

DEVELOPING A LEARNING MODULE OF COMPUTER NUMERICALLY CONTROL GSK 983 MACHINES TO ENHANCE STUDENTS' LEARNING OUTCOMES

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ABSTRACT

This study aims at: (1) producing a learning module of Computer Numerically Control (CNC) GSK 983 machines to enhance the students' learning outcomes, (2) investigating the learning process of CNC GSK 983 machines in vocational schools, (3) analyzing the effectiveness of the developed module in vocational schools. This study refers to the research procedure of design and development by Richey and Klein consisting of (1) observations of learning and products development, (2) internal and external validation, and (3) testing the effectiveness of the product in the field. The data was analyzed using T-Test. The results showed that: (1) the CNC learning outcomes in Vocational Schools did not meet the expectation; (2) learning modules of CNC GSK 983 to enhance the students' learning outcomes was developed, and (3) the developed module was effective to enhance the students' learning outcomes. The results of the t-test showed that there was a significant difference between the learning outcomes with the module and the learning outcomes without the module. It means that the module can improve the students' learning outcomes.

Keywords: computer numerically control GSK 983, learning module, learning outcomes

INTRODUCTION

The business and industrial world needs to do innovations to produce a high quality product in this global competition. The efforts conducted by the business and industrial world are utilizing automatic technology, Computer Numerically Control (CNC), and professional human resources and having high productivity.

Vocational high schools are formal education to train the students to have competence based on the labor's needs. Mechanical competence is one of popular fields in vocational high schools which produces the graduates with Computer Numerically Control (CNC) skills for industrial area.

To meet the needs of workers with CNC technology competence, Vocational High Schools work to improve the quality of graduates by improving facilities and infrastructure in the form of laboratory practice learning and CNC machines. The objectives is to produce graduates who have skills to operate CNC, especially for industrial process. Based on the technology development of metals

industry today, one of the tools used in CNC machine learning is GSK 983. The applied teaching method is teaching centered learning which is oriented to the teachers (more on teaching not learning), teachers do not act as a facilitator, a motivator, an innovator, a evaluator and a manager of the class. Mulyasa (2004: 43) explained that improving the learning effectiveness can be done by implementing learning modules. This study aims at finding out the learning process of GSK CNC 983 machines and developing learning module of CNC GSK 983 machines to improve the effectiveness learning process and the students learning outcomes.

The purpose of learning is to achieve the students' progress. This progress can be more effective and efficient if the students understand the meaning of learning. Gagne and Briggs (1979: 3) explain that learning is a human effort to assist the students through a set of process learning. The law number 20 of 2003 regarding the National Education System article 1 states that learning is a process of interaction among learners, educators and learning resources in a

learning environment. Miarso (2004: 545) also explains that learning is an attempt with aim and control, to make the students learn or make changes which are relatively settled on their selves or others. Another definition states that it is an activity of curriculum implementation on educational institutions in order to influence students to achieve educational (Sujana and Rivai, 2003: 1). Based on the explanation above, it can be concluded that learning as attempt to acquire the knowledge, ideas, attitudes, skills more easily, through the interaction among the learners, educators, learning resources and learning environment to achieve the learning objectives from the curriculum.

Learning resources have a crucial role for the continuity of learning programs in improving the intelligence or knowledge, attitudes, and skills. Learning resource is to support the learning process to run effectively. There are many teachers who do not empower the function of learning resources. It makes the students less interested and demotivated, then learning becomes less efficient. Department of National Education (2008: 5) explains that the learning resources can be defined as information presented and stored in the various forms of media and it can help students to learn as the embodiment of curriculum. Based on the above description, it can be concluded that the learning resource contains three elements, namely: (1) information; (2) what can be seen, heard, touched, and (3) facilitate student learning. Learning resources can be defined as anything that contains information that can be used either separately or mutually in a particular form to facilitate learners to achieve learning objectives.

Modules are often associated with self-learning activities since its function as a means of self-learning. The consequence is a module should be comprehensive so that learners can understand the field of study in the modules to obtain the targeted skills and competencies. Puji Mulyono (2001: 4) stated that the module is the smallest unit of subjects that includes the a

whole concept so that it can be learned separately without changing its meaning. Purwanto (2007: 9) stated that a module is a printed teaching materials which is systematically designed based on the specific curriculum and packaged in the form of learning units of for autonomous learning. Department of National Education (2008: 3) states that the media is printed instructional materials designed for independent learning. Ministry of Labour (2006: 3) states that the training module is a description of the training materials prepared based on standards of competence using competency based training as an approach to acquire the appropriate skills in the workplace.

Based on the review above, it shows that there is similar line that the modules are used as teaching materials for self-learning. Therefore, it is expected that a module should be able to give guidance to the students during the learning process. Based on the experts' view above, it can be concluded that a module can be defined as written or printed materials arranged systematically, comprehensively, and interestingly so that it can guide the students to learn autonomously or in groups. Finally, Tiwan (2010) pointed out that a module is effective resource for the learning process. The students who well prepared with learning module will perform better learning results.

METHODS

This study was conducted by using Research and Development Approach. The procedure development was based on Richey and Klein (2007: 68). The development model consists of three steps namely: (1) development, (2) validation, (3) implementation.

Richey and Klein (2007: 66) stated that the method covered preliminary stages of development, namely the preliminary study by using observation, literatur review, the scrutiny of the documents and the implementation of learning plan. The focus of the observation of

learning process includes learning models, methods, learning strategies, and the result of the observation will be used as reference to develop and design the learning modules of CNC GSK 983 machines. The examined documents include learning objectives, syllabus, lesson plans, teaching materials, the result of the work piece are used to determine the learning plan. Then, the implementation of the literature study was conducted by examining learning materials of CNC GSK 983 machines. The results become the components for the module development.

Internal validation is conducted through several steps, namely expert reviews, documentation, and research instruments. Internal validation was performed by subject matter experts, media experts, and peers. The experts were from the Graduate School, Yogyakarta State University while the peers were the experienced mechanical teachers from vocational high schools. The validated component consists of module assessment items, module assessment instruments, module acceptance instruments, readability module instruments, pretest-posttest items, evaluation questions, and competence tests. The component of validation modules includes syllabus, lesson plans, and job sheets. The recommendation from the experts was categorized as input to module revision. It was the preparation of external validation.

External validation was conducted through a field test and control evaluation. The field tests were conducted with limited participants and the field trials was with a larger scale. The limited test was conducted to examine the impact of the modules implementation, including: (1) the acceptance level of modules in the field, (2) the level of legibility, (3) the attractiveness level, (4) the level of implementation and (5) the level of effectiveness of the module. It involved a small group of 4 students selected randomly, in the CNC laboratory of SMK Negeri 2 Depok. The larger test was conducted to 8 random students, The test was designed to find out the acceptance

level, the implementation, the effectiveness of the module including retest, presentation, assignment, formative test, evaluation, and posttest. The result of this test was in the form of revision based on the recommendation from the teacher and students. The test of the module effectiveness was conducted with quasi-experiment with the design of pretest-posttest group control, as showed in Table 1 below.

Table 1. Experiment Design

Experiment	Q1	X	Q2
Control	Q3		Q4

Where Q1, Q2 and X are the pretest, the posttest and the treatment on the experimental group respectively. While Q3 and Q4 are the pretest and the posttest on the control group respectively

The research setting of module development was in SMK Negeri 2 Depok, Sleman Yogyakarta. The first data was resulted from questionnaires and literature studies. The second data, the readability level modules was obtained using the Cloze test method. It was in the form of quantitative data. The third data was obtained from internal validation that consisted of subject matter experts, evaluation experts and media experts.

The fourth data was obtained from the limited testing in the form of scores of a readability test, the results of a pretest, a posttest, assignments, a formative test, performance as well as qualitative data in the form of comments from students. The fifth data was gained from the extensive test, namely scores of the pretest and posttest tasks, the formative test, the performance as well as qualitative data in the form of comments from students. The sixth data were in the form of the results of the effectiveness test.

RESULTS AND DISCUSSION

The result of the preliminary study through scrutinizing the document were the learning objectives in the form of standards of

competence for the machine NC/ CNC machining center with the code of M7.18. It has four basic competencies and nine indicators with the industry validation. The basic competence consists of recognizing the parts of mechanical program of NC/ CNC, writing the program of NC/CNC, operational note sheet, and program trials.

The result document observation showed that learning objectives, syllabus, lesson plan, assignment were relevant to the goals. The learning plan also gives the opportunity for the students to cooperate and to discuss with their peers, the learning process run in the form of group. It was also used to anticipate the limited number of the machines.

The result of the field observation on CNC learning process showed that the implementation of learning process used speech, discussions, demonstrations, problem solving, practices, and assignments. The learning process was classical but the learning process can be semi-individual where the teacher often gave personal counseling to the students who found some difficulties.

The learning process that was previously described is not effective because most of the time allocation is wasted. The teacher should motivate the students to become autonomous learner by providing the students with more effective learning to improve the learning effectiveness. This can be done using the module of CNC GSK. The module development was started by analyzing the learning goals in this case the standard of competence of CNC machine adapted from SKKI NC/CNC machining Center. This competence was the closest one to the industrial needs with the code of M7.18 and to convince the goal accomplishment the industrial party should be involved. Materials determination is based on the learning goals to create the students who are competent in programming

and operating CNC machines in industrial sectors. Programming process by having assistance from CNC software like Mastercam was needed to overcome the difficult program and it can be handled in other places. It was useful for the schools with limited number of machines. The schools can use the machines as print out of CNC programs but both manual operation and programming should be learned.

The description of ability to operate CNC industrial machines was as follow: (1) using CNC machine software, (2) editing and transferring CNC program, (3) operating CNC machine to setting tools and PSO, (4) production test. The references were GSK 983M Milling CNC System Vol 1&2. This book was designed to support the development of CNC GSK 983 operation module.

The draft of this module was based on CNC mechanical engineering then composed into lesson plan which consisted of materials, learning sources, learning goals, methods, assessments, time allocation. The materials from lesson plans was arranged systematically in the form of learning module. The content was divided into four activities, namely first activity, making program with Mastercam software (it can be done at home) and completed with assignments, second activity, making program manually (it can be done at home) and completed with practices and assignments. Third activity, the competence to operate CNC GSK 983 machines, it was the practice that started with machine recognition, cutters, clamps, safety, setting tools and PSO, program transfer test as well as production test. Every activity above was equipped with the summary of materials, assignments, formative tests, and answer keys. The forth activity was to evaluate the students with a posttest and a performance test in operating CNC GSK 983 machines. The result of internal validation on the draft of the module from experts consisted of consistency, organization, attractiveness, evaluation and content, as presented in Table 2.

Table 2. The Validation Result

No	The Item of Module Feasibility	Score	
		A1	A2
1	Consistency	3.71	3.57
2	Organization	4	3.37
3	Attractiveness	4	4
4	Evaluation	4	3.25
5	Content	4	3.44
	Total	19.71	17.56
	Average	18.63	
	Category	Very good	

The result presented in Table 2 shows the score of 18.63 that is categorized as very good while the validation result from the peers

is 17.67 that is also categorized as very good. The limited test for external validation was conducted in 4 meetings. Every meeting has 6x45 minutes and 12 hours structured assignments. It needed a machine of CNC GSK 983, 4 computers with Mastercam software. The result of readability test with a cloze method gained the score of 26 and categorized as easy to be understood. The result of the questionnaire for the acceptance got the score of 29.5 and categorized as well accepted. Table 3 shows the result of performance indicator that can be mastered by the students.

Table 3. The Result of Performance Indicator

No	Activities	Performance Indicator	Number	Commulative
1	I	6,7,8,25,26,50,51,52,53-62, 64, 65, 69, 70, 71	23	23
2	II	44-49,63,68,72	9	32
3	III	1-5,9-24,27-43,66,67, 73-79	47	79
4	IV	80-90	11	90

The test for external validation was conducted in four meetings in 45 minutes and 12 hours structured assignments. It needed a machine of CNC GSK 983, four computers with Mastercam software. The questionnaire

result showed that the acceptance module obtained the score of 30.5 and categorized as very accepted. The result of performance indicator that can be mastered by the students is presented in Table 4.

Table 4. The Result of Performance Indicator

No	Activities	Performance Indicator	Number	Commulative
1	I	6,7,8,25,26,50,51,52,53,62,64,65,69,70,71	23	23
2	II	44-49,63,68,72	9	32
3	III	1-5,9-24,27-43,66,67, 73-79	47	79
4	IV	80-90	11	90

The effectiveness module was tested to 32 XII grade students of mechanical engineering who were selected randomly. They were divided into two groups, 16 students for control group and 16 others as the experimental group. Since there is only one machine, the students were divided into groups of four. Each group got four time meetings in 45 minutes and 12 hours structured assignments. The result of T-Test on pretest score as presented in Table 5 below showed that pretest score of control group and experiment group were $T_{score} = -0.154 < T_{table} = 1.753$. It means there was no significant difference on

pretest between experiment and control group or it can be said that the two groups had similar ability.

Table 5. The Independent T-Test of Pretest Score

Group	T	p	Summary
Pretest experiment and control	-0,154	0,875	No significant difference

The result of posttest score as presented on Table 6 below showed that $t = 5,811$, while $T_{table} = 1.753$, it means $t \text{ score} > t \text{ table}$ therefore it can be inferred that there was

significant difference on the posttest score between the experiment and control groups.

Table 6. The Independent T-Test of Posttest Score

Group	Summary
Posttest eksperimen - kontrol	5,811 <0,001 Significant Difference

The conclusion from the result of T tests on pretest and posttest is that H1 accepted and H0 denied or in other words the implementation of the learning module of CNC GSK 983 machines can improve the students' learning outcomes. The module had been proven theoretically and empirically to be able to improve the students learning results.

CONCLUSION

Based on the results of the study and the discussion above, it can be concluded that (1) CNC learning in Vocational High Schools did not meet the standard of competence, (2) the learning module of CNC GSK 983 machines can improve the learning outcomes, (3) the module is effective to improve the students' learning results. The result of T test showed that there was significant difference between the learning result with the module and without the module. It means that the module creates more effective learning process and give impact to the improvement of the learning results. There are several recommendation: (1) the modul can guide the students to achieve the learning goals (2) the learning process with the module should be supported with other learning components such as facilities and evaluation instruments, (3) The number of CNC machines and the module implementation should be improved to promote the students' skills in CNC machines.

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