Bringing Indigenous Knowledge into Physics Learning Instruments for Enhancing Students' Data Literacy:
Its feasibility and practicality

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ABSTRACT

This research aims to (1) determine the feasibility and practicality of indigenous knowledge-based learning instruments, and (2) measure the suitability of test items to be measured students' data literacy abilities. This study uses a 4D model research and development. Data collection techniques use assessment sheets and test items. These assessment sheets are given to three lecturers, and 2 physics teachers, while data literacy test items are given to 265 students from class XII as research subjects. The research places were conducted in Senior High School 1 Turen and Senior High School 1 Bululawang, Malang, East Java. This physics learning instruments consisted of lesson plans, student worksheets, and assessment of data literacy tests. The study results were analysed with qualitative and quantitative descriptive. Based on the assessment sheet result, it is known that the physics learning instruments based on indigenous knowledge have the feasibility and practicality in the excellent category with a total average has greater value than 3.25. Meanwhile, based on the QUEST analysis results, 10 items of data literacy questions have high reliability. However, two out of ten items of data literacy do not suitable for use in the implementation of indigenous knowledge-based learning instruments in Physics classrooms.

Keywords: Indigenous knowledge, data literacy, feasibility, reliability.

1. INTRODUCTION

As a result of technological growth in data collection, human life is becoming increasingly dependent on data flow (or big data) [1],[2]. Competitive nation civilization also resulted in heterogeneity development in the data information flow and it has an impact on human social life [3]. At present, society must coexist with data in various activities, especially decision making. Decision making based on data because data can be analysed or processed to create information. Then, the information obtained can produce knowledge that can help us to make better decisions [4]. Thus, the importance of the ability to process data is needed [5]. Intellectual ability to collect, manage, evaluate, and apply data, is critically referred to as the ability of data literacy [6].

Data literacy can be considered a life skill because human interaction with data is becoming increasingly common. Data literacy skill is not limited to certain people but needed the whole community [3]. Every society can be equipped with the skills needed to become a data literate society through data literacy competencies in school [7], [8]. However, the capabilities of data literacy are not consistent in the public, private, or academic sectors yet. Data literacy training requires a foundation for the community. This training can be started with data literacy competencies in schools. As an educator, the teacher needs special knowledge, skills, and dispositions to use data effectively before teaching it to students in schools [8].

In Table 1, the indicator of data literacy skills can be summarized into 4 parts [9].

Table 1. Indicators and sub-indicator of data literacy

Indicators	Sub-indicator
Observation of data	Read data in the form of shapes, images, graphs, tables, and diagrams
Collection of data	Interpreting the data obtained
Data Appraisal	Calculate data based on information in the form of graphs, tables or diagrams obtained
Application of data	Summarize and show information based on data results

Indigenous knowledge generally develops from the daily activities or habits of the local people [10], [11]. Indigenous knowledge can develop and become local wisdom that can be known well in society. One of the local-wisdom in East-Java is patrol music as a product of cultural locality in the Bandulan area, Malang [12]. Patrol music has become a tradition that has a function as a signal for the sahoor of the Muslim community during the month of Ramadan [13]. Until now, patrol music has become a way of life for the people of Malang City during Ramadan.

Indigenous knowledge-based learning can provide simple learning innovations for student character development [14]. It can be a learning innovation that generally attract students' interest in new learning. Students' interest hardly utilized during learning without vary innovation learning that created by teacher in the classroom [15], [16], [17], [18]. Indigenous knowledge needs to be introduced from an early age to students in the current era of technological development. Technological developments have always been a challenge to local wisdom which requires modernization in every aspect of human life. Therefore, the development of local wisdom-based learning can be one of the alternative lessons for the preservation of local culture as well as improving aspects of data literacy skills as a necessity in modern human life.

2. METHODS

2.1. Types and Subjects

This study used 4D research and development. Data retrieval used three expert lecturers, 2 physics teachers, and 265 students of class XII as research subjects. The research places were conducted in two schools, namely Senior High School 1 Turen and Senior High School 1 Bululawang, Malang, East Java.

2.2. Design and Instruments

This study aims to determine the feasibility and practicality of the learning instruments and measure the appropriateness of the data literacy test items. The learning instruments' feasibility is needed before it is implemented as a measurement tool for students' data literacy abilities. Physics learning instruments in this study consist of lesson plans, student worksheets, and assessment of data literacy tests. The design of students' worksheets is integrated with patrol music in the form of "kentongan" illustrations and patrol music information. The lesson plans design uses discovery learning models with sound wave subjects based on indigenous knowledge. Besides indigenous knowledge, the test item was also adjusted to the data literacy indicator. Before the main test assessment activities on students, observations were also made on students of class XII to determine the students' condition.

2.3. Data Analysis

The data collection technique used two instruments namely the assessment sheet of the instrument feasibility and data literacy test items. The data literacy test item consisted of 10 essay questions. The data acquisition test results in the form of values range from one to 5. If students answer correctly and completely will get a value of 5, whereas if the student's answer is wrong then students get a value of 1. All research results are analysed descriptively qualitatively and quantitatively descriptive. The product feasibility assessment is given to 3 expert lecturers and this assessment sheet is guided by the conversion of answers into scale values 1 to 4. Then, the sum score ($\sum x$) for each aspect in assessment sheets is divided by 3 assessors as judgements. The average value ($\bar{Y}$) for each aspect can be obtained with equation (1).

$$\bar{Y} = \frac{\sum x}{n} \tag{1}$$

with n is the number of assessors or responses. The average score for each aspect can be converted into qualitative data with four-scale that it is shown in Table 2 below [19].

Table 2. Converting A Score To A Category Scale Of 4

Interval Value	Category
$3,25 < x \le 4$	Very Feasible
$2.5 < x \le 3.25$	Feasible
$1.75 < x \le 2.5$	Moderate
$1 < x \le 1.75$	Less Feasible

Measurement of test instruments with QUEST use Table 3 and Table 4 to study the suitability of test data

items from the level of reliability and level of item suitability.

Table 3. Interpretation of reliability

Value	Category
$-1.00 \leq r \leq 0.20$	Lowest
$0.20 < r \leq 0.40$	Low
$0.40 < r \leq 0.60$	Moderate
$0.60 < r \leq 0.80$	Reliable
$0.80 < r \leq 1.00$	Very Reliable

Table 4. Criteria for item in quest

Compatibility with the Rasch Model		Difficulty Index	Criteria for Item
Infit MNSQ (x)	Outfit t		
$0,77 \leq x \leq 1,33$	$t \leq 2,00$	$-2 \leq b \leq 2$	Suitable
$0,77 \leq x \leq 1,33$	$t \leq 2,00$	$b > 2$ or $b > -2$	Moderate
$x < 0,77$ or $x > 1,33$	$t > 2,00$	$b > 2$ or $b < -2$	Not Suitable

3. RESULTS AND DISCUSSION

This research uses patrol music that has a connection with Physics subject, namely sound waves. Sound wave based on indigenous knowledge is integrated into the learning instruments developed. In more detail, the indigenous knowledge-based student worksheet display is presented in Figures 1 and 2.
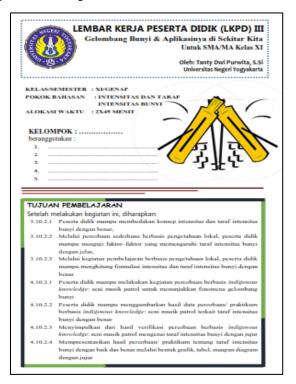

Figure 1 The front page of Student Worksheets III

Figure 2 Information about patrol music inside student worksheet ("stimulation" stage)

This study aims to determine the feasibility and practicality of indigenous knowledge-based physics learning instruments and the suitability of data literacy test items to be used. The development of indigenous knowledge-based learning instruments products was given to 3 lecturers and 2 Physics teachers to check the

feasibility and practicality of the product. Based on the literature study, some of the findings are summarized as evaluation components of indigenous knowledge-based learning instrument products. These components become some references in making learning instruments and feasibility assessments by assessors. The component in the lesson plan and student worksheets are shown in Table 5 and 6.

Table 5. Evaluation components of lesson plan

Rated aspects	Sub-Aspects
The Lesson Plan Component	Completeness of Lesson plan components in accordance with "Permendikbud" No. 22 of 2016
	Complete lesson plan identity in accordance with "Permendikbud" No. 22 of 2016
	The suitability of the formulation of indicators with basic competencies
	The suitability of the formulation of learning objectives with indicators of competency achievement
	Match learning objectives with the structure of form A (audience), B (behaviour), C (condition) and D (degree)
	The suitability of teaching materials with the formulation of competency achievement indicators
	The suitability of teaching materials with the formulation of learning objectives
	The suitability of teaching materials with approaches, models, and learning methods used
	The suitability of teaching materials with the level of understanding of students
Learning Activities	The suitability of learning activities with the discovery learning model
	The suitability of the learning activity scheme with the development of learning instruments based on indigenous knowledge
	The suitability of learning activities in developing aspects of data literacy abilities
Linguistic	Use of language according to PUEBI (General Guidelines for Indonesian Spelling)
	Simple sentence structure
Indigenous Knowledge	The use of indigenous knowledge in learning activities with discovery learning models

Table 6. Evaluation components of students worksheet

Rated Aspect	Sub-aspects
Content Feasibility	Suitability of students' worksheet components
	Suitability of students' worksheet contents
	The suitability of the discovery learning model in students' worksheet activities
	The suitability of the elaboration of indicators of achievement and standard competencies in the learning objectives in students' worksheet
Didactic Feasibility	Suitability of material sequence in students' worksheet
	Students worksheet facilitates the activities of high school level students
	Compliance with the instructions for using students' worksheet
	Availability of appropriate questions and direct students actively in the learning process
Linguistic	The suitability of the use of Indonesian in students' worksheet
	Suitability of sentence structure in students' worksheet
	Clarity of information in students' worksheet
Presentation	The suitability of the use of writing (font) in students' worksheet
	Appropriate placement of information, illustrations / pictures / photos in students' worksheet

	Appropriateness of layout, design and pages in students' worksheet
Indigenous Knowledge	The use of indigenous knowledge: patrol music art in students' worksheet

The results of learning instrument appraisal were obtained from 3 expert lecturers with the result of average value for each aspect is shown in Table 7 and 8 below:

Table 7. Feasibility results of lesson plan

Rated Aspect	Average	Category
The components	3.48	Very Feasible
Learning Activities	3.55	Very Feasible
Linguistic	3.33	Very Feasible
Indigenous Knowledge	3.33	Very Feasible
Total Average	**3.43**	**Very Feasible**

Table 8. Feasibility results of student worksheet

Rated Aspect	Average	Category
Content Feasibility	3.58	Very Feasible
Didactic Feasibility	3.67	Very Feasible
Linguistic	3.11	Feasible
Presentation	3.78	Very Feasible
Indigenous Knowledge	3.67	Very Feasible
Total Average	**3.56**	**Very Feasible**

An assessment from 3 expert lecturers described feasibility on all components of the indigenous knowledge-based learning instrument. Based on Tables 7 and 8 the results show the lesson plan feasibility has 3.43 as the total average value. This value is categorized quite feasible. This result was also obtained from the student worksheet based on indigenous knowledge (patrol music art) which has a total average value of 3.56. Thus, indigenous knowledge-based students' worksheets have excellent feasibility. This feasibility research shows that indigenous knowledge in the learning process design can be integrated. The research from Syaban and Wilujeng [20] shows that learning instruments based on local wisdom can be developed so it has expediency to be used in increasing scientific literacy. In others research by Khusniati, et.al. [14] shows that indigenous knowledge actually can be also integrated into learning instruments for student's conservationist character.

Assessment by the Physics teacher shows the practicality of the learning instruments to be applied to the classroom of students. Based on Table 9 below, the assessment of learning instruments that have been developed shows the value in terms of learning, material, media visual and indigenous knowledge has a greater value than 3, which is categorised as quite feasible category. So, this learning instrument can be used in the classroom because it has a very feasible category of its practicality. In Table 10 presents some sample questions of data literacy test that have been used in this research.

Table 9. Practical results of learning instrument by practitioners

Rated Aspect	Average Value	Category
Learning	3.50	Very Feasible
Material (Content)	3.75	Very Feasible
Media Visual	3.75	Very Feasible
Indigenous Knowledge	4.00	Very Feasible
Total Average	3.75	**Very Feasible**

Table 10. Sample questions of the data literacy test

Indicators	Item tests
Observation of data	Village heads and villagers sound some kentongan on the hill to signal danger. Two seconds later the sound was heard by Mr. Andi, who was looking for wood behind the hill. What is the distance between Mr. Andi and the residents on the hill? ($v = 300 \, m/s$)
Collection of data	

Data Appraisal	The sound intensity level of "kentongan" made of bamboo is 30 dB. If the threshold sound intensity level of $10^{-11} \ W/m^2$, what is the sound intensity level for 100 similar "kentongan" that can be produced in a patrol musical art performance?
Application of data	In the month of Ramadan, patrol music performances are held at 3 different places. It is known that the distance table between a listener and each source of the "kentongan" sound is played at points P, Q, and R as follows:

Sound Source Point	Sound Power (Watt)	Distance to listener (m)
P	314	10
Q	3.140	20
R	31.400	40

	Based on the information in the table, which of the three places has the greatest sound intensity?

Table 11. Summary of item and case estimate in quest result

	Mean	SD (adjusted)	Reliability of Estimate	Category for Reliability
Item Estimates	0.01	0.41	0.75	Reliable
Case Estimates	−0.31	0.32	0.59	Moderate

Besides the feasibility of the lesson plan and students' worksheet, the usage of the data literacy items has to need the appropriate requirements with the Rasch model criteria and have good reliability. In Table 11 is shown three from 10 items of data literacy test that has been used in the QUEST analysis. Based on Table 3 as a reference, it can be seen in the "item estimates" part in Table 10. All data literacy items have 0.75 value. This value indicates 10 data literacy test items have high reliability.

While the reliability of the items, the reliability of the research subjects (265 students) was also analyzed based on their ability level. Based on the reliability value "case estimates" in Table 11, it obtained a value of 0.59. This value means that the participant's reliability in this study is included in a moderate category or quite reliable. Thus, this value can be concluded that the repetition of the test with other test participants can produce the results that have moderate stability (moderate consistency).

Table 12. Empirical test analysis results on item data literacy test

Item Number	DIFFICULTY	Diff. Index	INFIT MNSQ	INFIT t	Criteria for Item
1	−0.37	Moderate	1.51	6.7	Not suitable
2	0.30	Moderate	1.15	1.6	Suitable
3	−0.73	Moderate	0.96	−0.4	Suitable
4	0.03	Moderate	0.98	−0.3	Suitable
5	−0.73	Moderate	0.98	−0.3	Suitable
6	0.26	Moderate	0.88	−1.5	Suitable
7	0.33	Moderate	0.84	−1.7	Suitable
8	0.69	Moderate	0.84	−1.3	Suitable
9	0.36	Moderate	0.69	−2.9	Not suitable
10	−0.15	Moderate	1.12	1.7	Suitable

Table 12 shows the item analysis results on each item. The results of Table 11 provide information in the form of item difficulty level for each item, namely in the DIFFICULTY column. The higher the value in the

DIFFICULTY column, then shows the difficult item is very high. Based on the results in Table 10, the whole item of data literacy items has a moderate level of item difficulty. However, based on the INFIT MNSQ (Infit MEAN SQUARE) and Outfit t value indicate that item number 1 and number 9 do not match the specified value range. Thus, out of 10 data literacy test items, 2 items are not suitable and the items don't fit the Rasch model. Based on the results of Table 11, it can be concluded that the developed indigenous knowledge-based learning instruments contained 8 valid items to measure students' data literacy abilities.

4. CONCLUSION

Based on the analysis results, the indigenous knowledge based-learning instruments development has feasibility and practicality to be used in the classroom for enhancing students' data literacy skills. All test items for data literacy measurement have a moderate level of difficulty. However, two out of 10 items of data literacy items from indigenous knowledge based-learning instruments do not fit the criteria of good items to be applied in class.

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