Analysis of Traditional Technology as a Learning Source for Physics

Arif Maftukhin, Mundilarto, Heru Kuswanto

Abstract: This study aims to: (1) produce an analysis of traditional technology as a learning source for integrated physics technological pedagogical content knowledge of prospective teachers and physics teachers, (2) obtaining information on the feasibility of the practicum model of a physics laboratory based on traditional technology blacksmith can increase understanding of local potential as well as improve understanding of physics concepts, (3) produce a practicum model of traditional laboratory technology based on traditional technology blacksmith which effectively increases understanding of local potential and improves understanding of physics concepts in high school. This research uses research and development. The product developed in this study is a physics laboratory-based practicum model based on traditional technology. The research design model in this study was adapted from the ADDIE development model. The development has the following steps. Analysis,Design, Development, Implementation, Evaluation. The results showed that traditional technology could be used as a source of learning physics by developing a practicum model of a physics laboratory based on traditional technology. Validation of feasibility of practicum models by media experts and learning experts obtained overall values of 3, 36 with good categories so that the developed models were feasible to use and reliability tests showed a percentage agreement of 96%, so the data obtained was reliable. In addition, the practicum model of a physics laboratory based on traditional technology can improve the ability to understand students' physics concepts and understanding local potential.

Keyword: Blacksmith, Learning Source, Physics Concept.

I. INTRODUCTION

Supporting physics learning in schools still has several obstacles including the unavailability of physics laboratories, the limited learning resources of students, the unavailability of practicum tools that are adequate in remote private schools, lack of practicum time, and even schools that do not do lab work, management and utilization of laboratories that have not meet the standards. This will certainly affect the students' understanding of the concept. Some schools observed by researchers have trends such as the above and from their students in understanding their physical concepts are still low even some have experienced misconceptions. Lack of innovation in learning and learning implements specific pedagogies to teach physical concepts by considering the characteristics of the concept and the right pedagogy as the implementation of Technological Pedagogical Content Knowledge (TPCK) [1][2]. In this study, physics learning relates both local potential and traditional technology in a region's society as a source of learning physics. So that students are able to understand the local potential of the area and utilize this potential as a learning resource [3][4][5].

The exploration of local potential as a learning resource needs to be done [3], local potential is an expression of the interaction of sustainable community groups. Local wisdom is a natural source of the creation of art, culture, and human resources that are characteristic of a particular region [6][7].

The science education policy has several important issues. Fensham [8] states that there are 11 important issues in science education policy. Issues relating to government policy 3 issues, 1 issue related to students and their background, and 7 issues related to teacher quality. Issues related to teacher quality are: (1) how technology relates to science in education (ways to link technology with science education), (2) the nature of science and inquiry (the nature of science and inquiry), (3) quality of learning in science (the quality of science learning), (4) the use of ICT in science and technology education (the use of ICT in science learning), (5) the development of relevant and effective assessment in science education (the development of appropriate and effective assessments for science education), (6) science of education in the primary or elementary years (science education starting from elementary school), (7) professional development of science teachers (increasing teacher professionalism). The issue of how to link technology with science education, the nature of science and inquiry in order to improve the quality of science learning and the role of professional teachers are factors that determine success in science learning.

Physics is one of the branches of Natural Sciences, which studies natural phenomena. Physics is a subject that contains subject matter in the form of theoretical and practical activities. Theory in Physics subjects includes conceptual material accompanied by equations and practical mathematical calculations presented to students. Whereas Physics practicum activities, students are introduced to laboratory tools related to physics theory [9].

The unavailability of laboratories, practicum tools, lack of laboratory time and laboratory management that is not optimal has led to a lack of understanding of the concept and misconceptions need to be given a solution. There are still schools that have laboratories but have not been able to carry out practicum optimally and have not carried out laboratory management properly so that student practicum activities are not carried out, laboratory equipment is poorly maintained, neglected and damaged unused as well as a lack of learning innovation and learning have not utilized traditional technology as a source study physics. In learning

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and teaching, innovation is needed by linking technology, local wisdom, culture to foster student character and preserve local potential [10][11][12].

Physics learning in high school has not linked local potential or traditional technology that is in the community of a region as a source of learning physics. So that students are unable to understand the local potential and traditional technology of their region and cannot explore this potential as a learning resource.Students of physics teacher / teacher candidates should not depend on existing learning resources; physics teachers will have to always innovate both about methods and learning resources. In this study, it is expected that prospective teachers can explore traditional technology as a source of learning physics. Teachers in physics learning should be able to implement three components of learning resources namely technology, pedagogy, and content or TPACK[13].

Research on mobile learning physics of local culture to improve the ability of verbal representation and diagrams to develop mobile physics learning based on local culture. alternative physics learning that is easily accessible and portable to facilitate student physics [5]. Research on the Development of Outdoor Learning Models through Local Wisdom Based Projects in Physics Learning, in this study, developed an outdoor learning model through wisdom-based projects in physics learning consisting of initial analysis, student analysis, concept analysis, task analysis, and formulation / specification of objectives learning. This study produced a syllabus, guidance on the use of models, teaching materials, and tests of cognitive learning outcomes, which were adjusted to the characteristics of the model, namely local wisdom-based [14]. Research on TPACK in Physics Classes: A Case Study of Preservice Physics Teachers. In this study described the knowledge of pedagogical content technology (TPACK) is considered as an important framework for promoting instructional competence of 21st century teachers. Technology-based learning environments have become commonplace in teaching practice to build a more effective approach to student learning. this study presents the results of their study on the physics learning of high school students which shows the impact of their design teaching methods on physics-specific content knowledge. In the end, this research put forward considerations and challenges regarding the preparation of physics teachers [1][2].

II. METHOD

The study aimed to produce an analysis of traditional technology as a learning resource for integrated physics technological pedagogical content knowledge of prospective teacher and physics teacher students, produce a practicum model of physics laboratory based on traditional blacksmith technology that is feasible to increase understanding of the local potential and improve understanding of physics concepts in high school.This research uses research and development. The product developed in this study is a physics laboratory-based practicum model based on traditional technology. The research design model in this study was adapted from the ADDIE [15][16]. The development has the following steps:Analysis, Design, Development, implementation, and Evaluation.

In the defining step, conduct observation and analysis. Observation of traditional technology at the museum of Tosan Aji Purworejo, observation of iron works at Suren Purworejo and Banyumas, as well as learning observations at senior high school Ma arif Cilongok. The analysis includes concept analysis, student analysis, analysis of learning and analysis of tasks performed to obtain information for making media, lab worksheets, lesson plans, and research implementation. Data collection techniques using observation and unstructured interviews [17][18][19].

At the development stage, validation and development tests were carried out. The validation process is assessed by media experts and learning experts. Validation by experts is done by filling out a validation sheet. Meanwhile, development tests are carried out on students through limited trials. In this step, it is possible to understand the student's response to the media. After the media is declared valid, then the implementation step is carried out. Implementation steps are carried out through product trials.

Study participants for limited trials consist of 7 students. Then, after a limited trial, extensive tests were conducted with participants divided into two groups; the treatment group and the non-treatment group. Each group was observed and given a pre-test and post-test. This research was designed into two classes; experimental class and control class. The experimental class uses a physical laboratory media based on traditional technology blacksmith. Control class using PowerPoint media, and displayed via LCD. Subjects from the experimental class were 24 students. Meanwhile, the control class subject is 20 students.

III. RESULT

The results of this study describe the results of validation in the form of practicum media and practical modules based on traditional technology integrated physical TPACK and practical validation, model implementation. Feasibility validation of practicum models by 1 material expert and 3 learning media experts obtained overall values of 3, 36 with good categories so that the traditional technology-based physics laboratory practicum model developed was feasible to use and reliability testing showed 96% precentage agreement, so the data obtained was reliable.

Knowledge of content, pedagogical knowledge, and technological knowledge integrated into the physics learning process as outlined in the learning plan based on expert recommendations of learning and evaluation material explains that pedagogical content knowledge and knowledge appear in learning planning and can be implemented. Mastery of content knowledge will influence pedagogical knowledge, selection of strategies or methods of learning is largely determined by the structure of the material to be studied. Content knowledge greatly influences the right technology knowledge to be integrated into physics learning. Technological knowledge requires time and special training for prospective teacher students to be able to use traditional technology in

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blacksmithing in the practical process. The TPACK element in mutual support learning can improve the quality of learning, deep content, process skills involving teachers, students in the use of traditional media technology.

Pedagogical knowledge is a good category. Physics teachers present material in accordance with basic competencies and learning objectives. The teacher conveys competencies and learning plans. The introductory material is delivered physically, mathematically, systematically by taking into account the concept, the use of quantities, units and symbols correctly. Teacher uses language that is easy to understand. Knowledge of pedagogy is very important in conveying material content.

Technology knowledge is a good category. It can be seen that the teacher has been able to integrate traditional technology to explore physical concepts. The link between knowledge of content and pedagogy strongly supports students' ability to master concepts. Knowledge of traditional technology content and knowledge can support students' ability to apply physics concepts with technology. Knowledge of technology and pedagogical knowledge is needed to complete temperature and heat material. The connection between TPACK supports each other to improve the mastery of content, pedagogical abilities and the use of technology in the learning process [20][21].

The response of physics teachers and prospective teacher students to the preparation of learning tools and the implementation of traditional technology-based physics laboratory practicum models TPACK integrated iron court is in a good category. Responses about models are very important to improve content knowledge systematically and deeply, pedagogical knowledge by applying various teaching skills and technological knowledge to be integrated into the physics learning process.

Related to Technology Traditional, Physics Concepts,Source Learning

Traditional technology is a technique that utilizes original traditional methods that often come from ethnic / cultural. Including methods that are practiced as trade or handicraft, often produced in limited quantities. Local potential is a regional potential to be a product or service that is valuable and can increase regional income and is unique and has a competitive advantage [7] [22].

Blacksmith

Pande besi or in English we know it with the term blacksmith. Blacksmith is the process of making agricultural tools or other tools that are made of iron in a way that is spiced to produce goods with high efficiency. The items produced are: sickle, hoe, crowbar, ax, machete, knife, etc. in this iron industry, consisting of 1 master and 2 people or more, the master is the person who works to hold iron which will be formed at once set the part that must be forged to become a tool shape as desired. Whereas *panjak* is the person, who works hitting or forging iron that will be made earlier. This iron casting depends on the direction of the master. You could say this master is a designer in iron. But at present the existence of the iron industry has begun to fade, this is because there has been modern equipment made by large factories. Over time, the iron industry became a rare industry, and we rarely see it again.

Physics Laboratory based on traditional technology

Traditional technology-based Physics Laboratory is the development of a practicum model of a physics laboratory that is designed with tools that are adopted from traditional technology tools made of portable iron, modified to be more practical and efficient. With the tools of traditional technology, the hope can be used for practicum so that students can observe, practice, evaluate and analyze, construct concepts and better understand the concept of physics during the learning process. Laboratory equipment is placed in a practical box that can be transported using a car or motorcycle to reach the school location. In research based on local potential and constructivism tools and materials are associated with the local potential of an area. Figure 1(a) Traditional technology from the observations of the Tosan Aji Museum in Purworejo, figure 1 (b) observations of the blacksmith village of Panembangan, Banyumas, Figure 1 (c) which was developed into a practical laboratory media based on traditional technology.

(a) (b) (c)

Fig. 1 Traditional Technology Blacksmith

Preparation before the traditional technology-based physics laboratory practicum activities through several stages (1) Conduct observations related to laboratory facilities at the school of research purposes, (2) Determine the location of the school, (3) Determine the type of practicum, the number of students participating in the practicum, and practicum time, (4) Implementation of traditional technology-based practicum to determine the feasibility of physical practicum, (5) Reflection, from the hypothesis with the results of the practicum, and (6) Integration, linking between concepts obtained,Synthesis

Agricultural Equipment Making Process (Sickle)

The process of making sabit (sickle) iron craft Suren Kutoarjo In carrying out the work of blacksmith requires a variety of equipment and materials, in the area of iron work there are many tools and materials, each tool and material is specially designed in accordance with their functions. Traditional crescent making:

(a) Equipment

The tools used by blacksmiths are the furnace (*prapen*), forging pads (*paron*), air pumps (*ubub*), clamps, hollow tools, hand grinding, hammer, sledgehammer, grinding machines, carving knives in

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various shapes and sizes, and pool cooler (*siblon*).

(b) Material

The materials used in making agricultural tools consist of 2 types, namely: main raw materials, additional raw materials.

- Main raw materials: iron, used steel rails, used steel per car, round steel, used steel plates, and steel bones.
- Additional raw materials: wood, charcoal, varnish, wood sandpaper, and paint.

(c) Process

Material in the form of iron or steel is put into furnaceand then heated to a temperature of 1000^0C (± 10 minutes), then forged by 4 people, one is responsible for pumping air, one is responsible for holding iron and directing iron, 2 people are in charge forge alternately until the shape of the iron changes, and if the iron temperature decreases marked by red which starts to fade iron is put back into combustion with time (± 10 minutes), then the iron is forged again to be formed again, after that the iron is reheated with time (±8 minutes), then formed according to plan with the tool until flat, after the iron forms a sickle then dip it into the cooling pool. After the iron was cold, the craftsmen carried out another task, namely the process of finishing the crescent making. This process aims to beautify the shape and sharpen it. In the past the equipment used was held manually, but now uses an electric grinder.

Benefits in the process of learning Physics

(a) Measurement

The process of making agricultural equipment using traditional technology can be used as a measurement practice; students can measure iron diameter, iron thickness, iron length, mass, volume, time and temperature.

(b) When iron is heated, students can observe and study the heat transfer process[23], [24].
   1. Radiation, students can feel heat when near furnace without direct contact with fire.
   2. Heat transfer through conduction will occur when students burn one end of the iron then the other end will feel hot because of the heat transfer in the iron.
   3. Convection of heat transfer by observing the process of boiling water in a pan over furnace.

(c) When the process of forging students can learn impulses and momentum is the quantity possessed by moving objects or particles. Impulse is the occurrence of work style in a very short time.

(d) After the wrought iron will turn into a thin shape like a metal plate. students can learn Hooke's law in this process, when elastic objects are treated outside their elasticity limits, the object will not return to its original form.

(e) After the formation process is complete, the sickle is then dipped into cooling pool in this process there is heat transfer, where the sickle dipped in cooling pool will be cold, students can learn thermal equilibrium, The zeroth law of thermodynamics and the Black principle.

IV. CONCLUSION

Based on the results of the discussion, the physics teacher and prospective teacher students on the preparation of learning tools and the implementation of the traditional technology-based physics laboratory practical model TPACK integrated blacksmith is in a good category. Responses about models are very important to improve content knowledge systematically and deeply, pedagogical knowledge by applying various teaching skills and technological knowledge to be integrated in the physics learning process.

REFERENCES

1. N. Srisaswadi, “The Role of TPACK in Physics Classroom: Case Studies of Preservice Physics Teachers - ScienceDirect,” 2012. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S187704281201779X. [Accessed: 19-Oct-2018].
2. A. Bertram and J. Loughran, “Science Teachers’ Views on CoRes and PaP-eRs as a Framework for Articulating and Developing Pedagogical Content Knowledge,” *Res Sci Educ*, vol. 42, no. 6, pp. 1027–1047, Dec. 2012.
3. I. Meliono, “Understanding the Nusantara Thought and Local Wisdom as an Aspect of the Indonesian Education,” *TAWARIKH*, vol. 2, no. 2, Mar. 2016.
4. R. Mungmachon, “Knowledge and Local Wisdom: Community Treasure,” 2012.
5. C. Vita and H. Kuswanto, “Physics mobile learning of local culture (fiddle) to improve the verbal and diagram representation competence | International Journal of Current Research,” 2018. [Online]. Available: http://www.journalcra.com/article/physics-mobile-learning-local-culture-fiddle-improve-verbal-and-diagram-representation-compe. [Accessed: 19-Oct-2018].
6. D. Das, M. Roy, and T. Basak, “Studies on natural convection within enclosures of various (non-square) shapes – A review,” *International Journal of Heat and Mass Transfer*, vol. 106, pp. 356–406, Mar. 2017.
7. N. G. Lederman, “Students’ and teachers’ conceptions of the nature of science: A review of the research,” *Journal of Research in Science Teaching*, vol. 29, no. 4, pp. 331–359, Apr. 1992.
8. P. J. Fensham, *Science Education Policy-making: Eleven Emerging Issues*. UNESCO, 2008.
9. “A technological acceptance of remote laboratory in chemistry education.” [Online]. Available: https://www.eduhk.hk/apfslt/v18_issue2/leett/page5.htm. [Accessed: 24-Oct-2018].
10. L. Novitasari and J. Handhika, “Fisika, Etnosains, dan Kearifan Lokal dalam Pembelajaran Sains,” *Prosiding Seminar Nasional Pendidikan Fisika*, 2017.
11. R. A. Fasasi, “Effects of ethnoscience instruction, school location, and parental educational status on learners’ attitude towards science,” *International Journal of Science Education*, vol. 39, no. 5, pp. 548–564, Mar. 2017.
12. S. Hariyadi, K. Fikri, and A. Fatahillah, “Integrasi Nilai-nilai Kearifan Lokal pada Pembelajaran IPA Berbasis Lingkungan di Sekolah-sekolah Wilayah Perkebunan Kopi Kalibaru,” 2016.
13. A. Pamungkas, B. Subali, and S. Linuwih, “Implementasi model pembelajaran IPA berbasis kearifan lokal untuk meningkatkan kreativitas dan hasil belajar siswa | Pamungkas | Jurnal Inovasi Pendidikan IPA,” 2013. [Online]. Available: https://journal.uny.ac.id/index.php/jipi/article/view/14562/0. [Accessed: 19-Oct-2018].
14. I. K. P. Damayanti and M. Mundilarto, “Developing Outdoor Learning Via Project Based on Local

Wisdom Model in the Physics Learning," *Jurnal Pendidikan Matematika dan Sains*, vol. 5, no. 2, pp. 114–124, Dec. 2017.

15. E. Mulyatiningsih, "Pengembangan Model Pembelajaran," *Diakses dari http://staff. uny. ac. id/sites/default/files/pengabdian/dra-endang-mulyatiningsih-mpd/7cpengembangan-model-pembelajaran. pdf. pada September*, 2016.
16. N. Aldoobie, "ADDIEModel," *American International Journal of Contemporary Research*, vol. Vol. 5, No. 6, 2105.
17. P. Kanhadilok and M. Watts, "Western Science and Local Thai Wisdom: Using Museum Toys to Develop Bi-Gnosis," *Canadian Journal of Science, Mathematics and Technology Education*, vol. 13, no. 1, pp. 33–48, 2013.
18. E. Ö. Z. YÜ CEL and M. Ö ZKAN, "Analysis of change in the environmental perceptions ofprospective science teachers: A longitudinal study," *Asia - Pacific Forum on Science Learning and Teaching*, 2018.
19. S. Rohadi, "Pengembangan LKS Pembelajaran Fisika SMA Berbasis Fenomena Alam Guna Meningkatkan Pemahaman Konsep Siswa," *RADIASI: Jurnal Berkala Pendidikan Fisika*, vol. 9, no. 2, pp. 1-6–6, Apr. 2017.
20. E. Erdas Kartal, W. W. Cobern, N. Dogan, S. Irez, G. Cakmakci, and Y. Yalaki, "Improving science teachers' nature of science views through an innovative continuing professional development program," *International Journal of STEM Education*, vol. 5, no. 1, p. 30, Jul. 2018.
21. M. van Eijck and W.-M. Roth, "Improving Science Education for Sustainable Development," *PLoS Biol*, vol. 5, no. 12, Dec. 2007.
22. S. Hartini, Misbah, Helda, and D. Dewantara, "The effectiveness of physics learning material based on South Kalimantan local wisdom: AIP Conference Proceedings: Vol 1868, No 1," 2017. [Online]. Available: https://aip.scitation.org/doi/abs/10.1063/1.4995182. [Accessed: 19-Oct-2018].
23. I. P. Canlas, "Color, Temperature and Heat: Exploring UniversityStudents Mental Thoughts," *Universal Journal of Educational Research*, 2016.
24. D. M. Kim and R. Viskanta, "Heat transfer by conduction, natural convection and radiation across a rectangular cellular structure," *International Journal of Heat and Fluid Flow*, vol. 5, no. 4, pp. 205–213, Dec. 1984.

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