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Physics Teachers' Ability in Planning and Implementing Cultural-Based Physics Learning Activities on Education and Training

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Abstract

There is increasing appreciation of the importance of using indigenous (traditional) knowledge for contextualizing school science instruction because it forms part of students' prior experiences and source of information that they carry to school learning. The purpose of this study is to describe the physics teachers' ability in planning and implementing cultural-based physics learning activities, and the relationship between the teachers' ability in planning and implementing cultural-based physics learning. The research was a quantitative descriptive study that included 20 physics teachers in one of the regencies of Nusa Tenggara Timur (NTT) as the subject of the study. The instruments used for this study were the assessment rubrics for the physics lesson plan and peer teaching. The data were collected by doing observation and documentation of participatory education and training activities with cultural approach, analysed descriptively quantitatively, and presented in categories, percentages and diagrams. The average ability of physics teachers in designing the lesson plans of cultural-based physics in the following categories was quite good: 17 teachers (85%) were in the good category while 3 teachers (15%) were in very good category. The average presentation of the peer teaching appraisal results was in fairly good category, only 1 teacher (5%) was in the less good category, then 14 teachers (70%) were in good enough category, and then 4 teachers (25%) were in good categories. In general, the physics teachers had presented good performances, which mean the training activities had a positive effect on the physics teachers' content and pedagogical knowledge. In education and training activities by integrating culture in physics learning activities responded very well, thus in every group discussion cycle, the teacher was able to identify the culture which was suitable to the content of existing material and implementing it in the peer teaching activities.

Keywords*:* Lesson Plan, Peer Teaching, Cultural-Based Physics Learning, Contextual.

INTRODUCTION

Learning implementation planning is one of the important activities which is usually the first step before the teachers get involved in the classroom learning process (Shulman, 1987). The planning (henceforth lesson plan), contains rational, structured and logical ideas about everything that must be done in learning that shows the teachers' way of thinking, innovative attitude, knowledge and experience related to the curriculum, content, and pedagogical aspects (Schuell, 1986). The lesson plan is a face-to-face education for one or more meetings (Permendikbud 22, 2016). This is developed from the syllabus to direct the learning activities of the learners in achieving the basic competence. Every educator at every educational level is obliged to develop a complete and systematic lesson plan, so that the learning process will take place interactively, inspiring, fun, challenging, efficient and motivating the learners to participate actively, as it provides sufficient space for initiative, creativity and independence according to talents, interests, and the physical and psychological development of the learners (Ball, 1996; Tamir, 1998).

The principles of designing a lesson plan are: 1) individual differences of the learners. The initial ability, intellectual level, talent, potential, interest, learning motivation, social skills, emotions, learning styles, special needs, learning speed, cultural background, norms, values, and or the environment of the learners are considered; 2) active participation of the learners; 3) learner-centered that foster the spirit of learning, motivation, interest, creativity, initiative, inspiration, innovation and independence; 4) development of the culture of reading and writing designed to cultivate reading aversion, reading comprehension, and expression in various forms of writing; 5) feedback and follow-up lesson plan that includes the design of positive feedback, empowerment, enrichment and remediation feedback programs; 6) emphasis on the linkage and integration of basic competence, learning materials, learning activities, indicators of competency achievement, assessment, and learning resources in a whole learning experience; 7) accommodate thematic-integrated learning, cross-cutting integrity, cross-learning aspects, and cultural diversity; and 8) application of information and communication technology in an integrated, systematic, and effective manner in accordance with the situation and conditions (Ministry of Education and Culture, 2016). Planning and execution are the responsibilities of the teachers. They decide on the shape

and content of their teaching such as how many presentations, questions, and discussions to take; time allocation for each of the teaching materials, and how to design in-depth instruction (Baird, *et al*., 1991; Borich, 2007; Banerjee, *et al*., 2014).

The principle of designing a lesson plan indicates the accommodation and cultural diversity in the learning activities. This is also related to the first principle of cultural background which is indeed very influential on the achievement of the learning outcomes. Cultural differences reflected in character, way of thinking and others give a considerable influence in the learner's achievement (Cobern & Loving, 2001). Culture is a living practice that builds the learner's initial knowledge (Aikenhead & Jegede, 1999; Chinn, 2014). This contextual prior knowledge needs to be raised and integrated into learning as a guide to learn the material in a formal context. Thus, a lesson plan can be developed in a cultural context to help accommodate the learners' early knowledge in leading them to understand the concept of the materials well. The lesson plan in physics cultural context is a learning plan that takes the theme of culture as part of learning, especially in the introduction of learning activities (aspects of observing and asking).

From the viewpoint of cultural anthropology, to learn science is to acquire the culture of science; students must travel from their everyday life-world to the world of science found in their science classroom (Van Driel, *et al.*, 2001; Gay, 2013). Education with the cultural approach is ideal for environments such as cultured plural Indonesia, then education should be rooted in the nation's cultural values were significantly able to comprehend the harmony and peaceful life in a pluralistic state. Physics learning should be allied with students' prior knowledge in order to harmonize the new concepts with students' prior knowledge (Janik, *et al*., 2009; Chinn, 2014). An, *et al.* (2004) in their study of mathematics teachers' PCK in cultural contexts, concluded that in addition to subject matter, the pedagogy, contextual, and cultural knowledge are important considerations in determining teaching strategies and how to understand students' thinking.

In the context of physics learning, lesson plan cultural context is a design that conforms to the characteristic of contextual and applicative content of physics. Cultures consisting of traditional ceremonies, traditional games, musical instruments, as well as tools used in life that are specifically different from other regions have a

blessing with real physical content. For example the Newton's Law material and its application can be found in: 1) *Pasola* ceremony, a thanksgiving ceremony for the ancestral soul of the people of West Sumba. The Alor tribe still uses bows and arrows for hunting and war; 2) *Kelakoti* or traditional spinning spinner from Ende; the traditional umbrella dance of *enene*; 3) Wood panel of indigenous house of *AmmuHawu* (traditional house of Sabu); and 4) *Etu*, traditional boxing ceremonies of the traditional Nagekeo community (Soko, *et al.*, 2017). The effectiveness of the cultural-based physics learning should be measured as an ongoing evaluation. Measurement of planning effectiveness based on lesson plan preparation principles, cultural aspects presented, as well as cultural linkage with the content of physics learning that will be taught.

METHOD

This research is quantitative descriptive research. The subjects were 20 physics teachers in one district in NTT. The research instrument was a validated lesson plan and peer teaching rubric. The items on the assessment rubric for lesson plan and peer teaching consisted of 1) selection and organizing teaching materials of cultural-based physics, 2) learning models and methods, and 3) selection of cultural-based learning resources/media. Data were collected by observation and documentation of participatory education and training activities with cultural approach, analyzed descriptively, and presented in categories and percentages. The Spearman correlation test was conducted to determine whether there is a correlation between the physics teachers' ability in designing and implementing cultural-based physics learning.

RESULTS AND DISCUSSION

The results of the study and discussion are presented in two major sections namely, the ability of the teachers in preparing the culture-based physics lesson plan and the profile of the teachers' ability in implementing the peer teaching of cultural-based physics learning.

Physics Teachers' Ability to Develop a Cultural-based Lesson Plan

The planning of learning activities of any subject is a very complex cognitive activity, because the teacher must apply knowledge from several domains (Leinhardt & Greeno, 1986; Resnick, 1987; Magnusson, *et al.*, 1999). The lesson plan was imposed through assessment cultural-based physics lesson plan generated by teachers was; (1) not good, (2) less good, (3) good, (4) very good. From the average score with a maximum score of

4, the average presentation of the results of the lesson plan assessment of 2.4, can be concluded that the design of culture-based physics lesson plan generated by the teacher was quite good. Details of the results of the culture-based physics lesson plan assessment by physics teachers can be seen in Table 1.

Table 1. Lesson Plan Assessment Results

	N	Minimum	Maximum	Mean	
	Statistic	Statistic	Statistic	Statistic	Std. Error
Selection and organizing teaching materials	20	1	4	2.54	0.63
Learning models and methods	20	1	4	2.50	0.44
Selection of learning resources/media	20	1	4	2.23	0.60
Valid N (listwise)	20				

Planning ability is a combination of the physics teachers' experience in carrying out learning activities, knowledge and experience gained in education and training of the discussion activities in the cycle I to cycle IV. That is, even though the physics teachers have never designed the lesson plan of cultural-based physics previously, the process of providing and sharing knowledge in education and training oriented ability is to develop the activities of cultural-based physics learning, and the discussion process on both or between the training participants with facilitators among the training participants consisting of senior and junior teachers. They were very helpful for physics teachers to be able to design a cultural-based physics lesson plan. In this process, junior teachers with little teaching experience can learn to design and implement learning activities from experienced senior physics teachers (Buaraphan, *et al*., 2007; Loughran, *et al.*, 2008; Etkina 2010; Hume & Berry 2011). Description of the physics teachers' ability in designing cultural-based physics lesson plan is described as follows:

Selection and Organizing Teaching Materials of Cultural-based Physics

The components of the selection and organizing the teaching materials of cultural-based physics gets a mean score of 2.5 or is in the good category, defines that the physics teachers were able to choose and organize teaching materials of cultural-based physics quite well. In preparing the materials in teaching, the physics teachers were able to establish the type, depth, and scope of the items that can help students achieve predetermined learning objectives. For example, in the lesson plan of Units and Measurements designed by J3. the purpose of learning to be achieved was

for the students to distinguish the principal amount and derive the quantities, in providing the examples in everyday life, the appropriate teaching materials were: (1) the understanding of units and measurements, (2) the instruments (traditional and modern) for measurement, (3) the procedures for the scientific work steps in experiments of measuring the life span of some local foodstuffs.

J3 explains;

"Units and measurements are the underlying concepts of physics with a series of concepts as written. These concepts are in accordance with the contents of the 2013 curriculum standards and based on my experience, these concepts can make it easier for students to understand both the size and the unit well."

By using a cultural approach, the setting of teaching materials was not only sourced or focused on the contents of the manual as it has been done. Physics teachers were able to adapt by shifting through teaching materials that are appropriate to the learning objectives to be achieved. This also indicates the teachers' maturity in decision-making related to the substance when choosing the essential content that will be taught to the students in the class content (adapting to learning objectives), and the depth of the content that students will learn (Hollon, *et al.*, 1991; Lee, 2014). Most teachers have been able to explore the culture and present it in their learning activities, in accordance with the expectations and objectives of the training to facilitate teachers in integrating culture in physics learning. However, there are a smaller number of teachers, especially junior teachers, who was not being able to adjust to the material of cultural-based physics to the allocated time frame. Those teachers were unqualified to sort out the types of information and knowledge that must have been taught in the learning activities or through another, in the same manner in giving the assignment. Though it can be understood because teachers consider that all the teaching materials that they prepare are intact and important to be conveyed in the learning activities. However, the teaching experience factor is significant in influencing the teachers' ability to organize these teaching materials (Clermont, *et al.*, 1994; Henze, *et al.*, 2008; Park, *et al*., 2010).

Learning Models and Methods

The physics teachers achieved a mean score of 2.5 on the components of the learning method, which means that the teachers were able to choose the model and the learning method well. In fact, most physics teachers chose to use contextual learning models, scientific approaches, and methods of

demonstration, experimentation, discussion and question and answer, but they were not able to describe the steps of the learning model appropriately. The use of a scientific approach to learning activities refers to the current concept of curriculum learning in 2013 which was also in line with the learning objectives of building scientific attitudes and procedural skills through the process of trying, associating and communicating them in writing presentations and reports correctly. The learning method used was the approach of the demonstration, experiment, discussion and question and answer, which was aligned with the contextual learning component of collaborative learning and in making a meaningful relationship in harmony with the scientific approach in component exploring, associating and communicating. There is an alignment among the use of the teaching methods and learning objectives and cultural-based physics materials, indicating that in preparing the learning activities, the teachers must understand the rules of interrelationship between each designed component. The physics teachers' ability choose strategies and learning methods in accordance with the objectives of learning and materials NTT-based physics is based on the understanding that the use of methods or learning strategies intended for learning can really support the achievement of goals to be attained in conforming with the cultural-based materials, simply oriented to the ease of application of learning methods, material completeness, or the student's final grade orientation.

Selection of Learning Resources/ Learning Media

Component selection of learning resources/ learning media obtained an average score of 2.2 or in the category of the least and the lowest when compared to the component selection of teaching materials and components model/learning method. There were some teachers who were able to establish learning resources/cultural-based learning media in tune with the purpose of learning, but some others were not. The inability of teachers to choose learning resources/learning media was seen from some physics teachers who chose the media of learning that is generally without cultural peculiarities. Aspects of conformity assessment of learning resources/learning media with the aim of showing 25% of teachers were not able to establish learning resources/instructional media in consonance with the purpose of learning well, can be seen in the cultural-based lesson plan the physics teachers prepared using learning media in accordance with cultural aspects that

were found and removed in learning activities. For example, in the lesson plan of Units and Measurements, J15 used the learning media in the form of *wati*, *mok*, and *tongka* to measure the volume of several types of local food (rice, green beans, corn grains), which are the objects in the life of the students who are often used in the measurement practice. Furthermore, the use of contextual learning media aims to train students to use measuring instruments properly in accordance with the calculated object in the accuracy of measurements including different measuring objects.

Based on the knowledge and discussion activities during the training, teachers realized the importance of using media in learning activities. The use of appropriate learning media will help students build on what knowledge they are learning. Teachers also recognized that learning media is not necessarily sophisticated but can utilize existing tools and resources in school and student environments, especially in cultural-based physics learning. The teachers used several traditional measuring instruments like *wati, mok, cewak* as a learning media of Units and Measurements, assigning students to observe traditional games such as *kelakoti* and *enene* for learning the topic of rotational dynamics and equilibrium of rigid bodies. In developing the cultural-based lesson plan culture, there is a process of transforming scientific knowledge into knowledge taught based on a complete analysis of content, pedagogical, and cultural aspects. The transformation process aims to make it easier for students to study physics (Tiberghien, *et al.*, 2009; Del Carmen, *et al.*, 2015).

Physics Teachers' Ability Profile in Peer Teaching

The assessment of teachers' peer teaching aimed to see whether teachers were able to implement a pre-designed cultural lesson plan. Peer teaching is the end of each cycle. There were five teachers who taught the same material by integrating culture, according to the results of group identification and discussion. Implementation of peer teaching was observed by two observers with an assessment the implementation of learning of cultural-based physics by teachers was; (1) very poor, (2) poor, (3) good, (4) very good. The average presentation of the peer teaching assessment results was 2.6 of the maximum score of 4, or it can be concluded that the teachers were able to carry out the activities of learning the cultural-based physics well. The details of the peer teaching peer-based assessment results of cultural-based physics by teachers can be seen in Table 2

Table 2. Peer Teaching Assessment Results

	N	Minimum	Maximum	Mean	
	Statistic	Statistic	Statistic	Statistic	Std. Error
Teaching materials implementation	20	2	4	2.80	0.36
Learning models and methods	20	1	4	2.70	0.55
Learning resources/media	20	1	4	2.30	0.28
Valid N (listwise)	20				

The teachers factor is one of the input variables that are very influential on the achievement of learning quality. The learning process will show the high quality if supported by all input readiness, including maximum teacher performance in teaching and learning activities. Sudjana (2002) in his research showed that 76.6% of student learning outcomes were influenced by teacher performance, with details: (1) the competence of the teaching, the teacher contributes 32.43%, (2) the mastery of the subject matter contributes 32.38%, and (3) the teachers' attitude towards the subjects contributes 8.60%. To see the suitability between cultural-based lesson plan and peer teaching implementation, the following will describe peer teaching assessment results based on each component of cultural-based physics learning.

Implementation of Teaching Materials of Cultural-based Physics

The average score on this component was 2.8 or the teachers were able to apply the teaching materials of cultural-based physics well. Components of the implementation of this teaching material were applied to the core learning activities and it was seen that teachers were able to carry out the learning in a row, were able to carry out contextual learning with cultural context, and were able to demonstrate skills in the use of learning resources and culture of NTT. For example, peer teaching topic Newton's Laws by S8. In the lesson plan, S8 chose *Pogo ngadhu* traditional ceremony, which is the traditional ceremony to take and bring a large log to be plugged in the middle of indigenous villages, and this custom ritual was also explained in peer teaching implementation by S8. *Ngadhu* or logs area symbol of the unity Ngadha cultural group. S8 asked the students to recite the habits of *gotong royong* in traditional ceremonies, and then explained *Pogo ngadhu* as the application of Newton's Law II concept. Teaching materials applied by teachers of S8 were also been in accordance with the purpose of learning, that was why students can explain Newton's second law and can explain the concept of Newton II law through an experiment. Overall, the teaching materials that

teachers apply to peer teaching are in congruence with the teaching materials developed in the lesson plan, and the teaching materials are not only sourced or focused on the contents of the manual as it has been done. Most teachers have been able to apply teaching materials that are appropriate to the learning objectives to be achieved and this ability indicates the maturity of the teachers in the decision-making related to the content or what will be taught to the student, that is choosing the essential content that will be taught in the class, with learning objectives), and the depth of content that students will learn (Hollon, *et al.*, 1991).

Cultural-based Learning Model and Method

The average score reached was 2.7, which means that the teachers were able to apply the model and the method of learning well. Most teachers chose a contextual learning model which was applied in peer teaching. Implementation of contextual learning model with scientific approach, as well as demonstration method, experiment, discussion and question and answer, in accordance with the concept of cultural-based learning with elemental exploration/cultural examples or the use of real problems in learning activities. The ability of teachers to apply models and learning methods in accordance with the objectives of learning and materials NTT-based physics is based on the understanding that the use of methods or learning strategies intended for learning can really support the achievement of goals to be attained in harmony with the material of cultural-based physics, simply oriented to the ease of application of learning methods, material completeness, or the students' final grade orientation. In applying the contextual learning model to all learning activities, teachers show mastery of subject matter and class, able to relate to the material with other relevant knowledge, mastering class, able to carry out contextual learning with cultural context, and able to foster student's enthusiasm in learning.

Utilization of Learning Resources/Learning Media

The component got an average score of 2.3; the use of learning resources/learning media by teachers was not good, there was 55% of teachers who did not utilize the media learning, especially media-based culture with good learning. In the learning resource component or learning media used, the teachers used traditional media or tools. For example, S2 used *Sasando* musical instrument and bamboo flute to explain Phenomenon of String and Organ Pipe. However, musical instruments and other traditional tools, showed only to

students, were not used as learning aids, but as the function of instructional media. Teachers only used learning resources/learning media that were in general (not containing cultural elements). The teachers actually already had the ability to choose the source of learning/learning media in compliance with the material of cultural-based physics but were not be able to function these traditional tools as a medium of learning. This may be because the teacher was not accustomed to in using traditional tools in the learning activities. The teacher rarely uses the learning media in the classroom, or the teacher does not have the ability to perform the form of interaction other than question and answer with the students. Based on knowledge and discussion activities during the training, teachers realized the importance of using media in learning activities. The use of appropriate learning media will help students build on what information they are learning. Teachers are already aware of the role of the media and that teachers can take advantage of existing tools and resources in school and student environments, especially in the learning of cultural-based physics, but the habitual factors made teachers have not been able to utilize cultural-based learning media.

There are several obstacles experienced by teachers during peer teaching. The time allocation, according to the several teachers becomes one of the obstacles in the implementation of the learning of cultural-based physics. In addition, the traditional teaching practice habits of teachers who are more likely to transfer material content affect their performance in peer teaching that emphasizes modern learning practices. This condition provides an illustration that teachers understand theoretically correct teaching practices and the presentation of learning with cultural integration, but the habits that have been running affect their actions in peer teaching as one of the outputs of training activities. Furthermore, there are some things that become indications for the implementation of this peer teaching. One of them is the small number of teachers who appear in peer teaching activities not in agreement with the signs of the application of learning activities, such as preparing tools and learning media that support learning activities, doing the opening activities well, mastering the materials well, identifying and integrating culture appropriately, and carrying out reflection and following-up exercises at the end of the learning activities. The least significant aspect of the assessment of teachers in peer teaching activities is the lack of the

teachers' action in linking the material with other relevant knowledge and follow-up efforts in providing direction, activities, or tasks as remedial/enrichment. In general, teachers performed well or it proves that the education and training activities have a positive effect on the teachers' content and pedagogical knowledge.

The Relationship Between The Physics Teachers' Ability in Planning and Implementing Cultural-based Physics Learning

The output analysis of the relationship between the teachers' ability in designing lesson plan and implementing peer teaching shows that the correlation coefficient value is 0.67 which indicates a strong positive relationship between the teachers' ability in designing and implementing cultural-based physics instruction. The correlation coefficient value is positive or it means the higher the teachers' ability to design the lesson plan, the higher teachers' ability to perform peer teaching.

Table 3. The Correlation of Teachers' Ability in Designing and Implementing Cultural-based Physics Learning

		Lesson Plan	Peer Teaching
Lesson Plan	Pearson Correlation	1	0.67**
	Sig. (2-tailed)		0.001
	N	20	20
Peer Teaching	Pearson Correlation	0.67**	1
	Sig. (2-tailed)	0.001	
	N	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

In general (65%) teachers' ability in performing the peer teaching is better than designing the lesson plan. When teachers doing their teaching, they are better able to develop knowledge and teaching skills. Itis assumed that the more detailed and strategic the planning, the more it will reduce uncertainty, increase efficiency, and support implementation (Hopkins & MacGilchrist, 1998; Bell, 2002). Despite the difficulties of learning implementation, the teachers who adjusted themselves to the class, students and ongoing activities, changed the mission as it unfolded, and then summarized it as if fully completed. Based on the reaserch finding, the education and training activities by integrating culture in physics learning activities responded very well, so that in the group discussion in every cycle, the teachers were able to identify the culture according to the content of the material and applied it very well in the peer teaching activity. The cultural-based physics learning is the creation and implementation of purposefully

developed plans for the teaching of contextually physics content, so it is what teachers often concisely refer to as planning and teaching/implementing. With cultural-based physics being the content of what is taught along with an overall process of how that cultural-based physics is to be taught, and the learning process being the more detailed plans and the way those plans are implemented.

CONCLUSION

The proper lesson plan is essential to the process of learning although the development of interesting lessons takes a great deal of teachers' time and effort. But it is also important to comprehend that the best planned lesson is worthless if interesting delivery procedures, along with good classroom management techniques, are not in evidence. The assessment of the physics teachers' ability in designing cultural-based physics learning and peer teaching is the impact of participatory training activities with the NTT cultural approach. The results showed the average value of teacher training participants' ability to design culture based physics lesson plan in the category was quite well. Teachers were able to establish the type, depth, and scope of the material that can help students achieve predetermined learning objectives. The average value of teacher training participants' ability in implementing cultural-based physics learning was in good enough category. Teachers were fit to carry out the learning, the contextual learning with cultural context, and the demonstrated skills in the use of the learning resources and culture of NTT. Most teachers apply contextual learning models with scientific approaches, as well as demonstration, experimentation, discussion and question and answer methods, in accordance with the concept of cultural-based physics learning with elemental exploration/cultural examples or the use of real problems in physics learning activities.

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