Multimedia interactive learning of pictorial projection mechanical engineering skills in vocational high schools

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Abstract. This research aims to develop interactive learning multimedia for learning pictorial projection in Mechanical Engineering Drawing. This study is a research and development using the ADDIE development model, namely: Analysis, Design, Development, Implementation, and Evaluation. The results of the material expert's assessment on the material quality aspect received a percentage of 86.25% in the Very Appropriate category, and on the aspect of material benefit, a percentage of 75% was obtained in the Eligible category. The results of the media expert's assessment on the program design aspect received a percentage of 90% in the Very Appropriate category, and in the multimedia design aspect, a percentage of 86.9% was obtained in the Very feasible category. The media developed was tested on 35 students of class X Vocational High School 2 Klaten. The results of the trial on students got a percentage of 80.33% in the Very feasible category. Thus the pictorial projection learning multimedia was feasible to use as a learning medium for class X Vocational High Schools in mechanical engineering expertise.

1. Introduction

In the learning process, teachers are always required to innovate so that students can get new experiences in the learning process and so that the learning that takes place becomes fun and interesting. Because the learning process in schools is currently one of the main highlights in improving education quality, innovation in the learning process can be in learning media development. One of the learning process problems is that students are often faced with difficult material, and the learning media used are not optimal in attracting students' attention. Development is carried out to create attractive and innovative learning media. With engaging learning media, it is hoped that it will make it easier for teachers to increase student motivation and understanding of the subject matter.

Technological advances are developing rapidly in the current era, especially in Information and Communication Technology (ICT). There are many benefits of ICT, one of which uses ICT in computer-based learning media in the learning process. The form of interaction and computer applications as a medium, especially in practice and training learning, simulation, discovery, tutorials, problem-solving, and games [1]. Computer-based learning media uses computers to present learning materials that allow students to participate actively, independently, and respond to student activities [2][3]. With this computer-based learning media, it is hoped that students in absorbing the material can increase. Learning media aims to make it easier to deliver teaching material from teachers to students to enhance effectiveness and efficiency in achieving learning objectives [4-6]. The other study showed that there is a significant increase in achievement in the experimental group students after using improved learning media [7].
Mechanical Engineering Drawing subjects are one of the subjects in Vocational High Schools. At Klaten 2 Public Vocational High School, this subject is taught to class X students of the Metal Fabrication and Manufacturing Engineering Expertise Program. Because it is an adaptive subject, students must achieve a grade of 7 in this subject to achieve a minimum passing grade. In this Technical Drawing subject, the basics of drawing by hand or manual drawing are taught, which will be very useful in machining. In the learning process of Mechanical Engineering Drawing subjects, the teacher is still dominant in delivering material using books as a medium to deliver. This tends to make students quickly bored in the learning process. This statement is based on field observations.

Based on field observations, students are less motivated and enthusiastic in participating in Mechanical Engineering Drawing learning, especially in essential pictorial projection competencies. Teachers' delivery of material mostly only uses power points and books without utilizing and innovating interactive learning media. Pictorial projection is one of the essential competencies in the Engineering Drawing subject, which teaches a way to display images of objects close to their actual shape and size in three dimensions with a single view. In pictorial projection, there are two groups, namely axonometric projections and oblique projections. Oblique projection is when an object is placed in front of the projection plane, and the observer is in a specific position to see the object so that it is as if the projection rays are parallel to the projection plane by forming an angle, the resulting image is an oblique projection [8]. Axonometric projection is that the object's position is tilted to the projection plane, then the length of the line, the angle, and the proportion of the sides in general vary and are not limited [9]. In general, this axonometric projection is divided into three types, namely isometric projection, dimetric projection, and trimetric projection. Given the importance of this subject, interactive multimedia learning media was developed, which is expected to provide new experiences that can change students' perceptions about learning.

Interactive multimedia is multimedia equipped with a controller operated by the user to choose what they want for the next process [10]. Multimedia can develop sensory abilities and attract attention and interest. Multimedia is expected to have a good impact because multimedia teachers can develop learning techniques to improve student learning outcomes. Multimedia for students is expected to make it easier for them to absorb subject matter quickly and efficiently, and independent learning can be applied. Multimedia will make it easier for users to remember the text, because, in its presentation, it can be accompanied by images and animations that can be used to attract the user's attention if used correctly [11].

The use of interactive multimedia-based learning media in learning will make boring learning fun because it is supported by various aspects such as sound, video, animation, text, and graphics. Interactive learning multimedia can help students to gain more in-depth knowledge and understanding of concepts. The teacher can explain the material with high abstraction power [12]. Utilizing interactive multimedia makes teachers no longer the only source of student learning. Interactive multimedia presents multisensory because it is multisensory; student participation is suitable for individual learning because there is a bifurcation, sifting, remedial, and flexibility in selecting menus [13]. So that interactive multimedia will increase student motivation and make students active in learning. Because with interactive multimedia, students can learn independently and can be done at any time.

Learning media to attract students' attention and make students active in the learning process can use interactive multimedia-based learning media. The selection of appropriate learning media will significantly benefit the learning process [14]. Making media can use the Adobe Flash CS6 application. Adobe Flash CS6 is a program designed to create reliable and lightweight two-dimensional animation. This application is widely used to create and affect websites, interactive CDs, logos, and simple games [15]. The advantages of Adobe Flash CS6 are that users can easily and freely create animations with free motion as desired, and users can import or save files of various types according to their desired needs [16]. The use of Adobe Flash CS6 in the form of interactive multimedia, of course, must be supported by the appropriate facilities and infrastructure such as computers, CD-rooms, and flash drives. In this regard, Vocational High Schools already have adequate computer laboratory infrastructure, making it possible to use learning media in interactive multimedia.
Based on this description, this research was conducted in order to develop an interactive multimedia learning using the Adobe Flash CS6 application. Development is carried out on Mechanical Engineering Drawing with Basic Competencies of pictorial projection delivered using attractive animations so that learning is not monotonous and boring. This media can be used for grade X students of Vocational High School for Metal Fabrication and Manufacturing Engineering Skills Competencies.

2. Methods
The research method is used for research and development. The research aims to produce a new product through the development process. The product developed is interactive learning multimedia pictorial projection material in the Mechanical Engineering Drawing subject. This study aims to develop and validate products, as well as implement the developed products. The learning media development model adopts the ADDIE model approach. Research-based product development consists of four main stages, namely: (1) analysis consisting of analyzing problems and the problem needs through observation; (2) design consisting of the stages of designing a learning media framework in the form of flowcharts and storyboards; (3) development includes the creation of learning media, (4) implementation includes validation of material experts, media experts, and field trials.

The data analysis technique used quantitative descriptive analysis, which was expressed in the distribution of scores and percentages against predetermined rating scale categories as seen in table 1. The results of the assessment from material experts, media experts, and students are in the form of qualitative data, which is then converted into a score using a Likert scale with the criteria for scoring the answers for each answer item having an assessment weight between 1-4 with alternative answers in the form of less feasible, adequate, feasible, and very feasible to use equation 1. The measurement or calculation results can be processed by adding, compared with the expected amount, and the percentage obtained [17].

| Category      | Percentage |
|---------------|------------|
| Very Worth    | 76-100%    |
| Well worth    | 56-75%     |
| Enough        | 40-55%     |
| Not worth     | 0-39%      |

3. Results and Discussion
This research's final product is Adobe Flash CS6-based learning media in the subject of Mechanical Engineering Drawing pictorial projection material by presenting six main menus, namely: instructions, essential competencies, materials, evaluation, bibliography, and profiles. This media is efficient because it is a .exe file format that can be easily used directly without installing Adobe Flash CS6 software. The learning media application file developed is 31 MB making this learning media very light to run even though it uses a computer with low hardware specifications.

This structured multimedia learning contains an intro page containing the Yogyakarta State University logo and the title of the learning media, an instruction page that contains information on how to use learning media, a basic competency page containing essential competencies and learning objectives, a material page that contains pictorial projection material In accordance with essential competencies, the evaluation page contains ten multiple-choice questions which are equipped with direct feedback in the form of true or false answers, a profile page that contains developer profile information, and finally a library page containing references used in making this learning media.
3.1 Due Diligence by Material Experts
Assessment of the feasibility of learning multimedia pictorial projection material on the subject of technical drawing is carried out by material experts and assessed based on two aspects, namely aspects of material quality and aspects of material usefulness. Data from material expert judgment can be seen in table 2.

| Aspect          | Percentage | Classification |
|-----------------|------------|----------------|
| Material Quality| 86.25%     | Very worth     |
| Material Benefit| 75%        | Well worth     |
| Average         | 80.62%     | Very worth     |

The percentage result of eligibility obtained from the evaluation of material experts is 86.25% with a very proper classification on the aspect of material quality, and on the aspect of material benefit, it is scored 75.00% with proper classification. The material expert's assessment results for assessing all aspects obtained a value of 80.62% with very proper classification. Thus it can be concluded that the learning media is declared feasible based on the assessment by material experts.

3.2 Due Diligence by Media Experts
Assessment of the feasibility of learning multimedia pictorial projection material on the subject of technical drawing is carried out by media experts and assessed based on two aspects, namely aspects of program design and aspects of multimedia design. Data from material expert judgment can be seen in table 3.

| Aspect          | Percentage | Classification |
|-----------------|------------|----------------|
| Program Design  | 90%        | Very worth     |
| Multimedia Design| 86.90%     | Very worth     |
| Average         | 88.45%     | Very worth     |

The percentage of feasibility obtained from the assessment of media experts is 90.00% with a very proper classification in the aspect of program design, and in the aspect of multimedia design, it gets a score of 86.90% with very proper classification. The results of the media expert's assessment for all aspects of the assessment obtained a value of 88.45% with very proper classification. Thus it can be concluded that the learning media is declared feasible based on the assessment by media experts.

3.3 Assessment from Students
Assessment of the feasibility of learning multimedia pictorial projection material on technical drawing subjects carried out by students only assesses the aspects of using learning media that are being developed. From the 35 respondents obtained at the trial stage, the percentage value was 80.33%, with a very feasible classification. Thus it can be concluded that the learning media is declared feasible based on the assessment by students.

3.4 Total Learning Media Assessment
The percentage of validation results from material experts, media experts, and student assessments is then added up, and the average value is sought to obtain the total average assessment of the learning media. The data on the results of the total assessment of learning media can be seen in table 4.
Table 4. Assessment results by media experts.

| Aspect                        | Percentage | Classification |
|-------------------------------|------------|----------------|
| Material Expert Validation    | 80.62%     | Very worth     |
| Media Expert Validation       | 88.45%     | Very worth     |
| Student Assessment            | 80.33%     | Very worth     |
| **Average**                   | **83.13%** | **Very worth** |

The percentage of material experts' eligibility is 80.62% with very feasible classification, media experts are 88.45% with very proper classification, and student assessment is 80.33% with very feasible classification. So after being calculated, the media got an average total assessment of 83.13% with very proper classification, and it can be concluded that the learning media is declared feasible or can be used for the learning process.

4. Conclusion

The learning media product for pictorial projection material in the Mechanical Engineering Drawing subject presents six main menus: instructions, essential competencies, materials, evaluation, libraries, and a developer profile in the form of a .exe file format 31 MB equipped with introductory music and animation. The results of the validation of the feasibility of learning media for pictorial projection material on the subject of Mechanical Engineering Drawing by material experts scored 80.62% with very proper classification, by media experts, it got a score of 88.45% with very proper classification, and the assessment of media students got a score of 80.33% with very proper classification. The total assessment of instructional media got an average of 83.13% with very proper classification. It can be concluded that the media is very suitable to be used as a medium in the learning process of pictorial projection material in Mechanical Engineering Drawing subjects.

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