character values, d) there is no integration of local wisdom issues about nature conservation into learning.

Learning is a core activity between students and teachers to achieve common goals [8]. Learning objectives can be achieved if

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students are actively involved in the learning process [9].

Efforts to increase student activity require teaching materials and appropriate learning models. One suitable learning model is causalitic. Causalitic learning is a model that considers that activity is oriented toward the learning process to develop potential participants who are educated in thinking causalitic and think analytics [10]. Previous research stated that the causalitic learning model improves students' physics problem-solving abilities, as seen from the pre-test and post-test [11]. Apart from that, other research states that causalitic model learning has a powerful influence on increasing creative thinking abilities and changes in students' character compared to conventional learning because that is so necessary to use causalitic models in learning in the form of the device [12].

The device of learning is a set of learning sources that makes it possible for students and teachers to do the activities of learning [13]. Several studies state that learning devices of the causalitic model is feasible, practical, and effective in improving students' creative thinking abilities [14], [15]. The devices are also practically used to improve students' problem-solving and creative thinking abilities by integrating character values [16].

One form of meaningful and exciting education is implementing character education, such as the value of caring for the environment [17]. Utilizing local wisdom in learning management is an excellent approach to instilling in students the values of love for the country [18]. Local wisdom values included in the teaching and learning process will make it easier for students to obtain knowledge and information [19].

Local wisdom-based science learning is science learning that integrates regional local wisdom characteristics into science learning [20]. Local wisdom is a critical context that makes learning more accessible for students according to their immediate environment [21]. Local wisdom is the ideas and values or life behavior of local communities that are considered of good value and wise so that they can be accepted, followed, and become guidelines for community behavior in everyday life [22]. However, local culture or wisdom is increasingly being marginalized by technological developments, so people tend to abandon the local wisdom they already have. Therefore, local culture must be integrated into the design and implementation process to preserve local culture in learning activities [23]. The diversity of cultures that have entered Indonesia means that the nation's identity and character must be strengthened by involving local wisdom in learning activities [24].

Science learning based on local, regional wisdom can be used as a learning reference to foster and instill local wisdom and character values in students [25]. Character is a silent and permanent trait that influences the attitudes and behavior of each individual [26]. Character is personality-related to humans with the creator, self-private, and the environment. Education Character is the hope of a country to its people; it will give birth to very educational participants, where participants can balance their cognitive, affective, and psychomotor attitudes to compete later when they become adults [27]. Character education also means conscious efforts planned and directed through a learning environment for the growth and development of all human potential who have good personality traits, morals, and character and have a constitutive positive effect on nature and society so that the character of education can be implemented in all formal and informal environments [28].

Problem-Solving Ability (PSA) is an effort to find a road to go out from difficulty or problem to achieve the desired goal [29]. Problem-Solving Ability (PSA) is the ability of the participant to educate and disclose the abilities he has in choosing or predicting in a way deductive various possibility consequences from a phenomenon, which contains a or several given causes, as well as capable of identifying how a or several reasons the can produce selected consequences or predictable [11].

Problem-Solving Ability (PSA) consists of six indicators, namely: (1) understanding, namely the ability to understand the ideas or ideas in each problem; (2) selection, namely the ability to choose causes and predict various possible consequences that can occur regarding the causalitic conditions in the problem or phenomenon; (3) differentiation, namely the ability to distinguish and select causes that can produce or become a factor in a specific effect; (4) determination, namely the ability to determine concepts, principles, theories and laws that can be used to support identifying one or several causes to produce an effect; (5) application, namely the ability to use concepts, principles, theories and laws needed to identify causes to produce a specific effect; and (6) identification, namely the ability to identify causes so that they can produce a specific effect [30].

Research Methods

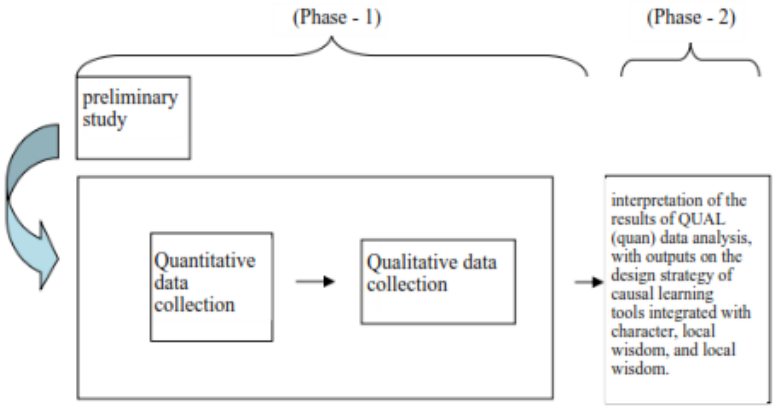

Figure 1. Research Stages with a Modified Model of Explanatory Design

This research uses a mixed method, a modification of Explanatory Design [31]. In the process, quantitative data is used to support qualitative data, and then the data from the quantitative and qualitative analysis are interpreted (Figure 1). Figure 1 shows that this research was conducted in stages Stage 1 and Stage 2. Stage 1 was a qualitative stage with an implicit quantitative phase. This stage consists of preliminary study activities, analysis of management strategies based on questionnaire data, process observation, and qualitative data analysis. Meanwhile, Phase 2 is the data interpretation phase of the Phase 1 process.

Results and Discussion

Assessment needs to be done because it is an important part of the learning process [32]. The results of hypothesis testing related to the Problem-Solving Ability (PSA) of Junior High School 3 Labuapi students show that implementing the Causalitic Science learning model integrated with character values and local wisdom is practical to improve students' PSA. The 24 samples were divided into three groups: Hi-group students, eight students with the highest initial PSA; lo-group students, eight students with the lowest initial PSA; and the rest Moderate Group. Furthermore, statistical analysis was conducted on PSA for Hi- and Lo-group learners.

Tables 1 and 2 show the significance of the increase in PSA for Hi-group and Lo-group learners. The increase is also indicated by the percentage of gain, which is categorized as high (74%) for Hi-group learners and moderate (60%) for Lo-group learners.

The analysis results also showed a significant difference between the final PSA of the Hi-group learners and the Lo-group learners. In this case, the Hi-group learners have a higher final PSA score than the Lo-group learners. However, the increase (gain) is similar. This shows that the implementation of the Causalitic Science learning model integrated with character values and local wisdom provides the same benefits for all layers of learners.

PSA has six indicators, namely IPSA-1 (understanding), IPSA-2 (selecting), IPSA-3 (differentiating), IPSA-4 (determining), IPSA-5 (applying), and IPSA-6 (identifying). Statistical analysis was also conducted on the difference in the final PSA of Hi-group and Lo-group students for each indicator (IPSA). The results show that the final PSA of IPSA-1 s.d. IPSA-4 has no difference for Hi-group and Lo-group learners (Table 3 to Table 6). For the final PSA of IPSA-5 and IPSA-6, there are significant differences between Hi-group and Lo-group learners (Table 7 and Table 8). Based on Tables 1 and 2, the final PSA scores of Hi-group learners (averages of 77 and 75) are higher than those of the Lo-group (averages of 56 and 52).

Table 1. PSA Indicator Score of Post-test Results for Hi-group Students

	IPSA-1	IPSA-2	IPSA-3	IPSA-4	IPSA-5	IPSA-6
	88	88	88	88	75	63
	88	88	88	88	75	75
	88	88	88	88	75	75
	88	88	88	75	63	63
	88	88	88	88	88	88
	88	88	88	88	75	75
	88	88	88	88	75	75
	88	88	88	88	88	88
average	**88**	**88**	**88**	**86**	**77**	**75**

Based on the PSA Score data in Table 1 and Table 2, the Wilcoxon non-parametric statistical test was conducted to analyze the differences in the scores of each PSA indicator between the Hi-group and Lo-group students. The test results are presented in Table 2 to Table 6.

Table 2. PSA Indicator Score of Post-test Results for Lo-group Students

	IPSA-1	IPSA-2	IPSA-3	IPSA-4	IPSA-5	IPSA-6
	75	75	75	75	50	50
	88	88	88	88	88	88
	75	75	63	63	38	25
	88	88	88	88	50	50
	88	88	88	88	63	63
	88	88	88	88	75	63
	25	25	25	13	13	13
	88	88	88	88	75	63
average	77	77	75	73	56	52

Table 3. Wilcoxon Sign Rank Test of Indicator-1 (IPSA-1) Score or understanding between Students of the Hi-group and Lo-group

		N	Mean	Sum of
IPSA_1_hi-group - IPSA_1_lo-group	Negative Ranks	0[a]	.00	.00
	Positive Ranks	3[b]	2.00	6.00
	Ties	5[c]		
	Total	8		

a. IPSA_1_hi-group < IPSA_1_lo-group
b. IPSA_1_hi-group > IPSA_1_lo-group
c. IPSA_1_hi-group = IPSA_1_lo-group

Table 3 shows three pairs of different data. Based on the record of item 1, the Wilcoxon test cannot be conducted because no critical value can be used. Here, the other five pairs of data are the same for the IPSA-1 indicator between students in the Hi-group and Lo-group. This result also shows no difference between the IPSA-1 score in Hi-group and Lo-group students.

Table 4 shows a similar number of effective pairs of IPSA-2 indicator data in Hi-group and Lo-group students, namely three (3) pairs of different data, and the remaining five (5) pairs have the same score. This condition causes no critical value that can be used for the Wilcoxon non-parametric statistical test (note criteria item 1). This condition implicitly shows no difference in IPSA-2 scores, namely the ability to select Hi-group and Lo-group students.

Table 4. Wilcoxon Sign Rank Test of Indicator-2 (IPSA-2) Score or selecting between Students of Hi-group and Lo-group

		N	Mean	Sum of
IPSA_1_hi-group - IPSA_1_lo-group	Negative Ranks	0[a]	.00	.00
	Positive Ranks	3[b]	2.00	6.00
	Ties	5[c]		
	Total	8		

a. IPSA_2_hi-group < IPSA_2_lo-group
b. IPSA_2_hi-group > IPSA_2_lo-group
c. IPSA_2_hi-group = IPSA_2_lo-group

Table 5. Wilcoxon Sign Rank Test of Indicator-3 (IPSA-3) Score or selecting between Students of Hi-group and Lo-group

		N	Mean	Sum of
IPSA_1_hi-group - IPSA_1_lo-group	Negative Ranks	0[a]	.00	.00
	Positive Ranks	3[b]	2.00	6.00
	Ties	5[c]		
	Total	8		

a. IPSA_3_hi-group < IPSA_3_lo-group
b. IPSA_3_hi-group > IPSA_3_lo-group
c. IPSA_3_hi-group = IPSA_3_lo-group

Table 6. Wilcoxon Sign Rank Test of Indicator-4 (IPSA-4) Score or selecting between Students of Hi-group and Lo-group

		N	Mean	Sum of
IPSA_1_hi-group - IPSA_1_lo-group	Negative Ranks	1[a]	1.50	1.50
	Positive Ranks	3[b]	2.83	8.50
	Ties	4[c]		
	Total	8		

a. IPSA_4_hi-group < IPSA_4_lo-group
b. IPSA_4_hi-group > IPSA_4_lo-group
c. IPSA_4_hi-group = IPSA_4_lo-group

Table 5 shows something similar to the conditions in Table 3 and Table 4, where there are only three (3) pairs of data with

different IPSA-3 Indicator Scores between students in the Hi-group and Lo-group. The other five (5) pairs have the same IPSA-3 Scores. Based on the note of criterion item 1, there is no critical value for the number of Ranks that can be used as a reference for the Wilcoxon non-parametric statistical test. Implicitly, the IPSA-3 Scores for students in the Hi-group and Lo-group are similar.

Table 6, in detail, shows the difference between the Wilcoxon test results in Table 6 and Table 7. However, it has the same principle, which cannot be concluded from the test results. This is because there are only four (4) data pairs with different scores, so based on the criteria note item 1, no critical value meets while the other four (4) data pairs are the same. The interpretation of the results of this analysis shows that the IPSA-4 scores for students in the Hi-group and Lo-group are similar.

Table 7. Wilcoxon Sign Rank Test of Indicator-5 (IPSA-5) Score or selecting between Students of Hi-group and Lo-group

		N	Mean	Sum of
IPSA_1_hi-group	Negative Ranks	1[a]	2.00	2.00
IPSA_1_lo-group	Positive Ranks	6[b]	4.33	26.00
	Ties	1[c]		
	Total	8		

a. IPSA_5_hi-group < IPSA_5_lo-group
b. IPSA_5_hi-group > IPSA_5_lo-group
c. IPSA_5_hi-group = IPSA_5_lo-group

Table 7 shows seven (7) pairs of different data and one pair that is the same. Based on criterion note 1, the critical value for the Wilcoxon test with seven practical databases is two (2). The smallest number of ranks is obtained in the positive ranks or criterion "a"; the IPSA-5 Score for Hi-group Students is less than the Lo-group, which amounts to 2.00 ranks. Meanwhile, for criterion "b" (IPSA-5 score for Hi-group students is more than the Lo-group), there are three pairs of data that fulfill, and for criterion "c" (IPSA-5 score for Hi-group students is equal to the Lo-group), there are four pairs of data. Furthermore, based on the criteria record for item 2, the number of calculated ranks (2.00) is qualified to be equal to or less than the critical value (2), so the null hypothesis is rejected. Thus, the assumption that there is a difference in the IPSA-5 Score, namely the ability to apply for Hi-group and Lo-group students, is accepted.

Table 8. Wilcoxon Sign Rank Test of Indicator-6 (IPSA-6) Score or selecting between Students of Hi-group and Lo-group

		N	Mean	Sum of
IPSA_1_hi-group	Negative Ranks	1[a]	3.00	3.00
IPSA_1_lo-group	Positive Ranks	7[b]	4.71	33.00
	Ties	0[c]		
	Total	8		

a. IPSA_6_hi-group < IPSA_6_lo-group
b. IPSA_6_hi-group > IPSA_6_lo-group
c. IPSA_6_hi-group = IPSA_6_lo-group

Table 8 shows eight (8) pairs of different data and one pair of the same data. Based on criterion note 1, the critical value for the Wilcoxon test with seven practical databases is three (3). The smallest number of Ranks is obtained in the positive Ranks or criterion "a," namely, the IPSA-6 Score for Hi-group Students is less than the Lo-group, which amounts to Ranks 3.00. Meanwhile, for criterion “b” (the IPSA-6 score for Hi-group students is more than the Lo-group), there are seven pairs of data that meet criterion "c" (the IPSA-6 score for Hi-group students is equal to the Lo-group). Furthermore, based on the note of criteria item 2, the number of calculated ranks (3.00) is qualified to be equal to or less than the critical value (3), so the null hypothesis is rejected. Thus, the assumption that there is a difference in the IPSA-6 Score, namely the ability to apply for Hi-group and Lo-group students, is accepted.

The treatment given to Hi-group and Lo-group students follows the syntax of the causalitic model which consists of four learning phases, namely: (1) orientation phase, (2) exploration and development phase of the concept of causalitic, (3) argumentation phase, and (4) evaluation phase [10]. In the first phase, the teacher provides examples of phenomena related to the material to be discussed. In the second phase, the teacher provides an introduction to the concept of the material. Furthermore, in the third phase, students are directed to work on student worksheets (LKS) that have been prepared by the teacher and adjusted to the form of questions for the integrated causal model of character values. Student worksheets (LKS) contain a causalitic table that includes assistance for solving physics problems or phenomena in the form of information on some of the cause-effect components, the number of cause-effect components, and examples of explanations. In the fourth phase, students are given space to align perceptions and revise perceptions that are still wrong.

4. Conclusion

The results of the analysis show the effectiveness of the implementation of the causalitic science learning model integrated with character values and local wisdom in developing the Problem-Solving Ability (PSA) of students of Junior High School 3 Labuapi, West Lombok Regency, West Nusa Tenggara Province. The device developed has been proven to have the exact alignment for all learners when developing the PSA. The developed PSA includes six indicators: understanding, selecting, differentiating, determining, applying, and identifying.

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