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A Project Based-Learning Design in 2D and 3D CADD Training with Inventor 2020 for Increasing Teachers' Competence of Machinery Engineering

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Abstract. Teachers with good competency will impact the quality of Education. The teachers' responsibility in educating, teaching, guiding, managing, training, and evaluating must be well-developed so that the results can directly contribute in improving the quality of education because qualified teachers could manifest a highly qualified education. Therefore, some factors that have determinant values need to be considered as necessary to construct qualified teachers. Teachers' competency improvement can be made in various ways, including through the training session. Teacher training aimed to advance the competence of teachers, especially for Machinery Engineering teachers so that they can meet the specified standards. The training model designed in the paper sought to explain 2D and 3D CADD training with the 2020 inventor using the project-based learning model. This paper was expected to be able to manifest the concept of teacher training using Project Based-Learning in training institution so that it can be able to help in improving the teachers' competency

Keywords: Project Based-Learning, CADD Training, Teachers' Competence

INTRODUCTION

The quality of education in our country is still far from what it is expected to be. Therefore work hard is needed by involving all stakeholders in the aims of boosting up the educational system as well as being able to compete in the era of globalization. On that account in educational reform, in which one of the main issues is improving the teachers' professionalism, it is something that must be done to create a higher quality education. Consequently, teachers' professionalism is a prompt necessity along with the increase of fierce competition in the era of globalization currently (Fenwick & Edwards, 2016).

A professional teacher will be able to give a maximum role if she/he has expertise that best match with her/his field and can be proven by competency certification. A professional teacher is not only indicated by their ability to enhance with the technological developments nowadays but also the personalities in communicating with students or others. Professionalism requires seriousness and adequate competency in order to consider a teacher is able to carry out an obligation as an educator (Van, Roeland, & Ellen, 2019). Teachers must have academic qualifications, competencies, teacher certification, physically and mentally well, also have the ability to realize national education goals. Teachers' competencies include pedagogical competencies, personality competencies, professional competencies, and social competencies. These competencies cannot be obtained automatically without going through an effort, like education and training. Either way, if a teacher does not go through the education and training, it will be worried that the competencies cannot be achieved. In the achievement and improvement of teachers' competence, a teacher needs support from various parties, such as from the government, school and especially from the teacher oneself. One way relating to the issue is by carrying out the teacher training to improve teachers' competency. Furthermore, related to the explanation above, this paper is written to explain a project based-learning design in 2D and 3D CADD training with Inventors 2020 in order to improve the competence of machinery engineering teachers. This paper will also explain the design of 2D and 3D CADD training using Inventor 2020 and the implementation of project based-learning training models in 2D and 3D CADD training.

METHODS

This research used review literature to explain the project based-learning design model in 2D and 3D CADD training with inventor 2020 to increase teacher's competence in mechanical engineering. Literature review comes from books and journals both national and international. Data collection techniques were documentation and observation. Furthermore, from the documentation in the form of relevant references, the researcher analyzed it and compared it with observational data made by the researcher for two months at the training center.

RESULTS AND DISCUSSIONS

In this section, researchers divide results and discussions into two, 2D and 3D CADD Training Models Using Inventor 2020 and Implementation of Project Based Learning Training Models in 2D and 3D CADD Training. Next, the following is the explanation.

2D and 3D CADD Training Models Using Inventor 2020

Project based-learning model is a learning process that centers on the process of learning itself, relatively timed, and focuses on the real-world problem by combining the concepts of a number of components both knowledge, discipline or sub-field (Ismuwardani, Nury, & Doyin, 2019). A study states that the results of the project based-learning model is quite useful in designing effective learning. Hence, it is potential enough to fulfill the demands of learning (Rice & Shannon, 2016). The training model conducted by the author uses project based-learning. The training design that was proposed consists of 7 stages; (1) 2D and 3D CADD explanation; (2) 2D project; (3) making 2D images; (4) evaluation; (5) 3D projects; (6) making 2D images into 3D; and (7) Evaluation. The further detail about the design training is shown in Figure 1 in order to get a better understanding relating to the steps of using 2D and 3D CADD training with Inventor 2020.

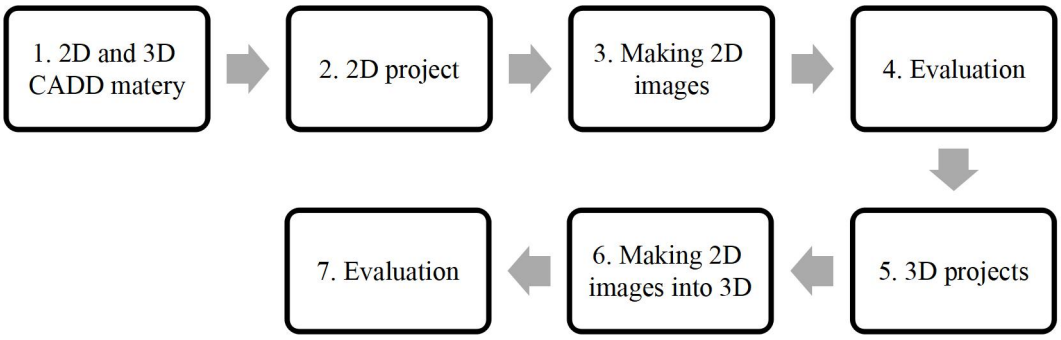

Figure 1. Steps of the Project Based-Learning Model 2D and 3D CADD Using Inventor 2020

Based on Figure 2 about steps of the project based-learning model 2D and 3D CADD using Inventor 2020, the explanation is as follows:

- First, providing the explanation of 2D and 3D CADD training using the 2020 Inventor to the trainees within the specified time.
- Second, the trainees are given a 2D project to work on.
- Third, the trainees make 2D drawing on the 2020 Inventor.
- Fourth, the training instructors evaluate the trainees' 2D drawing on the 2020 Inventor.
- Fifth, the training instructors provide 3D projects to trainees but only to those whose 2D drawing has been accepted and matched with the example given by the instructor.
- Sixth, the trainees draw 3D training using Inventor 2020, the 3D drawing is made using 2D drawing that has been evaluated by the training instructor.
- Last, the training instructors evaluate the results of 3D drawing by trainees.

Implementation of Project Based-Learning Training Models in 2D and 3D CADD Training

Training is a systematic approach in learning and development process that enhance individuals, groups, and organizations (Jha, 2016). Training is needed because the improvement of abilities, knowledge, and skills of talented employees are proven to be a source of a competitive advantage (Ronald, 2006). With training programs, teachers can also get the competencies and skills needed as well as to reduce mistakes that might occur during the teaching process (Dessler, 2005).

The implementation of the project based-learning training model in 2D and 3D CADD training consists of three stages: preparation, implementation and evaluation.

1. The first stage is preparation including; (1) the trainees fill out the registration form (personal identity), it aims to obtain the temporary data from the trainees; (2) the trainees verify the data before the training session begins; (3) the trainees fill in the attendance list; and (4) the trainees fill in the ATK handover data. At this stage the instructors must be more careful in preparing ATKs such as paper and computers that have been installed the 2020 Inventor application.
2. The second stage is the implementation in which the trainees are given an explanation about 2D and 3D inventors within the time of 60 minutes. After that the trainees are given a job sheet in the form of drawing to work on in the form of 2D and 3D for 90 minutes. The instructor accompanies the trainees during the process, so that the trainees can easily ask the instructor if they find some difficulties. In this second stage the instructor must be alert in guiding the trainees who have difficulty doing their jobs.
3. The third stage is training evaluation to provide an assessment from the beginning to the end of the training. The evaluation process involves all instructors. The involvement of all instructors' function to control and provide input to the training that has been completed (Saleh, 2013). There are several scopes of assessment, namely:
   - The suitability of the image construction, this part is measured by several indicators: the suitability of the shape and size of the image/picture view with the specified measurement given, such as the thread shape and the accuracy of the construction of the drawing lines, axes and size lines.
   - Projection rules and cuts in the picture, this part is measured by several indicators: the accuracy of the selection of the main views and other views and conformity of the type of projection with the layout of the view image.
   - The rules for displaying image size, such as functional, non-functional sizes and additional sizes, this part is measured by several indicators: the accuracy of the measured field/part and the values and symbols used, rules for placing numbers/size values, and the accuracy in setting the layout for size.
   - The rules for showing the tolerance of geometry in the image that are tolerance for shape, orientation position and rotate. Then from the assessment the instructor will conduct an evaluation to find out the strengths and weaknesses that must be corrected during the training.

Finally, the implementation of project based-learning design in 2D and 3D CADD training with 2020 Inventors in order to improve the competence of machinery engineering teachers needs to be carried out well and optimal by the instructor. The implementation stages need to be considerably given much attention by the instructor, especially in the preparation phase on which the instructors must provide the material and the computer. On the other hand, the instructor needs to provide comprehensive assistance. While at the evaluation stage, the communication of all instructors involved is very important to provide maximum. The evaluation results that are recommended by researchers are pre-test and post-test.

CONCLUSION

Being able to develop teachers' competencies by holding teacher training using the project based-learning model as described above indicates that. project based-learning models can be used as a reference by training institutions to improve teachers' competency. However, the authors would like to suggest in using the Kirkpatrick model. The Kirkpatrick model consists of 4 stages: reaction, learning, behavior, and result.

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