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Physics Graphical Representation Test of Straight Motion Kinematics Based on Boti Boat Local Wisdom: Development and Validity

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ABSTRACT
This study aimed to produce the test instrument to measure graphical representation integrated to Buton tribe local cultural in the form of the Boti boat for senior high school student in Physics. It's due to graphical representation importance competence in physics to train 21th century skills. This research develop physics graphical representation integrated to Boti boat local culture in Straight Motion Kinematics topics. The Research and development reseserch with 4D model is used. The research subjects were local students in Bau-Bau city (130 students in total). Both content and empirical validity is deeply taking apart. Finally, the feasibility content was validated by experts and physics teachers then, the data were analyzed according to V-Aiken Analysis. The content validity shows test items are declared valid with a range of V-Aiken values from 0.80 to 1.00. Empirically, the Partial Credit Model (PCM) used to measure goodness fit, reliability, and difficulty index. This study indicated that the goodness fit with a range of 0,97-1,20. Indeed, all items difficulty levels range are normal with a range of -0.52-1,30. Finally, this test instrument which is integrated to Boti boat local wisdom are able to use for measuring Physics graphical representation competence in physics learning.

Keywords: *Test instrument, Boti boat local culture, Graphical representation, Physics learning*

1. INTRODUCTION

The world is in the industrial revolution 4.0 era [1]. In this era, competition is quite tight with competition for the human resources [2],[3]. This is determined by the nation's education level. Improving the education quality starts from improving the quality of learning [4],[5]. Improving the learning quality begins with arranging appropriate learning according to current conditions. Physics subject is learning that requires an increase in the quality of learning [6]. This is due to physics requires the ability to reason in thinking and the ability to have multiple representations to explain various natural events and solve problems, both qualitatively and quantitatively [7],[8]. However, the students' representational competence has not been trained much in learning physics [9],[10] especially graphical representation competence. In fact, this ability is needed by students in studying physics [11-12] so that physics learning that trains graphic representation skills need to be trained.

Good learning also needs to be supported by an appropriate assessment [13],[14],[15]. Thus, physics learning is also expected to be able to train and measure students' graphical representation competence [16],[17]. With regard to the graphical representation competence, the facts show that the students' physics graphical representation has not been measured optimally [18]. This is due to the lack of instruments to measure students' physics graphical representation competence. The lack of instruments to measure the physics graphical representation competence increases the chances of selecting an inappropriate assessment model in learning. Selection of the assessment model that is not appropriate will have an impact on the physics low learning achievement [19],[20],[21]. Evidently, the PISA (Program for International Student Assessment) ranks

in the field of Science, Indonesia is ranked 70 out of 78 [22]. The physics achievement of Indonesian high school students in the international arena is still low. Therefore, it is important to develop a physics representation instrument for high school students because the right assessment can encourage students to learn well.

The assessment model also affects students' thinking abilities [23],[24],[25]. Teachers must plan well and involve students in learning activities that can encourage and develop graphical representation competence [26],[27],[28]. Assessment can be implemented to assist students in improving their graphical representation competence [29],[30]. This is supported by another opinion, that graphical representations can encourage students to think deeply about the subject matter [31],[32],[33]. Thus, it can be concluded that the graphical representation ability test can stimulate students to develop their abilities.

Items development is depend on context. In fact, multiple choice tests are more widely used than other testing forms [34],[35]. This is because multiple choice tests have advantages. Multiple choice tests can cover most of the material being tested. In addition, students' answers can be corrected easily and quickly yet the answers are definitely right or wrong [36],[37]. Thus, the multiple choice test is still the prima donna in evaluating senior high school students' physics learning. Therefore, it is important to develop a multiple choice test of the physics graphical representation competence.

The revised 2013 Curriculum demands an innovative learning and assessment. This innovation can be done by integrating technology while keep the local values around due to keep the indigenous knowlegde for high school students [38],[39],[40]. Boti boat as the local wisdon of Bau-Bau city is relate to straight motion concepts. This local culture will be interesting when integrated to physics lerning for students. Therefore, it is necessary to develop a graphical representation test instrument based on boti boat local culture. This article will discuss the test assessment development of graphical representation on straight motion kinematics.

2. METHOD

This research is development research used 4D model taking the phases of the Define, Design, Development, and Disseminate stages [41]. The development procedure carried out can be seen in the flow diagram in Figure 1. This study subjects were 130 second level senior high school students in Bau-Bau city. The stages are presented below:

2.1. Define

This stage is conducting of three phases. There are material, variables and concept analysis. This stage is carried out through observation and research studies to obtain some data needed. Some things obtained from the analysis phase are indicators of graphical representation, the material study being taught, and matters related to the boti boat local wisdom.

2.2. Design

In this stage, the test instrument design is carried out. The design is adjusted to the analysis results in the previous stage. The test instrument design is in the multiple choice form with five possible answered. The multiple choice questions are chosen due to easier for correcting [30]. The questions developed are related to Boti Boat Local Wisdom as much as 50% of the whole problem. The test instrument developed consisted of 10 physics graphical representation and the assessment system was adjusted to the graphical representation indicator. The graphical representation aspects used are: (1) Analysis, (2) Evaluate, (3) Implement, (4) Determine.

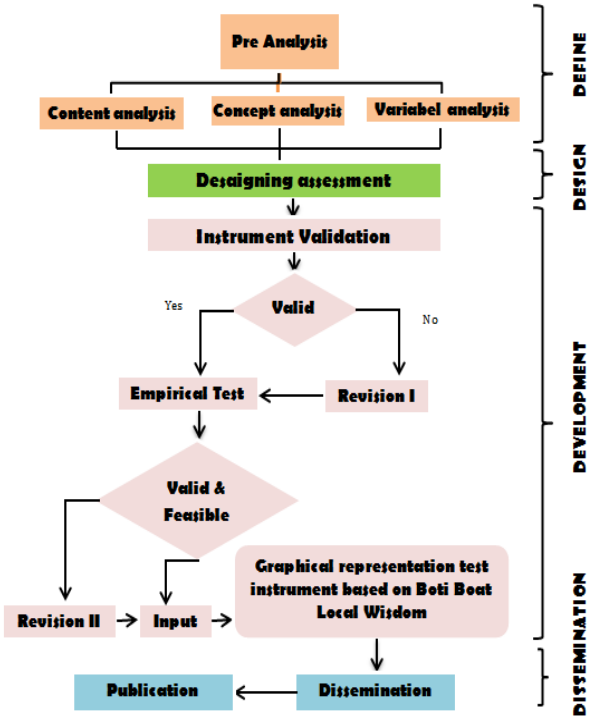

Figure 1 Development procedure

2.3. Development

This stage is carried out both expert and empirical validation. The graphical representation test instrument was validated by 2 expert lecturers and 1 physics teacher. The validator provides an assessment with 5 dichotomous aspects for 1 question. Then, the data were analyzed to obtain the Aiken validity coefficient [42]. The corrected revision is based on the validator's suggestion.

Then, the empirical test is conducted on the students. The questions tested in the multiple choice question on graphical representation with a dichotomous score of 0-1 (10 questions in total). The empirical tests results are used for the test items analysis using the Partial Credit Model (PCM) as an the Rasch model extension for the 1-PL model. This model The sample is fit to this research subject total due to size for the 1-PL model in the form of the Rasch model is 30-300 respondents [43],[44]. Item analysis was performed. The results analysis will show goodness fit, reliability, and index difficulty.

3. RESULT AND DISSCUSSION

The analysis result of the graphical representation test instrument on straight motion kinemathics based on the boti boat local wisdom is presented in this section. Then, both content and emphirical result is also deeply presented. An empirical test is carried out to test the test instrument before it is used for extensive trials. The test instrument tested consisted of 10 graphical representation questions. The subjects of the empirical test were 130 students of second level from SMA Negeri 4 Kota Bau-Bau, SMA Negeri 3 Kota Bau-Bau who had received material straight motion kinematics in first class. The results of the empirical test are used to determine whether or not each item is valid. In addition, the results of the empirical test also help to sort out the questions. The test indicators are presented in Table 1.

Table 1. Graphical representation indicators

Question No.	Indicatos
Q1	Presented a a motorbike moving graph with a certain distance and time, students are asked to analyze the motorbike speed.
Q2	Presented a boti boat moving problem with a certain time and speed, students are asked to analyze the boat's acceleration.
Q3	Presented several graphic images, students are asked to analyze and determine the appropriate graph and according to regular straight motion and straight motion changes in order
Q4	Presented a graph of the relationship between time and speed of a boti boat from rest, students are asked to analyze the distance the boat traveled at a certain time.
Q5	Presented a graph of the relationship between time and speed of a botanical boat from rest, students are asked to analyze the boat's movement at a certain time
Q6	Presented five graphs of velocity against time, students are asked to analyze the graph of the relationship between speed and time of a boat moving with regular straight motion and straight motion changes in order
Q7	Presented the problem on a graph, students are asked to determine the average speed of the boti boat
Q8	A graph of the relationship between speed and time is presented, students are asked to analyze two botanical vessels moving in regular straight motion and straight motion changes in order
Q9	Presented a graph of the speed of the boat against time, students are asked to determine the distance traveled by the boat
Q10	A right-shaped image of the track is presented, students are asked to determine the average speed of people crossing the track

3.1. Content Validity

Content validity is an instrument assessment to determine which instrument can measure what the researcher variables be tested [44]. In this study, the variable is graphical representation for physics in Senior High School Students. The validation results by three validators (2 lecturers and 1 physics teacher) were analyzed using V-Aiken analysis to obtain content validity. The interpretation result are presented in Table 2.

Table 2. The validation results of the physics graphical representation test instruments

Item of question	Aiken Coefficient (V)	Category
Q1	1,00	Very high
Q2	0,80	High
Q3	0,87	Very high
Q4	1,00	Very high
Q5	1,00	Very high
Q6	1,00	Very high
Q7	0,80	High
Q8	0,87	Very high
Q9	0,87	Very high
Q10	0,93	Very high

Based on responses and judgments by 3 validators, the V-Aiken's value of 8 question items is in the range of 0.80 - 1.00. This states that all items included in the very high classification except Q2 and Q7 included in the high classification. Thus, all item is valid based on the content validity. In addiion, Each item about the graphic representation ability is subjected to an empirical test. The empirical test results were analyzed according to the Partial Credit Model (PCM). Each of the results of the empirical test data analysis is presented below:

Goodness fit is used to determine whether the item is significant, meaningful, directed, and beneficial [45]. The validity of the graphical representation test items was analyzed using the Quest program. Goodness fit results can be analyzed by the outputs in the INFIT MNSQ and OUTFIT MNSQ sections. This is to show the compatibility of each item with PCM with an INFIT MNSQ acceptance limit of 0.77-1.30 [46] and an OUTFIT MNSQ acceptance limit of 0.5-1.5 [47]. The results of goodness fit questions about pictorial representation are presented in Table 3.

3.2. Goodness Fit

Table 3. Item fit graphical representation test

No Question	INFIT MNSQ	OUTFIT MNSQ	Status	Category
Q1	1,19	1,13	Fit	Valid
Q2	1,20	0,93	Fit	Valid
Q3	1,09	1,13	Fit	Valid
Q4	1,00	1,25	Fit	Valid
Q5	0,97	1,06	Fit	Valid
Q6	1,14	1,25	Fit	Valid
Q7	1,07	1,06	Fit	Valid
Q8	1,03	1,13	Fit	Valid
Q9	1,01	0,68	Fit	Valid
Q10	0,97	0,58	Fit	Valid

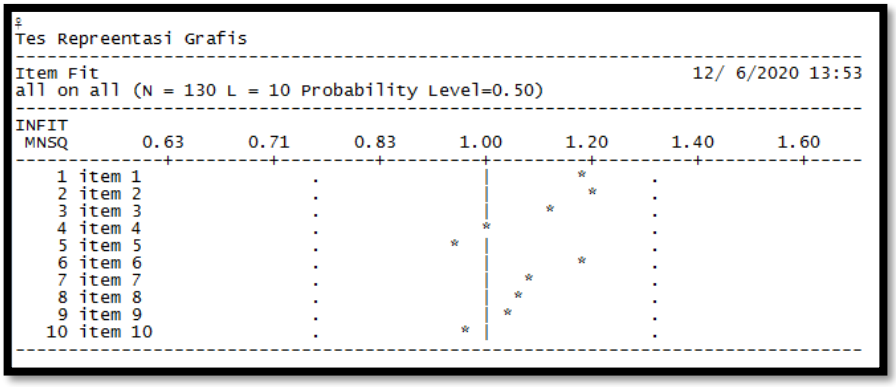

Figure 2 Distribution of graphical representation question items by Compatibility with the PCM model

The analysis results in Table 4 show that all items of graphical representation that are fit with the 1-PL PCM model. The results presented in Figure 2 show that all items INFIT MNSQ are 0,97-1,20 within the acceptance range or limit, namely 0.77-1.30 [47]. While, all items OUTFIT MNSQ are 0,58-1,25 within the acceptance range or limit, namely 0.5-1.5 [48]. This states that all item number questions serve to measure the graphical representation ability of students.

3.3. Reliability

The reliability of the test can be seen through the item reliability and the person/case reliability. Reliability serves to show a description of the ability of students who take the test from the results or test scores. The results of the QUEST output for the reliability of the graphical representation test instrument are summarized in Table 4.

Table 4. Reliability estimation

Reliability	Reliability Coefficient
Summary of item estimates	0.62
Summary of case estimates	0.90

Table 4 shows the item reliability value of 0.62 and person reliability of 0.90. The graphical representation test instrument was still acceptable because case estimates item estimates were still in the fairly high category.

3.4. Difficulty Index

The level of difficulty of graphical representation test items can be seen from the QUEST output on the difficulty index section. The results of the graphical representation analysis are presented in Table 5.

Table 5. Difficulty index item about graphical representation

Item of question	Difficulty	Category
Q1	0,26	Good
Q2	-0,18	Good
Q3	0,29	Good
Q4	-0,12	Good
Q5	1,30	Good
Q6	-0,52	Good
Q7	-0,31	Good
Q8	-0,08	Good
Q9	0,29	Good
Q10	0,06	Good

The items are categorized as good if they are in the range of -2.0 to 2.0 [48]. Items with a difficulty level of -2.00 mean that the item is very easy, while a value of 2.00 means that the problem is very difficult. The results in Table 6 show that all items in the graphical representation fit in whole category. Indeed, the most difficult questions is Q5 with a value of 1,30 however the easiest item is Q6 with a value of -0,52.

4. CONCLUSION

Based on the study results, it can be concluded: (1) the graphical representation test instrument was developed in the form of multiple choices on straight motion kinematics based on the Boti boat local wisdom. (2) The graphical representation test instrument has fulfilled the validity, then has obtained empirical evidence. (3) The content validity shows that the graphical representation test items are declared

valid with a range of V-Aiken values from 0.80 to 1.00. (4) Empirically, the goodness fit shows that all item graphical representation test is declared fit with a range of values INFIT MNSQ are 0,97-1,20 within the acceptance range or limit, namely 0.77-1.30. While, all items OUTFIT MNSQ are 0,58-1,25 within the acceptance range or limit, namely 0.5-1.5 This states that all item number questions serve to measure the graphical representation ability of students.In addition, the reliability coefficient shows that each item on the test instrument of the graphical representation is consistent in measuring. Besides, all items in the graphical representation test instrument were categorized because they were in the range of difficulty index -0.52 to 1,30.

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