Effectivity of Online Learning Teaching Materials Model on Innovation Course of Vocational and Technology Education

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Abstract. In Indonesia, development of education was not faster than technology development (era of revolution industry 4.0), so that combination between education and technology were needed so that both of them could be balance. So that, it needed development of teaching materials on innovation course at Technical Vocational Education and Training (TVET) used Problem Based Learning by online. This study was carried out in TVET Magister Program at Universitas Negeri Padang. The type of study was Research and Development (R&D) and model of study was 4-D model (define, design, develop, disseminate). The instrument was validated by 3 of experts judgment, Aiken's validity result was 0.929 and ICC reability was 0.811. Effectivity result was obtained of gain score, it was 0.774 that was showed from increasing of student outcomes (pretest-posttest). This study produced teaching materials that were effective and appropriate for learning in the revolution industry 4.0 era.

Keywords: Revolution Industry 4.0, Problem Based Learning, Technical Vocational Education and Training, Online Teaching Materials.

1. Introduction
Technology changes the habits of human life in the era of globalization. In the era of industrial revolution 4.0 (RI 4.0), the presence of online motorcycle taxis began to destroy traditional motorcycle taxis [1], and the presence of smartphones began to replace items such as; radio, type recorder, watch, alarm, and camera. This situation has a positive and negative impact on employment [2]. This is a challenge for the world of education, especially higher education. Because there has been a lot of dismissal of work rights and closed companies, and on the one hand new jobs with other types of technology-based jobs arise, for example in the Indonesian Banking Workers Union Communication Network, there have been 50,000 bank employees dismissed due to technological developments [3]. Industry 4.0 has full control over the life cycle of a product [4], and this has an impact on education. Indonesia education in industrial revolution 4.0 has also been felt like the widespread use of learning media to increase interest in learning [5], internet use in Web-based learning, blended learning [6], oneline or distance learning courses [7]. Distance learning is a form of technology utilization in the world of education [6], and this collaboration will advance the world towards the next level [8]. Because digitalization & automation have an impact on increasing productivity, especially in the world of education [4]; [9].

Humans must continue to think and develop themselves in this opportunity, especially in higher education which must be responsive like maximum computer utilization [10].
Graduates who are ready for RI 4.0 must certainly pass a quality learning process [11], technology-based, & completion-oriented problems [12]. One of the collaborations in the world of education with technology is in blended learning such as figure 1.

![Blended learning](image.png)

Figure 1. Blended learning [13]

Seeing this phenomenon, it is possible that someday there will be learning without buildings, but only through computers or Smartphones [12]. The Faculty of Engineering, Universitas Negeri Padang (FT UNP) realizes this is a challenge because technology is its consumption every day (theory and practice). Vocational technology education program (PTK) or PTK FT UNP study program must continue to innovate in order to survive in the era of RI 4.0, because in fact not all students can focus and concentrate in learning. In the 2018/2019 odd semester PTK innovation course, only 4-6 people participated in group discussions in the class, and not yet optimally utilized technology (e-learning, blogs, youtube, and others). Then the desire arises to innovate in making teaching materials relevant to the development of RI 4.0 technology that can improve the quality of graduates who are ready to face every challenge in modern times.

2. Theory

2.1. Teaching materials
Interesting teaching materials will make the learning process fun, informative and effective [14]. Teaching materials are a set of information and tools arranged systematically, containing competencies that must be mastered by students, and can be learned by students, such as; books, modules, games, videos and more [15].

2.2. Problem Based Learning
Problem Based Learning (PBL) is a learning approach using real problems as a context with an orientation to learning about critical thinking and problem solving skills, and to obtain essential knowledge from subject matter. There are five core characteristics of PBL, namely: 1) the use of problems as the beginning of the learning process, 2) group collaborative learning, 3) Student oriented, 4) teachers as mentors, 5) time allocation for independent learning. [16]; [17].
2.3. **Learning in the network**

Computer and network based learning (CNBL) is a learning model utilizing web and internet technology [18]. There are three functions of the CNBL for learning activities in the classroom, namely as supplements that are optional, complementary, or substitute [19]. Even CNBL can help solve problems more deeply [20].

3. **Research Method**

This Research & Development (R & D) research uses a 4-D model (model Four D; define, design, develop, and disseminate) [21]. To be clearer about the steps of the activity, it can be seen in Figure 2.

![Figure 2. Flow of the 4-D Research Model](image)

4. **Validity & Reliability**

Validation of teaching materials using inter-rater or variance analysis techniques based on the inter-rater reliability index (Intraclass Correlation Coefficient or ICC), where a product can be said to be reliable if it has a minimum reliability coefficient of 0.7 [22]; [23]. Azwar states that validity comes from the word validity which means the accuracy and accuracy of a measuring instrument/instrument in carrying out its measuring function. A product has high validity if the tool runs the measuring function according to what is measured [24].

Test the content validity is done by looking at the content validity coefficient (content validity coefficient) -Aiken's V with numbers 0 to 1.00. The results of the validity analysis with the technique of the Aiken's V expert content validity coefficient are 0.929 and the inter rater reliability (ICC) expert is 0.811. This shows that the instructional materials innovation products are valid and reliable. This means that the development of teaching materials is valid and reliable to be used by lecturers as teaching materials for PTK innovation courses using PBL.

| Table 1. Recapitulation of Results of Material Innovation Coefficient Validity Analysis Teach Aiken’s V Expert and Reliability of ICC Expert |
|---------------------------------------------------------------|
| **Validator** | **Coefficient** | **Classification** |
| Validitas Aiken’s V (Expert Judgement) | 0.929 | Valid |
| Reliabilitas ICC (Expert Judgement) | 0.811 | Reliable |
5. Result and Discussion

5.1. Effectiveness Test Results
This teaching material is declared effective (with a Gain Score = 0.774). This can be seen from the increasing student learning outcomes. Besides that, there is also a significant increase in the process of a more lively discussion and more essential arguments. These results can be seen in Table 5 and a significant increase in Figure 3.

| Table 2. Pretest and Posttest Evaluation Results |
|--------------------------------------------------|
| Result                                           |
| Value                                           |
| Pretest                                         |
| Posttest                                        |
| 1370.5                                          |
| 2012.8                                          |

The Mean Value or Score

62.3
91.5

5.2. Discussion
RI demands 4.0 that must be possessed by students namely being able to think critically, creatively, communicatively, and collaboratively. One right for that is the PBL learning model. The PTK innovation course that links many problems is very appropriate to use the PBL learning model. This PTK innovation course is the culmination of a postgraduate program lecture before the thesis, because this lecture leads to the latest innovations related to all aspects of education, especially PTK. It is also related to the design of thesis research that will be carried out by PTK graduate students. In its application, PBL learning models are combined with the development of teaching materials in the form of modules, powerpoints, and learning videos. From the results of the effectiveness test, it is known that this teaching material is very effective in increasing student learning values / results. Another impact, students are more active in discussing and able to argue related to the substance of the topic of learning, and have an impact on the use of technology in accordance with the times, namely using the internet (e-learning UNP). On the other hand, this teaching material is able to answer the challenges of RI 4.0 in terms of forming the character of critical, creative, communicative, and collaborative thinking.
6. Conclusion
The results of this study can be concluded that;

- This teaching material is proven to be valid, & effective as evidenced by expert judgment, easy to understand, improving student learning outcomes with very good grades.
- This teaching material is able to improve student presentation skills, essential arguments, and increase the intensity of the use of technology in learning.
- This teaching material provides convenience to lecturers in learning
- PBL learning model is very appropriate to be applied in PTK innovation courses that play more with problems and problem solving.

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