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Development of Learning Models in Core Competency Practice Courses Department of Mechanical Engineering Education Manado State University

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ABSTRACT

The learning process obtained from universities to develop students' soft skills is also influenced by practical experience in the field. To develop soft skills in students, they have been given theories and practices that support the lessons in higher education, so that students have experience that can be used as a basis when entering the world of work. This research aims to develop a practical learning model in the Department of Mechanical Engineering Education, Manado State University. This research is developing research to develop a practical learning model. The online practice development model uses six interactions, namely interactions between students and lecturers, students with material, lecturers with material, students with students, lecturers with other lecturers, and material with material, through synchronous/asynchronous media. The results of this research show that the product developed is very suitable to be implemented to support online practical learning for core courses in higher education. This research has produced an online learning model for core subject practice with a flexible blended learning strategy at a low cost for students of the Mechanical Engineering Education Study Program. The resulting conclusion is that this model has the advantage of being able to create an online collaborative work environment. Validation by experts is carried out qualitatively and quantitatively.

Keywords: Development, Learning Models, Core Competency, Practice Courses, Mechanical Engineering Education, University

INTRODUCTION

The educational process is a change in a person's knowledge, skills, and attitudes, so education should produce outcomes with proportional abilities between hard skills and soft skills. Many lecturers have the perception that students who have good competence are those who have high exam or test scores. The learning process obtained from universities to develop students' soft skills is also influenced by practical experience in the field. To develop soft skills in students, they have been given theories and practices that support the lessons in higher education, so that students have experience that can be used as a basis when entering the world of work later. This experience can be obtained from practical courses (subjects) Automotive Electrical, Motorcycles and Small Motorcycles, Plate and Forging Work, Car Air Conditioning, Gasoline Motor Technology, Diesel Motor Technology, Painting Technology, Welding, Machining, Chassis Technology, and Field Work.

The implementation of practical learning that has occurred is that there is still a lack of practical tools and materials in the laboratory or workshops so students have to take turns using existing tools or materials, there is a lack of implementation of practical learning by lecturers, and standard operating procedures for practical procedures have not been carried out properly by lecturers. For practical course students, the lecturer's learning model is still offline and has not implemented online learning. During the COVID-19 pandemic, it has demanded a practical learning system without direct face-to-face interaction between lecturers and students but carried out online using the internet network. Lecturers must ensure that teaching and learning activities continue, even though students are at home. The solution is that lecturers are required to be able to design practical learning models as innovation by utilizing online media.

Following the Minister of Education and Culture of the Republic of Indonesia regarding Circular Letter Number 4 of 2020 concerning the Implementation of Education Policies in the Emergency Period for the Spread of Corona Virus Disease (COVID-19). The practical learning system is implemented via a computer or laptop device connected to an internet network connection. Lecturers can carry out practical learning together at the same time using groups on social media such as WhatsApp (WA), Telegram, Instagram, the Team Viewer application, or other media as learning media. In this way, lecturers can ensure that students take part in practical learning at the same time, even in different places.

In this research and development, what was carried out was: (1) developing an online practical learning model, and (2) knowing the effectiveness of the learning model. It is hoped that the results of this development research can be used to overcome students' practical learning problems. Competencies in this development research include cognitive, affective, and psychomotor aspects.

The main problems identified from the results of survey observations and interviews with the head of the education department found that practicum learning implementers still had many shortcomings in terms of lack of tools and materials, lack of implementation of learning by lecturers, operational standards of practical procedures not yet implemented by practical course lecturers and lecturer learning models. is still offline and has not implemented online learning.

The research objective is to develop a practical learning model in the Department of Mechanical Engineering Education, at Manado State University. Specifically, the objectives of this research are to produce a flexible and low-cost practical learning model for core courses in the Mechanical Engineering Education Department, to determine the feasibility of the model developed, to produce practical learning tools from the model developed, to find out the feasibility of the practical learning tools developed, and to know the effectiveness of the practical learning model developed. The expected product specifications are: The practical model development model for core competency practice courses majoring in mechanical engineering education in the form of an online-based practical learning model is one of the practical learning media for core competency practice courses majoring in mechanical engineering education. The practical learning model for core competency practical courses in the mechanical engineering education department is an online-based practical learning model with a presentation that is more interesting, easy to understand, and practical for students to use. The practical learning model for core competency practical courses in the mechanical engineering education department is an online-based practical learning model that can be used anytime and anywhere.

METHODS

Development style

This research is an attempt to solve educational problems, especially practical learning through product development. This product development was carried out using the model previously used by Anderson (2008). This development model views that an online learning model can be described as an interaction between learning components. In online practical learning, there are six interactions, namely interactions between students and lecturers, students with material, lecturers with material, students with students, lecturers with other lecturers, and material with material, through synchronous/asynchronous media. Through Anderson's development model, the structure of the model and the interactions between its components were prepared to form an online practical learning system for practice in the Welding Practice course in the Mechanical Engineering Education study program at the Faculty of Engineering, Manado State University, undergraduate program.

Development Procedure

The choice of development procedures is very important, considering that the product being developed will be widely used in the learning process, especially in practical activities. Therefore, the development procedure needs to involve various scientific trials that will be used to validate and at the same time ensure the learning effect on product use and the perceptions of its users, namely students and lecturers/instructors. This research uses development research procedures from Borg & Gall (1983).

The development of this practical learning product begins with conducting research or preliminary studies through literature reviews and the latest products of practical learning that have been developed in various universities in terms of model and implementation aspects. This preliminary research activity was also carried out in the form of observations and interviews with practical lecturers in laboratories, especially those in the Mechanical Engineering Education Department, Faculty of Engineering, Manado State University to find problems that arise in carrying out welding practical activities.

Next, planning is carried out by identifying and defining the competencies to be obtained from carrying out welding practical activities. In the planning phase, the objectives of providing welding practice on each topic provided are also formulated and the sequence of practicum topics that will be given is formulated. Exploration of information technology infrastructure and software is also carried out in this phase to find the required model components such as the availability of a web server and internet connection in the university environment to support the creation of an online environment, the availability of LMS and shared-desktop environment creation programs as well as simulator programs which is close to the real form.

This research then carried out initial product development in the form of a hypothetical model of welding practice learning in an engineering education study program environment. The initial products developed also include learning tools to support the learning model being developed, including welding practice units (SAP), welding practice textbooks, welding practice guides, simulator use guides, online practice learning guides for lecturers, instructors, and students, and assignment evaluation tools. introduction, pre-test, practical activities, post-test, and report preparation tasks. This initial product was then validated by experts using the Delphi technique and the first revision was carried out based on the experts' suggestions.

This hypothetical model of practical learning which has received a validation process from experts is then tested on limited subjects and the results are used as a basis for carrying out a second revision of the practical learning being developed. Next, expanded trials were carried out by adding subjects and user institutions, and the results were used to revise the product being developed. The results of the revisions in this phase are the final products that are declared valid and meet the specified development criteria. The product that has been successfully developed is then implemented and socialized to the user faculty and lecturers who teach practical courses in the Department of Mechanical Engineering Education, Faculty of Engineering.

RESULTS AND DISCUSSION

Learning Impact Analysis

Learning impact analysis is carried out to see the effectiveness of products that have been validated by experts in a digital engineering practice learning process. As stated above, the learning impact test of this product was carried out on 24 students participating in Core Course practice. The subjects of this research were given a pre-test before taking part in practical activities with the model developed and took a post-test after each practical session at each session held. The pre-test and post-test are given online with strict supervision via video conference facilities by the instructor.

In this learning impact test, effectiveness is measured by determining the significance of the difference between the group's average test scores before practice (pre-test) and after practice (post-test) at each session using the t-test. The criteria used are that the post-test and pre-test scores are declared to be significantly different if the resulting t-test scores have an error probability (p) smaller than 5%. These results indicate that there is a significant difference between the post-test scores and the pre-test scores for all practical sessions held. A positive sign in all the mean differences between the post-test and pre-test scores means that there is a significant increase in the mean scores for each practical session held. The results of data analysis on the overall average score also showed that there was a very significant increase in the score of 11.46 points due to the influence of the application of the model developed in the practical activities carried out. By paying attention to the results of this analysis, it can be stated that the use of online learning models applied in each session of digital engineering practice activities has been proven to have a positive impact, namely increasing student learning achievement. To further clarify the impacts resulting from the application of the developed model.

Student learning achievement as a result of the influence of applying the model developed is very fluctuating. This fluctuation followed the initial pattern of ability which could be caused by the different levels of difficulty of the material practiced in each session. The curves in the picture above show that student learning achievements in the good category occurred in the 1st session, 3rd session, 4th session, and 7th session, while achievement in the sufficient category occurred in the 2nd session. 5th session and 8th session. The 6th session is a practical session with the lowest learning achievement or is in the poor category. This situation occurred because, in the 6th session, students received material on the topic of flip-flop which was generally felt to be material with a greater level of difficulty than the material in the previous sessions. This is normal, because in the 6th session students received new material which was an introduction to sequential logic material, whereas in the previous five sessions, students received practical learning with combined logic material whose understanding process was relatively easier. Thus, it can be stated that the low learning achievement in the 6th session was not caused by the implementation of the model, but rather due to the nature of the material which had a greater level of difficulty than the previous material.

Based on the analysis carried out above, it can be stated that the implementation of the online learning model for core subject practice developed in this research can have a positive impact on improving student learning outcomes.

Analysis of Perceptions of Products

Analysis of product perceptions is divided into two parts, namely analysis of perceptions on instructional aspects and product appearance. On average, subjects had a perception of 73.8% regarding the clarity of basic competencies and objectives. Following the instrument items used, these results show that the model developed includes basic competencies and learning objectives that must be achieved by students, is formulated in a simple, operational manner, and uses communicative language. In this case, the subject also felt that the formulation of learning objectives stated in the model could increase motivation to achieve them. shows clear stages towards achieving competency, and is known before practice is carried out. From the aspect of clarity of learning instructions, subjects also had good perception at an average level of 78.5%. This fact shows that the learning instructions contained in the model tools, namely the online learning guide, simulator use guide, and Core Course practice guide are easy to learn.

Subjects also gave a good perception regarding the aspect of ease of understanding the material or carrying out practice with an average percentage of 71.4%. Based on these results, it can be stated that the subjects viewed the model developed as containing practical materials/activities in communicative language so that they were easy to learn and easy to implement. Subjects also felt they had gained new knowledge after carrying out the practice. However, in this research, it was found that students still found it difficult with a perception level of 56% to carry out online practical activities. The difficulties that arise are largely due to obstacles related to the provision of internet infrastructure, such as limited bandwidth available, which results in slow access to the data needed to carry out this online practice. With a perception level of 76.9% regarding aspects of breadth and depth of material, it has been shown that the subject feels that the material contained in the model being developed is not too difficult, but also not too easy and within the range of the subject's abilities. In this case, the subject has given a positive perception of the breadth and depth of the material. The aspect of accuracy of the presentation was also perceived well by the subjects with an average perception level of 77.5%. In this case, the subject feels that the material provided has been presented in stages from easy to difficult, from simple to more complex, or from concrete to abstract. Subjects also felt that the presentation of the material had been carried out systematically so that it was easy to understand, attracted interest and attention, and reflected a close relationship between practical topics.

Furthermore, the interactivity aspect obtained an average perception degree of 75%. This means that the subject feels that the learning model developed has provided equipment that can foster cooperation or collaboration in groups and can create high levels of interaction between students and the available devices. Another finding from this research is that the subjects perceive that the online learning implemented has provided a high level of flexibility in terms of time and place of practice. Students feel that by using this model, practical activities can be carried out in any place and at any time. Subjects also felt that online practice was more enjoyable than practice using a real laboratory. Subjects have given their perception of this flexibility aspect at a good level with a percentage of 74.7%.

Meanwhile, the subject's perception of the accuracy aspect of the evaluation reached a good level with a percentage of 79.1%. This level of perception shows that the model applied has met the conditions: (1) provides pre-test and post-test questions that follow the learning objectives in each practice, (2) the questions presented can strengthen mastery of the material, (3) the question material is following the material concepts given in practical activities, (4) the questions given can encourage students to think critically, logically, systematically and analytically, and (5) the level of difficulty of the questions is given appropriately. gradual from easy to more difficult levels.

Perceptions of this product were given by subjects consisting of students and instructors. If you look at the total score, the average percentage of instructor perception appears to be higher than the average percentage of student perception. In this case, the average percentage of instructor perception reached 81.8% or was in the very good category, while for students it was in the good category or with a score of 73.1%. This situation occurs because the instructor has received more intensive training than the students during the preparation period for implementing this online practice. Apart from that, based on the observations that have been made, in various preparatory activities, the lecturer always instills a great sense of responsibility in the instructor for the successful implementation of this online practice. Thus, instructors feel they must have better knowledge and skills than students. As the instructor's knowledge and skills improve in playing their function as an online practice guide, their perception of the instructional aspects of the product also increases, making the level of perception given higher than the level of perception by students. By paying attention to the results of the analysis of the components of perception in the instructional aspect as carried out above, it can be stated that in general, the subjects have given a positive perception with a percentage of 75.8% towards the instructional aspect of the product developed through this research.

This level of perception illustrates that in the subject's view, the product being developed is equipped with instructions for use that are easy to learn and easy to implement. From the graph above it can also be seen that the readability of the product is perceived very well by the subjects with an average perception level of 82.5%. This situation illustrates that the display of letters on (1) the virtual laboratory portal as a means of managing online practical administration, (2) the Solidworks simulator program as a means of replacing real tools and materials, and (3) the Team Viewer program as a means of online collaborative work, easy to read so it helps students' understanding. The image quality of the product being developed is also perceived well by the subject. This is reflected by the average perception level value of 79.6%. This indicates that the images and illustrations included in the product, especially those provided by virtual laboratory portals, simulator programs, and online collaboration support programs, are of good quality so that they attract interest and motivate students to learn. The color composition aspect received a very good perception by instructors and students with an average level of 82.7%. These results indicate that in the subject's perception, the color composition of the model and supporting devices has been arranged to produce a good and pleasing composition. In the aspect of communication quality, from the qualitative data obtained, several subjects gave poor perceptions. This is because, sometimes subjects experience unexpected technical obstacles such as limited internet connection speed so that online practical equipment cannot be carried out normally. However, in general, with an average perception level of 71.7%, subjects have given a good perception of aspects of the communication facilities provided by the product. This indicates that communication facilities such as chat rooms, video conferences, voice-over IP, and file transfer can be used easily and smoothly to support online practice activities.

Meanwhile, the ease of operation aspect obtained a perception level of 79.2%, which shows that the product being developed, in the subject's perception, is easy to operate. The ease of operation of this product is indicated by the results of the subject assessment which shows that the menus provided by the learning devices are easy to recognize, read, understand, and operate. By paying attention to the results of the analysis of the product appearance components as carried out above, it can be stated that in the view of the subjects consisting of instructors and students, the product developed has provided a good appearance with an average perception level of 78.8%.

Final Product Revision

At the trial stage, apart from subject perception analysis data, qualitative data was also obtained in the form of comments or suggestions for improving the model from both the student subject group and the instructor subject group. Based on the identification of qualitative data, even though it was only cases, several subjects felt that the main obstacle to implementing online practical learning was problems related to limited internet facilities. Subjects considered that internet connection problems such as slow data access were the main obstacle to implementing this online practice. Based on this reality, it appears that the implementation of synchronous online mode to support online collaboration, especially in running simulators, in some cases has not run smoothly. Therefore, it is necessary to change the learning scenario if the synchronous online conditions are not met. By providing asynchronous online scenario information, the model becomes more flexible, especially when during a practical session there are problems involving the internet connection. This learning scenario will provide an opportunity for the practice group to change the collaboration mode from synchronous online, namely using simulators simultaneously at one time, to asynchronous online, namely by continuing to practice online but the collaboration is carried out asynchronously. In this case, students carry out practice using the simulator offline and the results are shared via the file-sharing application in the Team Viewer online collaboration support program.

Apart from problems related to limited internet connections available, test subjects also experienced problems related to implementing the guided inquiry method regulated in the digital engineering practice guidebook. The implementation of guided inquiry methods has made the nature of presenting practice guides very common. The nature of this presentation is indeed a requirement of using the guided inquiry method, which requires students to be able to develop the methods used to obtain the required data. In this case, the guide only provides brief information about the description of the practice being carried out and the objectives to be achieved. To be able to carry out the practical tasks listed in the guide, students are required to carry out intensive exploration of various sources which is considered a burdensome activity. By taking into account the perception of the subject, the Core Course practice guide has been equipped with an attachment that shows the references needed to carry out practical assignments, especially preliminary assignments, and design the required practice methods. The hope is that with this revision, the products developed, especially the Core Course practice guides using the guided inquiry method, can be used more easily. Based on the research stages that have been carried out, the product developed in the form of an online practical learning model has met the necessary feasibility requirements so that it can be implemented to support the implementation of core course practical activities in higher education.

Meanwhile, quantitatively, by assessing the model on five validation aspects, e-learning experts gave an average consensus percentage on all validation aspects of 83.3%, which means that the model is very suitable to be implemented to support online core course practice activities. Qualitative assessment by instructional design experts showed that the model developed was deemed feasible to implement if the relationship between the guided inquiry model and meeting activities was further clarified. This revision of the model based on qualitative validation resulted in a blended model that describes the roles more explicitly of students, instructors, and lecturers so that the implementation of the guided inquiry method can be reflected in every practical activity carried out. From the quantitative aspect, based on the model's assessment of five validation aspects, instructional design experts have given an average consensus percentage for all validation aspects of 91.7%, which shows that the model is declared very suitable for implementation. Qualitatively, learning multimedia experts state that the model developed is worthy of implementation if it can be applied in everyday life as long as the operating conditions are met. Revision of the model based on the results of this qualitative validation resulted in a model guide that lists the requirements for operating the model in terms of information infrastructure, hardware, and software that must be provided as well as initial skills that must be mastered by model users, including lecturers, instructors and students. Quantitatively, the multimedia learning expert's assessment of the model developed from five aspects of validation resulted in an average consensus percentage of 87.5%, which shows the product is very worthy of implementation. This research also produces model-supporting learning tools which include: a virtual laboratory portal with access address http://www.ptk-pps.unima.ac.id/elab, online learning model guide for practice core courses in higher education, SAP Core Courses, Core Course textbooks, solidworks simulator operating guides, online practice learning guides for lecturers, instructors and students, as well as practice guides for core courses using the guided inquiry method. The results of expert validation state that all learning tools developed through this research are suitable for use as support for model implementation. Instructors and students responded positively to the product being developed with an average percentage of perception for the instructional aspect of 77.8% and the product appearance aspect of 78.8%. Through this research, it has also been proven that there is a significant difference between the post-test and pre-test scores for each practical session and overall, which shows that the product developed has been able to have an impact on increasing student academic achievement in digital engineering practice.

CONCLUSION

This research concludes that in general it can be stated that the product developed is very suitable to be implemented to support online practical learning for core courses in higher education. This research has produced an online learning model for core subject practice with a flexible blended learning strategy at a low cost for students of the Mechanical Engineering Education Study Program. The model is equipped with a web-based virtual laboratory portal that provides practice support tools and learning management functions, as well as a SolidWorks simulator that provides virtual tools and materials for digital engineering practice. The model has the advantage of being able to create an online collaborative work environment. Validation by experts is carried out qualitatively and quantitatively. Qualitatively, experts in the core subject area agree that the model is feasible to implement if: (1) the implementation takes into account the characteristics of the course being practiced; (2) has significant differences with existing models; and (3) provides simulations whose characteristics are close to real phenomena in digital engineering design. From this qualitative aspect, the model revision that was carried out resulted in a model guide that describes: (1) that model implementation needs to pay attention to the characteristics of the courses being practiced; (2) the differences between the developed model and existing models, and (3) an explanation of the weaknesses of the solidworks simulator compared to real equipment, especially in the concept of floating input for digital devices. Quantitatively, the model has been assessed based on five validation aspects, namely: (1) problem identification; (2) determining product type; (3) development program objectives; (4) model structure and components; and (5) model completeness. Based on these aspects, experts in the core subject areas provided validation that the model was very feasible to implement with the average consensus percentage for all aspects reaching 83.3%. After assessing the model developed, the e-learning learning expert qualitatively validated that this learning model was feasible to implement if the model guide explicitly included the types and parties who had used the previous model. Revision of the model based on this qualitative validation resulted in a model guide that outlines the types of simulator-based learning that exist and the parties that have used them.

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