Developing assessment of higher order thinking skills in physics learning based on local wisdom

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Abstract. This study aims to develop an assessment of higher-order thinking skills in physics-based on local wisdom. This research through four (4) stages of development: defining, designing, developing, and distributing. The results show that the validity value of 3.94 on the rating scale of 3.0 ≤ SV ≤4.0 with a correct category and can be implemented with small revisions. The practicality of assessment is obtained from the readability of assessment instruments with a percentage of 81%, the level of difficulty of the instrument with a percentage of 72%, and responses from respondents with a percentage of 83%. Assessment effectiveness is obtained from learning completeness, where classical completeness is 100%, and indicator completeness is 90.5%. Thus the assessment of higher-order thinking skills in physics-based on local wisdom can be said to be feasible to be disseminated.

1. Introduction
Science, environment, and culture are three essential things that cannot be separated. Science learning material is always closely related to the environment and culture. Proves a harmonious relationship between the environment and nature [1]. The relationship between science learning and local wisdom is around 85% [2]. For example, in science learning materials discussing sound waves, then in the environment and culture, there are traditional musical instruments related to the content.

Learning science at school cannot ignore cultural elements because the culture is inherent in the daily lives of students [3]. This is in line with the results of the study [4] showing that the science wisdom-based module with the theme of volcanic eruption is very feasible to use in junior high school of science teachers on topics related to natural phenomena and ecosystems. Other research related to local wisdom, shows that nine local Balinese wisdom values namely religious, honest, tolerant, responsible, ashamed when failing to carry out tags and obligations, wanting to know and generous, working har, showing concern and friendly with nature, reflecting on self can be implemented by physics teachers in teaching [5].

In line with the statement above that local wisdom-based learning is difficult to apply because teachers are not able to integrate with local wisdom [6], research results about 80% of teachers are familiar with local wisdom but no one teacher is able to apply science learning [7]. Many students forget about learning science-based on local wisdom [8], besides the influence of external culture is more dominant so that local wisdom is forgotten [9]. Learning science cannot be separated from local wisdom because local wisdom has become part of the community in their lives.

Various problems with learning science-based on local culture need an assessment tool to measure students' abilities. One of the devices is an instrument of high-level thinking skills in learning local-based physics science. Assessment can be interpreted as an activity about the learning progress of
students by using various procedures, such as formal tests, inventory, checklist, self-assessment, portfolio, projects and other activities [10]. Assessment is the process of gathering information to monitor progress and make educated decisions when needed [11]. Many other researchers have developed an estimate of higher-order thinking skills, but the assessment of higher-order thinking skills based on local wisdom is still rarely practised. Based on the results of initial observations on students from the physics study program at UIN Mataram that 85% of students do not recognize local wisdom in their lives [12].

To train students to have high order thinking ability so the teacher must have tall order thinking skills anyway. High order thinking skills is one of the essential skills that should be possessed by prospective science teachers [13] because of this skill; students must be taught to solve various problems [14]. Creativity is one part of higher-order thinking skills. In the world of work, creativity must be possessed by workers to produce quality products [15-17]. Based on survey results in the United States in 2007, 99% of respondents agreed that creativity and collaboration are skills that students must possess in driving the global economy [18].

Nevertheless, reported that, for the first time in decades, creativity has declined in all age groups in the United States [19]. The decline of creativity is evident in children became less imaginative, less able to synthesize information, not motivated to elaborate ideas in detail, and not being able to capture the essence of the problem. In Indonesia, the creativity of students still classified as low. The results showed that the Indonesian creativity index was very low, ranking 81 out of 82 for developing countries [20].

In the developed world, creativity was established as early as possible through education [21] because the institution believed to be the most appropriate place to develop children's creativity and talent [22]. However, the current education policies often inhibit the creativity of teachers because of the workload and the demands of the curriculum so that it makes it difficult to develop creative ideas in teaching, as a result, imposes no original sense students [23]. The majority of science teachers teach by the demands of the curriculum and believe that they are not ready or don't have enough time to show the creativity in their classes [24].

Based on the gap above, then, the researcher considers it essential to know the high order thinking skills of students to the physics material based on local wisdom. It contained in a study entitled “development of higher-order thinking skills assessment on the physics material based on local wisdom.

2. Methods
This research is development research. This development research produces high order thinking skills assessment on physics material based on local wisdom which is developed by the model of 4-D, namely: Define (definition), Design (design), Develop (development), and Disseminate (disseminating).

2.1. Define
Define stage is to set and defines the terms of learning. Define stage includes two significant steps: first analysis of the needs consists of the purpose and concept. Then, the second is the analysis of the characters revealing the students’ mindset and mastery of learning material.

2.2. Design
The design stage aims to design a learning device. Four steps to be done at this stage, namely: (1) preparation of test standards (criterion-test construction), (2) the selection of media (media selection) which suitable with the characteristics of the material and learning objectives, (3) the choice of the format (the format selection), which is reviewing the assessment formats and specify the size of the assessment that will developed, (4) making the initial draft (initial design) according to the selected size.

2.3. Development
The development stage is the step to produce a product development that is done through two phases, namely:(1) assessment experts (the expert appraisal) followed by a revision, (2) experimental development (developmental testing).
2.4. Dissemination

The dissemination process is the last stage of development. The dissemination stage is done to promote the development product in order to be acceptable to the user, either an individual, a group, or a system. Manufacturers and distributors should be selective and work together to package the material in the proper form. Dissemination can be done in other classes with the purpose to find out the effectiveness of the devices using in the learning process. The distribution can also be done through a method of transmission related to learning practitioners in a particular forum. This form of dissemination to get feedback, correction, advice, assessment, to improve the end product development to be ready to be adopted by the users of the product.

Data analysis in this research describes the validity, effectiveness, practicality and high order thinking skills assessment. Analysis of the data conducted inductive based on the facts which are used to answer a problem formulation that has formulated in a more stressed the significance of the research than generalization [25].

The validity of context and validity of content to high order thinking skills assessment on physics-based on local cultural material using a descriptive qualitative. The obtained data are analyzed by an average score of each aspect analysis of Practicability of Assessment. Data analysis techniques which are used at this stage is a quantitative descriptive technique percentage. Analysis of The Effectiveness Assessment The Student creativity data is obtained by using a test of creative thinking in the form of a question that is done at the beginning and end of the meeting material thermal adaptation of "the Scientific Structure Creativity Model (SSCM)." Tests are used in the form of a written question in the form of the test description of as much as 5 questions. Scoring procedure tests of creative thinking are the sum of fluency score, flexibility score, and originality score. The subject's fluency score obtained by directly calculating all the answers of the question to each assignment which is given by that subject without paying attention to the quality of the answers. Flexibility score is obtained by calculating the number of approach or content area which is used in that answer. Originality score is developed from the tabulated the frequency of the whole answer which is obtained. The frequency and percentage of each answer are calculated. The probability of an answer smaller than 10%, given the score 2 points; the probability of 50 to 10%, given the scored answer 1 point; the probability of a response greater than 50%, given the score the answers of 0 points. In addition to the validation instrument for creative thinking expert, has also analyzed the sensitivity the questions.

3. Results and Discussion

3.1. Validity

This development product is an instrument of high order thinking skills assessment on physics material based on local cultural content. Simulation designs the process of teaching, which aims to make easy the researcher when they do test to the prototype that is already in the correct category. The results of that simulation is to arrange the steps which will be done when performing a test, and that step begins by setting up the task of learning activities which will be performed, then give an explanation related to the product which is developed and begin to assess the process of determining by the instruments of assessment which produced.

High order thinking skill assessment on physics material based on local culture that developed in this research chooses the material consisting of: (1) the introduction of the assessment term, measurement, assessment, and evaluation; (2) the HOTS (Higher Order Thinking Skills); (3) the local wisdom; (4) high order thinking skills Assessment based on local wisdom. There is the following example instruments test higher-order thinking skills based on local wisdom:
• Do you know the concept of physics contained in your little game? If you remember, write these concepts!

• Find out your traditional games by a similar physics concept! Art and sound often found in regions with various types. This is the following presented some of the techniques in the local wisdom.

The art of mashing rice in the Bima region produces a distinctive sound, no less exciting with the typical architecture of Lombok, which is called Gendang Beleq. Both of these traditions similarly produced the music. Besides that tradition, there are a variety of tools specifically designed to create a sound that is nice to hear, such as flutes, harps (Katipu) and others.

• Design the traditional tools which contain the concept of temperature and heat.

• Design traditional house or arch region by using the symbols and of the physics science.

The review result of an expert to high order thinking skill assessment on physics material based local wisdom can be seen in Table 1.
Table 1. The Results of the Validation of the Assessment

| Component KBTT     | Average of judgment | Category     |
|-------------------|---------------------|--------------|
| Content feasibility | 3.92                | Very Valid   |
| Language          | 3.90                | Valid        |
| Presentation      | 4.02                | Very Valid   |
| Sum               | 11.84               |              |
| Average           | 3.94                | Very Valid   |

Table 1 shows the validation results from the three validities; the average scoring of validity for all components is 3.94 with a correct category. Besides that, information, Table 3 also informed about the validity of content (content validity) where the assessment result of the validity is 3.92 with very valid categories.

States the feasibility of an instrument as a consistent procedure classification suitable with the level of maturity of the students. Assessment (Assessment Guides) the tools of assessment include 3 (three) dimensions of competences assessments, namely: Applying, communicate, and practice of science [26]. The results tests of studying are not able to express all materials which exist in a particular field of study, though for only one semester [27]. Therefore, it should be taken most of the content in the form of sample tests as the sample should be able to reflect the material contained material from all fields of study. More specific detailed criteria that have content validity is a test that measures particular objectives and aligned to the material or lesson content that is given [28]. Thus, validity assessment to the assessment which developed to have a high-reliability percentage. Where the assessment test that is developed has a specific meaning and be specific, as the example of the instrument above.

Empirical support also expressed [29] in which the characteristics of assessment are two, namely; 1) participants in the creation a product or engaged in an activity (action) such as experimentation, practice, and so on, 2) product from performance tests is more important than any work or its performance. Suggestion advice and content of expert commentary about the development of higher-order thinking skill assessment on physics material based on local wisdom are as follows:

- The colour of the font (font colour) is not appropriate.
- There is no numbering and description of the image as well as some image no introductory remarks (image suddenly appeared).
- The images created are not appropriately designed.
- Assessment terms adapted to the context.
- Space settings or layout is not yet appropriate.

Based on the expert judgment of the content to the development of high order thinking skill assessment on physics material based on local wisdom as listed in table 3 above that the progress of high order thinking skills assessment physics material based on local wisdom is in a very valid qualifications so that it can be used with little revisions. There is the revision of the definition on table 2 as follows:

Table 2. Revision of Higher order Thinking Skills Assessment

| Item which revise                                      | Revised   |
|--------------------------------------------------------|-----------|
| Font colour (font colour) does not match               | Revised   |
| There are no numbering and captions, some accessible no introduction (a picture suddenly appears) | Revised   |
| Images made are not well designed                      | Revised   |
| The terms in the assessment tailored to the context    | Revised   |
| Room or layout settings are not yet appropriate        | Revised   |

Based on suggestion from the validator, the revisions which have been made in this assessment is on the eligibility of presentation components consist of; (1) the color of the font (font color) is not appropriate; (2) there is no numbering and description of the image as well as some pictures no
3.2. Practicality

The practicality of assessment is seen from the result of the evaluation. Some components which become the source of data are the practicality of readability, difficulty level and the response of the students. This is the following data about practicality. The technique of close procedure obtains the readability. The percentage level of assessment readability presented in table 3 below:

| Respondent | Assessment of science | Percentage of Readability (%) | Category |
|------------|-----------------------|------------------------------|----------|
| 1          | 75                    | Medium                       |          |
| 2          | 85                    | High                         |          |
| 3          | 85                    | High                         |          |
| 4          | 75                    | Medium                       |          |
| 5          | 85                    | High                         |          |
| Average    | 81                    |                              | Suitable for learning |

Table 3 shows the percentage levels systematically readability science assessment. The student got a score of 75%-85% for the level of readability of high order thinking skills assessment on physics material based on local wisdom, 81% score or percentage, so that level category of readability on tall order thinking skills assessment on physics material based on local wisdom is the material appropriate to learning.

The difficulty level of assessment evaluated in several stages. Each stage involves every four meetings (4) times. Each session, the lecturer suggests students underline the sentence which does not understand. In terms of difficulty level, experts suggested that to develop the mathematical ability of the students; learning must become an environment where students can engage actively in many learning activities useful. Stated that the knowledge created by the students themselves, not found like a stone or a gift [30]. Data about the level of difficulty assessment is obtained from 5 students as samples, as for the data presented in table 4.

| Respondent | Assessment | Percentage of difficulty (%) | Category |
|------------|------------|-----------------------------|----------|
| 1          | 7.60       | Small                       |          |
| 2          | 6.65       | Small                       |          |
| 3          | 7.80       | Small                       |          |
| 4          | 7.50       | Small                       |          |
| 5          | 6.50       | Small                       |          |
| Average    | 7.21       | Very Easy                   |          |

Table 4 shows the percentage level of difficulty in a systematic assessment of high order thinking skills in physics material based on local wisdom. The percentage of pressure on tall order thinking skills assessment on physics material based on local wisdom between 6.50%-7.50%, or an average percentage score of 7.11%, thus categorized small or very easy.

Construct Validity/book Format: it corresponds to a valid category, the results of students responses about 82.50% students are very interested in the assessment book, 17.5% of students interested enough, 0% less interested and Content Validity (Content and language) is suitable with a valid category. The
results of students' responses about 85.75% of students are very interested in the questions, 14.25% of students interested enough, 0% less interested. Other things that student response is as much as 32.50% of the students rate the assessment book is very new, 75.62% student rate is relatively new, 4.38% of the students calculate the less recently, 8.75% students assess very easy, 83.12% of students judging quite quickly, 8.13% of students judging difficult, 1.25% of students judging very difficult.

Students response on high order thinking skills component drilled, 26.95% students' rate is very new, and student rate 61.72% fairly recently, 11.33% of the students rate the less recently. As much as 56.25% very interested that student learning with assessment to improve students' high order thinking skills can be applied to the next subject, 42.75% of students judging quite impressed and no students who are less interested or not interested. Student response to the lecturer’s explanation when teaching and learning activities, 37.50% of students judging very clear, 62.50% student rate is quite clear, and no student assesses less clear or not transparent. Student response against the guidance of a lecturer during the discovery activities, 28.13% students assess very clear, 71.87% student rate is quite clear, and no student assesses less bright or not clear. Student response to the components of the assessment sheet products, high order thinking skills is 1.03% of students judging straightforward, 60.42% students assess fairly quickly, 35.42% of students deciding difficult, and 3.13% of the students is fierce.

One way to improve critical thinking skills which is part of the high order thinking skills of students such as the ability to analyze, synthesize and evaluate is to use the guided inquiry model because students can find concepts of the problems being studied [31].

3.3. The effectiveness

The indicator results of the study high order thinking skills on students of class A and class B can be seen in Figure 3 below.

Based on Figure 3 above, obtained information that high order thinking skills assessment on physics material based on local wisdom, all indicators of the problem utterly. The tall order thinking ability has three components, namely the thinking skill, thinking habits, and meta-cognitive [32]. High order thinking skills can be improved by giving the question in the form of an open-ended question, assignments in class and feedback in the learning. Explains about feedback, if the work results of the students appreciated and improved, the sense of self-worth to the creative process would increase, and if the work results of students rated are critically then it can build skills creativity and aesthetics [33].

4. Conclusion

The assessment was developed based on a valid appraisal of the validator. The validity score of 3.94, so it is the category of correct. Therefore, the evaluation being developed can be applied to students of Physics Tadris UIN Prodi Mataram.

High order thinking skills assessment on physics material based on local wisdom practically to improve high order thinking skills of students. It is based on the results of the score category level of
readability of high order thinking skills assessment on physics material based on local wisdom 81% it means that the material is suitable for learning. Furthermore, the percentage level of difficulty high order thinking skills assessment on physics material based on local wisdom between 6.50%-7.50%, or an average percentage score of 7.11%, thus categorized small or straightforward. As for the learning activity has been increased from the beginning of learning to the end of learning with the excellent interest accumulated score reaches 100%. In addition, there are no constraints that are cornering the category. It is supported by the response of the students to the learning process, with students’ learning activity has been increased from the beginning of learning to the end of learning with the excellent interest accumulated score reaches 100%. In addition, there are no constraints that are cornering the implementation of high order thinking skills assessment on physics material based on local wisdom which is developed. it means that the assessment can be easily applied (practical).

High order thinking skills assessment on physics material based on local wisdom effectively to improve the high order thinking skills.

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