Development of Technical Drawing Module Based On Projection and Sectional Views Equipped with Lego Block Assembly Media Assistance

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Abstract. This research is motivated by the lack of practical learning media in the discussion of projections and pieces in the learning process of technical drawing courses. Referring to the discussion, the researcher made a module "Teaching Drawing Technique Module Main Subjects of Projection and Pieces Equipped with Information Technology Lego Viewer Media Assistance" which later will be a support in the learning process so as to help students individually achieve learning goals in a learning process. Learning media that will be applied in engineering drawing courses, will later be developed using the 4-D development model (four D models) which consists of 4 stages, namely: (1) Define, (2) Design, (3) Development, and (4) Disseminate. The defining stage includes the initial analysis, student analysis, concept analysis, task analysis, and specification of learning objectives. The design phase consists of the preparation of tests, media selection, format selection, and initial design (initial design). At the development stage it consists of module validation by expert lecturers, student response questionnaires, and about the pretest posttest for students. Whereas the deployment is not carried out due to the limited time of the study. The results showed (1) the module products developed were very feasible to use (2) students showed a positive response to the module developed (3) student learning outcomes improved with good categories.

Keywords: module, 4 d learning (four D model), the results of the study.

1 INTRODUCTION

Education in technical drawing is one of the subjects in mechanical engineering which is very important and must be understood by every student. Mastery of projection drawing skills, sectional drawings and selection of views taught in technical's is needed for students when they graduate and work in the industry or become lecturers. Engineering graphical communication is a core skill to acquire and refine during engineering studies. One of fundamental student's outcomes during engineering studies concern an ability to communicate effectively [1]. Robb et al [4] claimed that free hand sketching and dimensioning are considered fundamentals pre – requisites for engineering students that wants to use CAD tools properly. Free hand sketching performs multiple functions simultaneously and is generally considered a communication language and facilitator and documented as an essential part of the engineering design process, as it starts the formal process of product specification [3-5]. Impelluso and Metoyer – Guidry [10] claimed that the undergraduate engineering curriculum often focuses on theory and lacks practical focus. The authors advocated a shift towards "learning by doing". Extensive literature reviews have shown that very few research publications are devoted to teaching engineering drawing at educational institutions. Raine [6] discussed the importance of teaching engineering students the use of parametric – design software packages, such as *Pro – Engineer* and *Solidworks*. Barr et al [8] discussed an approach to teaching engineering graphics through a reverse – engineering project for groups of four students. Students disassembled an object, made hand – sketches and used them to develop 3D solid models, which were used for rapid prototyping. Hands – on activities and team work proved to be effective. Based on observations in State University of Surabaya, Mechanical Engineering Department, it showed that technical's was one of the subjects that students often complain about. It occurred because the content is difficult to understand and the learning model used by the lecturer is still less attractive. In projection drawing skills, students were told to draw projections of an object in the form of an image, rather than drawing it in the form of a real object. It was difficult for students to comprehend projections from orthogonal view to isometric's. In

drawing skills, student have not been able to determine the side of the x, y, z projection view so that it is difficult to draw sectional view, besides the technical drawing reference book has no structured steps on how to draw the correct pieces. The absence of learning media for non-symmetrical pieces that make it difficult for students to imagine objects to be drawn. As a result, there are still many student learning outcomes that are not optimal. Based on the pretest data provided, the data obtained from the State University of Surabaya D3 Engineering Production students 2017/2018 academic year are as follows:

Table 1. Values of engineering design courses 2015/2016 academic year

Value	Category	The number of students	Percentage
86 – 100	A	1	4,55%
76 – 85	A -	4	18,19%
66 – 75	B	0	0%
56 – 65	B -	2	9,1%
46 – 55	C	0	0%
0 – 45	D	15	68,1%
The number of students		22	100%

Based on that problems, then in the mechanical engineering department, the faculty of engineering of State University of Surabaya in particular, in the technical drawing course requires learning tools that are able to support and assist students in mastering these competencies. McKenna and Agogino [2] described an instructional module for teaching integrative design using six simple machine elements, work with an online module was combined with hands – on activities using a LEGO set. Baronio et al [3] showed the concept and development of an interactive self – learning tool named Technical Drawing learning Tool – Level 2 – TDTL – L2, designed to teach dimensioning criteria of mechanical features concerned to elementary machining operations for mechanical technical drawings. TDLT – L2 represents an intuitive interactive tool, based on video and drawing animations, that links real machining processes with the dimensioning of the correspondent workpiece represented in technical drawing. The objective of this paper is to develop module of technical's in order to ease the students for studying. This module discusses the subject of various projections and how to present the correct sectional views. The development used is development of technical drawing module based on projection and sectional views equipped with lego block assembly media assistance. The development used 4 – D model consist of (1) Define, (2) Design, (3) Develop, (4) Disseminate.

2 METHODOLOGY

The development used 4 – D model consist of (1) Define, (2) Design, (3) Develop, (4) Disseminate. In this study only reached at the develop stage.

Figure 1. Research Flowchart

Stage I : Define

This defining stage aims to define learning conditions that begin with an analysis of the objectives of the boundaries of the content developed by the device. Determination of this stage is done by analyzing the basic competencies, objectives and boundaries of the content developed in the learning device. The define stage includes 5 steps, namely :

1. Front – end analysis
2. Students analysis
3. Concept analysis
4. Duty analysis
5. Spesification of learning objective

Stage II : Design

This stage is done to design the initial form of learning content. This stage can be done if it has determined the learning objectives developed. The purpose of this stage is to design technical drawing module based on projection and sectional views. The first step in this planning phase is to compile a test that aims to find

out the skills and competencies of students in learning, the selection of module formats, media selection, and the initial design of technical drawing module.

Stage III : Develop

This stage aims to improve the results of the module design to be better, this is done by asking for input in the form of criticism and suggestions from expert lecturers. Steps that must be taken, namely :

1. The expert validation
2. Development test
3. Evaluation
4. Report

2.1 Research design

Technical drawing learning module based on projection and sectional views validated by an expert validator, from the validation module can be known to be feasible if it is feasible to be revised and then tested on students later in the trial, students will be given a questionnaire response to the module tested . To find out the achievement of student learning outcomes competencies after using the module, this study uses the research trial design used is Pre-Experimental Design with One-Group Pretest-Posttest Design.

O₁ X O₂

(Sugiyono, 2013 : 74 – 75)

2.2 Research instruments

1. Module Validation Sheet
This instrument is used to collect expert lecturer assessment data on the module being developed. The results of the expert lecturers' assessment will be used as a reference to revise the module developed. The module assessment aspects are in accordance with the list arranged in the module validation sheet by expert lecturers.
2. Student Response Questionnaire
This questionnaire contains a number of written statements that reveal the attitudes and opinions of students about learning modules with lego block media assisted by information technology in the subject of Technical Drawing on the subject of projections and sectional views. Completing or distributing this questionnaire was done after the completion of the learning activities. As for filling out the questionnaire, students were only asked to choose answers that are in accordance with the opinions or responses of students regarding the module developed by checking the appropriate column.
3. Test sheets
Test sheets are used to measure the learning outcomes of students' knowledge and skills during the learning process using modules, the test sheets are in the form of case-based essay questions and there are answer keys and assessment rubrics to facilitate the assessment, the pretest and posttest tests. The results of the assessment will be stated in the form of numbers and letters based on the value intervals.

2.3 Data analysis

The type of data analysis used in this study is the analysis of quantitative data and qualitative descriptive data.

1. Questionnaire for expert lecturers
Analysis of questionnaire data from expert lecturers includes the results of the validation of the module which includes language, design, and content.

Table 2. validity value criteria

Category	Scale
Invalid	1
Less valid	2
Valid	3
Very valid	4

2. Questionnaire for student's responses

Analysis of the results of student responses to find out how much the results of student responses to the media (modules). the range of scores is described in the table below.

Table 3. Scale of module practicality

Category	Scale
Poorly	1
Not good	2
Good	3
Very good	4

3. Student learning outcomes

Learning outcomes are obtained from instrument question sheets (pre-test) and (post-test) that students do. The indicator of the success of this action research is if student learning outcomes during the learning process increase. This is indicated by the value of individual learning outcomes ≥ 75 and classical completeness $\geq 75\%$.

Table 4. Percentage of improving learning outcomes

Percentage	Criteria
81 – 100	High
65 – 80	Moderate
51 – 64	Enough
0 – 50	Low

3 RESULT AND DISCUSSION

Module feasibility

The feasibility of technical drawing of the subject of projections and sectional views from the results of the validation of material experts, linguists and design experts. The following is a recapitulation of the feasibility of the module from the expert validator.

Table 5. Summary of module feasibility

No	feasibility aspect	Score	Category
1	Content	3,4	Very valid
2	Language	3,6	Very valid
3	Design	3,4	Very valid
	Average	3,5	Very valid

These results indicate that the module of technical drwing of the subject of the projection and sectional views developed are very valid for use in learning.

Responses of students

Student responses to the module applied to the limited trial by giving a student response questionnaire to 10 students.

Table 6. Responses of students

Category	Poorly	Low	Good	Very Good
Percentage	0%	11%	50%	39%

Result of Student's values

a. Stage I

The first phase of learning outcomes was held on April 6, 2018 in the State University of Surabaya, Mechanical Engineering Department. The technical implementation is by giving a Pre-test question, after working on the pre-test questions students are given an explanation of the material in the module and at the end of the learning activity students work on formative questions. The results of data processing in the pre-test carried out in the first stage obtained poor results.

b. Stage II

The second stage of Learning Outcomes was held on April 27, 2018 in the State University of Surabaya, Mechanical Engineering Department. The technical implementation is that the students conduct a discussion of the tasks contained in the module and at the end of the activity the students work on the post test questions, with 1 student student getting a score below SKM and 9 students getting a score above SKM. This shows that the use of teaching modules to draw techniques on the subject of projections and sectional views can increase the value of students in technical drawing at the State University of Surabaya Mechanical Engineering Department.

Table 7. Summary of the result

Test	Average	Number of Students	
		Accomplished	Not Accomplished
<i>Pretest</i>	40	0	10
<i>Post test</i>	79	9	1

4 CONCLUSION

Based on a series of activities that have been carried out by researchers, as well as referring to the results of research and discussion, some conclusions are obtained as follows :

- Modules developed get very decent ratings
- The results of student responses to the developed Module get a very good response.
- Student learning outcomes after using the developed module get higher.

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