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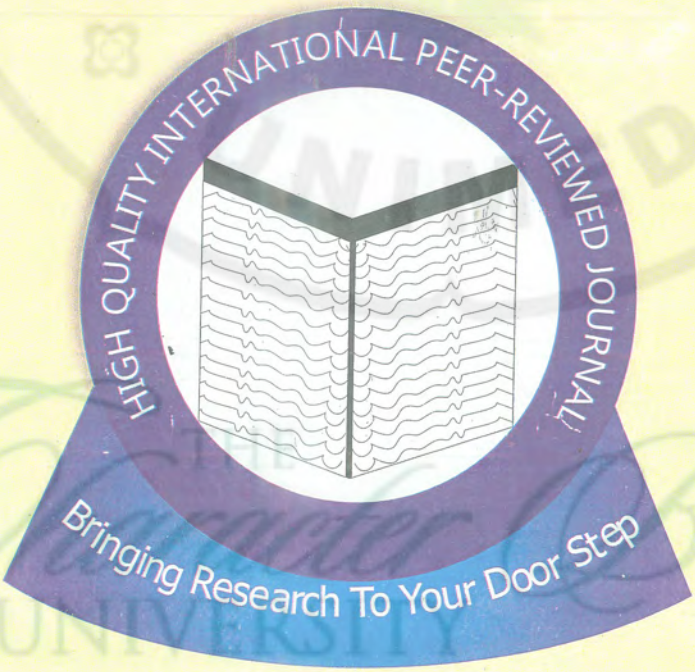

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Keywords: Development of learning model, based on interactive multimedia, machine tools

Introduction

CNC (Computer Numerical Control) Machine Tools is among the subjects of expertise Production Systems that require working practices in workshops CNC machines are required for all students of Department of Mechanical Engineering, Faculty of Engineering Unimed. Standard Competence is to apply the basic concepts of CNC machine tools in producing metal work pieces. While the basic competence to be achieved is able to use CNC Machine Tool TU-2A, TU-3A CNC, CNC ET-120, CNC VMC-100, and carry out project work (Emco, 1989; 1992).

CNC Machine Tools lectures are still limited when compared to the average number of students that the course program per semester as many as 30 people. Especially if it is associated with a number of professors who take care of the course is also limited (2). Therefore, one among the alternatives that the presentation of the courses run more effectively and efficiently is to provide a model of learning by using interactive media

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multimedia-based learning to students. Thus during the practicum students are expected to learn more efficiently (Silaban, 2012). On the basis of these ideas, then lectures to support student learning effectiveness and efficiency of the Department of Mechanical Engineering Unimed can be implemented properly.

Power (1987) saw that the use of CNC machine tools can in terms of system equipment CNC machine tools, which has three basic components, namely program instructions, control unit, and the machine tool itself. Management of the three basic components that require skilled labor, not just skills pressing or adjust the cutting tool pads Ingestion / slicing the work pieces, but require specific knowledge, namely (1) planning of the ability to process information from the work pieces to be made, (2) programing such as planning and determination of steps or movements of machine tools in the form of a sequence of instructions by a computer, and (3) execution in the form of test pads to the machining process the actual object.

In accordance with the three demands specialized knowledge, then qualified manpower needed not just a machine operator but more pads programmer CNC machine tools. Level manpower in the industry with CNC machine tools, namely, Operator, Programmer, and Chairman of the workplace. Position operator will usually be filled vocational school graduates, the post graduate programmer by DIII, while the leader of the workplace is filled by graduates of S1. DIII special mechanical engineering graduates as middle level manpower should be able to master all three specialized knowledge, they should be able to bridge the manpower level engineers with operator level manpower. When associated with costly investments in equipment CNC machine tools and rapid development of industrial technology, the industry requires a workforce that is always able to adapt to any changes.

Fritz (2004) states that the required job skills pads complexity of this century requires more work involving cognitive ranch and suggested adding a problem-solving skills. To prepare the work force in accordance with the needs of expertise in industry, education and training institutions have to provide and equip adequate teaching and learning process in accordance with the purpose of craftsmanship skills, the problem is how the learning process is carried out so that the skills acquired skills in accordance with the purpose of learning. Programming CNC machine tools is basically solve a problem with the order or image by translating the work pieces into abstract shapes and workmanship of the work pieces. Skills combine various concepts into a program in the form of rules for solving a problem processing the work pieces, show qualified subject matter is more in need of intellectual skills than motor skills.

According to Gagne (1992) intellectual skills is one of the five categories of abilities learned abilities. These five capabilities that are: (1) intellectual skills; (2) cognitive strategies; (3) verbal information; (4) motor skills; and (5) attitude. Based on the classification of learning materials, learning objectives and approach the learning process that leads to the achievement of one of the pads on the human ability intellectual skills, the main theoretical studies in this study using a taxonomy Gagne. Fifth skills that are taught in the taxonomy Gagne have the same goal that facilitate student learning according to the learning goals. Furthermore Gagne (1992) states that a person's intellectual skills are ability that allows a person to respond to its environment through symbols, language and numbers. Results include responses can describe or generate a real object in his own environment, relationships between objects, the use of

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numbers in summation, and an overview of various other symbols associated with spatial ability.

The importance of learning strategies increasingly necessary when units are associated with the constraints of limited instructional time, because the choice of the right strategy can reduce the learning time. The fact that there are learning CNC machine tools at the moment is learning more emphasis on the use of learning strategies as usual demonstration held on the practice of learning materials in the workshop or laboratory machine tools. Though learning CNC machine tools, has provided equipment simulation or simulator, they tend not to equip a simulation with consideration of efficiency, resulting in a real hands-on learning. The problem is which one is better learning strategies with actual or using a CNC machine tool simulator or with interactive multimedia learning media.

Interactive multimedia is a combination of various media from the computer, video, audio, images and text. By definition Hofstetter (2001) "interactive multimedia is the use of computers to combine text, graphics, audio, moving images (videos and animations) into a single entity with a link and the right tools allowing the user multimedia able to navigate, interact, create, and communicate ".

Benefits and advantages of using interactive multimedia in learning are as follows: (1) more learning system; (2) an innovative and interactive; (3) The teacher will always be required to be innovative in seeking a breakthrough creative learning; (4) able to combine text, pictures, audio, music, animated images or video in a unity of mutual support in order to achieve learning goals; (5) increase the motivation of learners during the learning process to obtain the desired learning objectives; (6) able to visualize the material which has been hard to be explained merely by an explanation or a conventional props; and (7) to train more independent learners in gaining knowledge.

The purposes of this study are: (1) develop a learning model with the implementation of interactive multimedia-based learning media; and (2) implement a learning model with the implementation of interactive multimedia-based learning media. This learning model is able to contribute in the development of quality education in Unimed. The development model of synergistic and collaborative learning is able to produce a maximum of competence in learning.

Methodology

This study is a research and development (Research & Development) instructional media, particularly in the form of learning via interactive multimedia based teaching materials for courses in CNC Machine Tools and practices programming material CNC, which is more responsive or reactive instead of proactive. Research and development consists of three stages: pre-development models, model development and application of models in which the study refers to the R & D cycle Borg and Gall (1983), the description has been modified and aligned with the objectives and conditions of the actual research.

Research framework outlined in the procedures in the following order: gathering data current conditions for the diagnosis of needs, data analysis, development and selection of alternative actions, test new models, check the reaction, collect new data for diagnosis, repeat the

analysis and development, and revise the model. The method used in this study is a combination of qualitative and quantitative methods (mixed method).

Stages of the process of research and development is done in stages, which at every step of the developed always refer to the results of the previous steps and eventually acquired a new educational product. Steps in R & D consists of ten steps, namely: (1) research and information collecting, (2) planning, (3) develop preliminary from of product, (4) preliminary field testing, (5) main product revision, (6) main field testing, (7) operational product revision, (8) operational field testing, (9) the final product revision, and (10) dissemination and implementation.

The study was conducted at the Department of Mechanical Engineering, Faculty of Engineering, State University of terrain and mechanical engineering workshops, laboratories CNC. Both trials individual, small group testing, and the main trials conducted in Unimed. The subject of research in preliminary studies, trials, and implementation are students and faculty. In the study of this development, taking into account the place, the existing technology and the availability of facilities / infrastructure that support the learning process. At this stage of development of learning models, targeting in this case is a lecturer, an expert in learning, a field of study, and students assess learning model that has been developed based on criteria as follows: (1) evaluator who carried out the evaluation expert learning (expert judgment) is determined based on its expertise, (2) evaluators who carried out the evaluation is determined based on the ability of the practitioner / lecturer with the classification expert field of study.

Data analysis in this research and development using quantitative descriptive analysis. All data were analyzed with descriptive statistical techniques that quantitatively separated by category to sharpen judgment in drawing conclusions. Data analysis in research and development is described in three, namely the preliminary study phase, development and validation.

At this stage of development of some analytical approach used is: (a) the implementation and results of design development models, described in the form of data presentation, and then analyzed qualitatively, (b) the limited test, the results of testing the application of the design models were analyzed with the approach of quantitative, (c) to test more widely, in addition to using approach qualitative descriptive analysis, also used statistical analysis (quantitative), with statistical formulas t-test to measure the results of the application of the design models on the conditions before (pre) and after (post) application. At the stage of validation, significance and effectiveness of the results of applying the model was analyzed using a quantitative approach (quasi experimental), by comparing the results of the group (research subjects) experimental and control groups, the condition before with after application.

Table 1: Stages of Development

Stage	Activity
Development	Research and data collection beginning Preparation of preliminary research Preliminary research results. The design needs analysis models.
Product Development	Making multimedia-based interactive teaching materials. (1) Creating a navigation structure and design of the page; (2) Create a script (frame)

Stage	Activity
	program narrative and edit them with Adobe Audition 3 in the audio-visual studio video intro with the technique of blue screen (blue screen) using a Mini DV camera. Shooting process performed in the audio visual studio; (3) Edit the background (blue screen using Adobe Premiere Pro program; (4) Record video tutorials how to use the service operations with the CNC Machine Tools Blueberry program; (5) Change Flash Back AVI video format into flash video file format (FLV) using the program Xilisoft Video Converter; (6) Creating a basic concept application CNC machine tools based page designs that have been created Previous; (7) program publish applications have been completed to a CD
Evaluation	Early trials. Studies of matter experts, instructional design, and media experts and perform repair on every commit Review (expert testing)
Application	Field Trial. Product testing interactive media-based learning materials multimedia on some student respondents S1 Mechanical Engineering, State University of Medan
Revised	Operational Improvements. Continuous refinement of interactive multimedia based learning media

Results and Discussion

Results

Search results of the questionnaire are stocked found that 86% of lecturers states require media interactive learning in the learning process so that the learning process more effective, and 98% of students stating require interactive learning media so they can make as a means of learning individually.

Individual testing is done in two Prodi Mechanical Engineering Education. Individual testing of each of the three students with less ability, moderate and clever. The purpose of the trials was to identify individual learning product shortages after reviewed by experts. Assessment and input from this trial is about the presentation of learning products covering aspects of display and presentation aspects of the material contained in the learning of computer-aided CNC machine tools.

Results of the evaluation form to the learning assessment scores in each aspect of the display can be seen in Table 2.

Table 2: Learning Assessment Score CNC machine tools Interactive Multimedia Individual Trial on Display Aspects

No	Indicator Assessment	Score average	Criteria
1	The beauty of the display screen	4.33	Very Good
2	Text Readability	4.33	Very Good
3	The quality of images and animations	4.00	Good
4	The composition of colors	3.67	Good
5	Navigation	3.67	Good
6	Carrying capacity of music	3.33	Medium
7	Interaction	4.00	Good
Amount		27.33	

An average	3.90	Good

Table 3: Learning Assessment Score CNC Machine Tools Individual Trial Interactive Multimedia Content at Aspects

No	Indicator Assessment	Score average	Criteria
1	Suitability material	3.67	Good
2	Clarity study guide	3.67	Good
3	Ease understand the sentence in the text	3.67	Good
4	Ease understand the subject matter	3.67	Good
5	The accuracy of the order of presentation	3.67	Good
6	Adequacy practice	3.67	Good
7	Clarity feedback	3.00	Medium
8	Help to learn to program	4.00	Good
Amount		29.02	
An average		3.63	Good

Data collection individual testing done by asking the students to follow the learning CNC machine tools. noting part poorly understood and discussed weaknesses. In addition. students are also asked to fill out a questionnaire on the quality of learning CNC machine tools Interactive Multimedia.

Table 4: Learning Assessment Score CNC machine tools Interactive Multimedia Trials Small Group on Display Aspects

No	Indicator Assessment	Score average	Criteria
1	The beauty of the display screen	4.33	Very Good
2	Text Readability	4.17	Good
3	The quality of images and animations	4.33	Very Good
4	The composition of colors	4.00	Good
5	Navigation	4.50	Very Good
6	Carrying capacity of music	3.67	Good
7	Interaction	4.33	Very Good
Amount		29.33	
An average		4.19	Good

Table 5: Learning Assessment Score CNC machine tools Interactive Multimedia Try Small Group on Material Aspects

No	Indicator Assessment	Score average	Criteria
1	Suitability material	4.33	Very Good
2	Clarity study guide	4.17	Good
3	Ease understand the sentence in the text	3.83	Good
4	Ease understand the subject matter	3.33	Good
5	The accuracy of the order of presentation	3.83	Good
6	Adequacy practice	3.50	Good
7	Clarity feedback	4.00	Good

8	Help to learn to program	4.33	Very Good
Amount		31.32	
An average		3.91	Good

Table 6: Learning Assessment Score CNC machine tools Interactive Multimedia Field Trial Class B1 and B2 at Aspect Display

No	Indicator Assessment	Class B1		Class B2	
		Score average	Criteria	Score average	Criteria
1	The beauty of the display screen	4.15	Good	4.00	Good
2	Text Readability	4.15	Good	3.86	Good
3	The quality of images and animations	4.00	Good	3.71	Good
4	The composition of colors	4.30	Very Good	3.86	Good
5	Navigation	3.95	Good	3.43	Good
6	Carrying capacity of music	3.60	Good	2.52	Medium
7	Interaction	3.75	Good	3.19	Good
Amount		27.90		24.57	
An average		3.99	Good	3.51	Good

Score assessment of the learning components of CNC machine tools are also contained in the material aspects of each can be seen in Table 7.

Table 7: Learning Assessment Score CNC machine tools Interactive Multimedia Field Trial Class B1 and B2 in Material Aspects

No	Indicator Assessment	Class B1		Class B2	
		Score average	Criteria	Score average	Criteria
1	Suitability material	3.95	Good	3.90	Good
2	Clarity study guide	3.90	Good	3.52	Good
3	Ease understand the sentence in the text	3.80	Good	3.38	Good
4	Ease understand the subject matter	3.70	Good	3.43	Good
5	The accuracy of the order of presentation	4.10	Good	3.62	Good
6	Adequacy practice	3.55	Good	3.57	Good
7	Clarity feedback	3.55	Good	3.48	Good
8	Help to learn to program	4.95	Good	3.71	Good
Amount		31.50		28.61	
An average		3.90	Good	3.58	Good

Assessment by experts of material and media experts on every aspect of an overall assessment determined the average score and categories. Then analyzed to determine the

appropriateness of the developed software learning software CNC machine tools and interactive multimedia quality of software generated learning software computer aided CNC machine tools.

Discussion

The development is one of the domains of the domains contained in the concept of Educational Technology. The concept of Educational Technology by AECT (Association for Educational Communicatoins and Technology) is the theory and practice of design, development, utilization, management, and evaluation of processes and recources for learning. Based on the definition of educational technology AECT 1994 above it can be concluded that the structure of region / domain of educational technology include planning, development, utilization, management, and evaluation. Development according Seels and Richey (1994; 35) is "Development is the process of translating the design specifications into physical form."

Development is a process of transition or the translation of the design specifications into physical form. In this case, the end of the development process will result in a product, in which before the manufacturing process begins with the process of making the product design. In this study developed interactive multimedia learning model based on CNC machine tools are indispensable in practice on student learning mechanical engineering education programs. The results of product development of interactive multimedia learning on CNC machine tools is felt by the students and the learning process by the lecturers so as to improve student results.

Interactive multimedia learning model based on CNC machine tools focusing on the core concepts and principles of a discipline, to facilitate students to berinvestigasi, problem solving, and meaningful tasks. This is consistent with the statement Gagne (1992) that is the ability of a person's intellectual skills that enable a person to respond to its environment through symbols, language and numbers. Backed by research Triyono (2005) to the effect of learning strategies and mechanical aptitude for the skills of CNC machine tools show that; (1) learning should use simulation learning strategies; (2) high mechanical gifted students will be better when using simulation learning strategies; (3) low mechanical gifted students more effectively use learning strategies demonstrations.

Interactive multimedia learning model based on CNC machine tools made also confirmed that students in providing employment opportunities, shows that aspects of good learning and good work is very important to be done by the students. This shows 65.91% and 83.21% of the study of the work performed (Silaban, 2012). Related to the lecture material Machine Tool CNC, the student must learn and work for the development of competence on cognitive and psychomotor besides affective also continue to be improved by doing a job readiness, so the chance that they acquired in the lecture bench can be put to good use and not squandered.

Machining processes on CNC machine tools which have a factor of accuracy and speed with a displacement motion automatic machine Numeric Control (NC) would be very difficult to be presented when relying on verbal learning with the help of visual or media image and text information only. Simulation of CNC machine tools that use computer-based technology is one category of the review of learning technology development area. Seel and Richey (1994:

42) states that the computer-based technologies are ways to produce and deliver materials by using a device which is based on micro-processors.

Of theory and discussion about the skills of CNC machine tools, it can be concluded that the skills of CNC machine tools is a problem-solving skills of making the workpiece with the help of CNC machine tools. Creating workpiece with CNC machine tools is an abstraction of the workpiece so that the process outlined in the shape of the workpiece and is expressed through a sequence of instructions known or computer programming. The skills that lead pads problem-solving skills is a form of intellectual skills that put more emphasis on mental processes in solving a problem.

In addition to controlling factor, the advantages of CNC machine tools according Rochim (1993: 470), among others more thoroughly (accurate), more precise (precise), more supple (flexible), and more productive (productive). These advantages compared to machine tools conventionally only be achieved if a controlling factor, in this case a computer has been equipped with software (software) such as the operating system (operating system), programs completeness (utility programs), and application programs in particular (special application programs). Through the software is a technician will utilize CNC machine tools into the creation of a program of making the work piece.

Conclusion

CNC machine manufacturing industry plays an important role in the manufacture of components or parts of a machine / tool precision with bulk quantities. PC as an input to the CNC machine is very dominant role in the performance of CNC machines. CNC machines are used for work on the workpiece with a high degree of difficulty required PC with high performance as well. CNC machine has a standard code as input that can be executed via the PC recommended by the manufacturer to operate the CNC machine CNC machine. Industrial CNC machine maker in addition to providing software for CNC machine also provides design software CAD / CAM synergy with CNC machines produced.

Interactive multimedia development can contribute practical, especially in the implementation of the learning process for lecturers to provide convenience in carrying out learning so the impact on the effectiveness of the learning process and can improve student learning outcomes. Thus this interactive multimedia learning media can be considered for lecturers in the delivery of learning material with an interest in the interactive learning process so that students can quickly in response to through symbols, language and numbers through a computer-based interactive multimedia learning on CNC machine tools.

Product development of multimedia computer-based learning on CNC machine tools can serve as an effective teaching aids for teachers in managing the learning activities of students, both classically and individually. Product development of multimedia computer-based learning on CNC machine tools is also efficient to overcome the limited time available at the solid / number of the subject matter to be resolved so that the multimedia products has become an alternative method that is effective, efficient and attractive in presenting the lesson material in addition to the use of conventional methods use the textbook as a primary source.

Product development of multimedia learning materials CNC machine tools as part of an effort

to improve the quality of learning in education at an educational institution, so as to integrate the information and communication technology (Information and Communication Technology / ICT) in the curriculum of education, will reflect an institution in higher education with the demands of progress, modernization and globalization.

From the test results can be seen that the indicators exist, the average respondent to the quality of the display that shows the clarity of the instructions for use of instructional media CNC machine tools properly, the legibility of text / writing is pretty good, the quality of image display is quite good, serving animation , good color composition, clarity of sound / narration either, carrying the music on the program either. The average respondent's presentation stated the purpose of clarity good lesson, clarity of instructions to learn good, easy to understand sentences good, easy to understand the subject matter well, the accuracy of the order of presentation is quite good, clarity feedback / response is good, help learn to program well enough, so the material interactive multimedia-based teaching technology courses very precise CNC machine tools used by the students to better understand the use of CNC machining practices, so as to improve the quality of learning and very easy to operate. In addition, interactive multimedia-based learning media to provide a new method of learning with media facilities sound, animation and video in order to reduce the saturation in student learning.

Suggestion

By looking at the role and importance of multimedia computer-based learning CNC machine tools as described above as well as the advantages it has in comparison with other media, it is deemed necessary to realize real effort to do the development of a multimedia computer-based learning that is interactive in order to improve quality learning-based active learning, so that it can effectively achieve the learning objectives and learning outcomes to the maximum so hopefully in turn will improve the quality of education.

Development of interactive multimedia computer-based learning in this CNC machine tools that can be used to obtain some of the benefits for students on the product development of interactive multimedia computer-based learning can be used for; (1) facilitate active learning for learners so as to reduce the passivity of student learning; (2) increase the effectiveness of learning so as to improve the achievement of students' competence; (3) improving the efficiency of learning so as to optimize student learning time; (4) media that appeal to students so that they can increase learning motivation; and (5) an alternative source of motivational self-learning (can increase motivation) and situational (can be executed anytime / anywhere) for the students.

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