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# The development of interactive learning media by manufacturing helical gear using milling machine

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**Abstract.** This study is categorized as research and development (R&D) which aims to develop and determine the feasibility of interactive learning media by making helical gear using milling machine. The data collection method uses questionnaire. The respondent subjects are material experts, media experts, teachers, and students. The research data are quantitative and qualitative and these were analyzed using quantitative descriptive analysis techniques. The results of the study are interactive learning media by making helical gear using milling machine equipped with texts, images, videos and questions. The results of assessment of learning media from material experts gave 3.04 included in very feasible category. Media experts gave 3.64 included in very feasible category. Teachers gave 3.15 included in feasible category. Assessment of limited field trial got an average 2.99 included in feasible to be used category. An extensive field trial got an average 3.30 is included in very feasible category. Based on those results, the learning media is suitable to be used in learning process on helical gear material.

## 1. Introduction

Education is the delivery of knowledge, values and skills by educators to students. Education as a place to develop human beings based on certain foundations. In Law No. 20 of 2003 article 1 paragraph (1) of the National Education System states that "Education is a conscious and planned effort to create an atmosphere of learning and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by himself, society, nation and state " [1]. Education will not be separated from the development of Science and Technology (Science and Technology). The progress of science and technology requires the use of various learning media and increasingly sophisticated equipment in the learning process. Today learning activities prioritize the role of students and the use of multimedia for learning, obtaining information, and adjusting information. Learning multimedia is a multimedia application equipped with a controller that can be operated by the user [3]. But in reality, there are not many education providers that utilize technological developments, especially the use of multimedia in the learning process.



Well-designed learning utilizing multimedia technology enables students to learn more, understand what is learned better, and improve the quality of learning. One use of multimedia technology in learning is the use of learning media. Learning media can be used in the context of presenting information in front of a group of students [2]. In the current technological era teachers are required to not only master the subject matter. However, teachers must also be clever in determining learning media, compiling learning media and using interesting learning media.

Conventional machining techniques are one of the productive subjects that combine theory and practice. One of the basic competencies found in conventional machining subjects is applying the procedure of tilt gear grinding techniques. To be able to master the tilt gear shifting technique requires good competence in understanding theory and practical ability. Based on observations when making observations, the reality in the field, especially in learning conventional machining techniques in Vocational High School 2 Depok Sleman student learning achievement is still low as evidenced by the percentage of graduation based on the value of the Minimum Mastery Criteria (MMC).

Students at Vocational High School 2 Depok Sleman especially students in Metal Fabrication and Manufacturing Engineering are more interested in subjects that can be directly observed than subjects that only provide theory. This is evidenced by many students who pay less attention when the teaching and learning process takes place. The reason for the low attractiveness of these students is possible because of the quality of instructional media that is less attractive to students. Differences in the ability of each teacher's ability to deliver learning material and the ability of each student to capture material delivered by the teacher can affect the effectiveness of the learning process [4]. Therefore the teacher must be able to choose the right learning media so that the material presented can be truly understood by students.

Since many schools already have computer laboratories and some students already have their own laptops, the use of computer-based learning media is now relevant. But the use of computers in the learning process is less than optimal. Limited computer-based learning media to be used in the learning process is the cause of computer use that is not optimal. Interactive computer-based learning media are very necessary for the learning process, especially in Vocational High School 2 Depok Sleman. Interactive learning media that are dynamic are very supportive to be used in the learning process, because interactive learning media is able to explain material that has high and complex abstraction power [5]. The use of interactive learning media is expected to reduce obstacles that are often experienced by teachers and students in the learning process.

## **2. Research Methodology**

### *2.1. Type of Research*

This research uses research and development methods or known as Research & Development (R&D). Research and development methods are research methods used to produce new products and test the effectiveness of these products [6]. The product produced through this research is in the form of interactive learning media for making oblique gear for Vocational High School 2 Depok Sleman students as well as knowing the feasibility of the learning media.

### *2.2. Research subject*

The subjects of this study included 1 material expert lecturer, 1 media expert lecturer, 1 subject matter teacher, and class XI Metal Fabrication and Manufacturing Engineering students at Vocational High School 2 Depok Sleman with total of 28 respondent.

### *2.3. Procedure*

The research procedure in this research development uses the 4D model [7]. There are four stages: define stage, design stage, develop stage, and disseminate stage. This define stage is often called the needs analysis phase. This stage is to establish and define development requirements. In general, in this definition the development needs analysis is carried out, the requirements for product development that is in accordance with the needs of the user and the research and development model (R&D model)

suitable for developing products. The design phase is the stage of making a prototype or initial product. In the context of developing teaching materials, this stage is carried out to make learning media in accordance with the framework of the contents of the curriculum and material analysis results.

The develop stage is the stage of making media and improving media based on expert advice, teacher assessment and field trials. At this stage there are steps that must be done namely; validation by material experts and media experts, revisions based on expert advice, teacher assessment, revisions based on teacher's advice, limited field trials, revision based on trial results, then extensive field trials. Disseminate stage is carried out by publicizing the results of media development. In the context of the development of instructional media, the disseminate phase is carried out by means of socialization of teaching materials through distribution in a limited amount to teachers and students.

#### 2.4. Data, Instruments and Data Collection Techniques

The data taken is the result of validation of material experts, media experts, supporting teachers, and students. The research instrument used in this study was an expert validation instrument, an instrument of teacher eligibility, and an instrument of eligibility for students. Data collection techniques carried out by observation and interviews at the stage of looking for potential problems. And a questionnaire to obtain data on the feasibility of learning media developed.

#### 2.5. Data analysis technique

Data analysis techniques in this study used quantitative descriptive techniques. The type of data generated in the form of qualitative data and quantitative data. Qualitative data in the form of criticism, suggestions and responses from material experts, media experts, and teachers are used as a basis for revising the product while quantitative data in the form of scores assessment material experts, media experts, teachers, and respondents, namely students.

The measurement scale uses a Likert scale. The evaluation criteria for each instrument have a rating weighting between 1-4 with alternative answers in the form of very improper, improper, improper, and very feasible on the assessment instrument material experts, media experts, and teachers. Whereas students' assessment instruments are strongly disagree, disagree, agree, and strongly agree. Distance intervals between scoring scales are calculated using the formula [8], with results in accordance with those presented in Table 1.

**Table 1.** Classification of Feasibility

Average Score	Category
3,26 s/d 4,00	Very decent
2,51 s/d 3,25	Worthy
1,76 s/d 2,50	Not feasible
1,00 s/d 1,75	Very Inadequate

Quantitative data derived from material experts and media experts, teacher assessments, and assessments from students were then calculated on average using equation 1.

$$X = \frac{Mx}{n} \quad (1)$$

Where:

- X = average score
- Mx = total score
- N = total population

The average score results are then converted to the level of eligibility according to Table 1. The classification tables are grouped into four categories: very feasible, feasible, not feasible, and very improper. The learning media that are developed are suitable for use in learning if they have a minimum average score of 2.51 or a decent criterion.

### 3. Results and Discussion

Interactive learning media for tilting gears with a milling machine is included in Research and Development (R&D). The R&D model used is the 4D Thiagarajan model in Endang Mulyatiningsih (2013: 161) covering four stages. The first stage is defining or defining is done by observation and interviews with students and teachers at school. This stage is to find out the problems in learning at Vocational High School 2 Depok Sleman on the competence of Metal Fabrication and Manufacturing Engineering expertise. The results of this stage are the material content of inclined gears, curriculum analysis, student analysis, and the ultimate goal of learning.

Furthermore, the design phase of this design research process the data obtained in the previous stage. The first step is to create a flowchart and storyboard to design the shape of the learning media developed. After the design form is completed then it is realized with Adobe Flash software into an interactive learning media for making helical gears with a milling machine. The design phase produces an initial product or prototype. The finished prototype is then used for research material.

To produce the final product, a development phase is carried out. Interactive learning media making inclined gear with this milling machine through the process of expert validation, assessment of subject teachers and product trials to students to determine their eligibility. The product trial phase for the student is carried out twice, firstly testing a limited field product with a number of respondents 6 people then a large field test with a total of 28 respondents.

The first step is to validate the material expert. Material expert assessment includes two aspects, namely the suitability of the material and aspects of the quality of the material. The results of the material validation assessment can be seen in table 2.

**Table 2.** Results of Expert Material Validation

Assessment Aspects	Score	Category
Conformity of Material	3,28	Very decent
Quality of Material	2,80	Worthy
Mean	3,04	Worthy

The results of the validation by the material experts in table 2 for the material suitability aspect obtained a score of 3.28 included in the very feasible category. The assessment of material quality aspects obtained a score of 2.80 included in the feasible category. The results of the expert material assessment for all aspects obtained an average score of 3.04 in the proper category. The data obtained shows the appropriateness of the contents of the learning media material which is then criticized and given advice by the material expert for consideration of improving learning media so that it gets a good and proper learning media.

After the learning media has been validated by the material expert, the next step is to validate it by the media expert. The assessment conducted by media experts consists of three aspects, namely aspects of media operation, aspects of media appearance, and writing. The following results of the evaluation of media validation can be seen in table 3.

**Table 3.** Media expert validation results

Assessment Aspects	Score	Category
Media operations	3,60	Very decent
Media Display	3,84	Very decent
Article	3,50	Very decent
Mean	3,64	Very decent

The results of the assessment by media experts in table 3 obtained scores for aspects of media operation 3.60 included in the very feasible category. Rating on the aspect of appearance obtained a score of 3.84 included in the very feasible category. Rating on the aspect of writing obtained a score of 3.50 included in the very feasible category. The overall results of the assessment aspects of media experts obtained an average score of 3.64 with a very decent category. The data obtained shows the feasibility of instructional media and then the advice given by media experts for consideration of improvement in learning media so as to get good and proper learning media.

After the learning media has been validated by the material expert and the media expert, the next step is to evaluate the instructional media to the teacher. The aspects assessed for teacher assessment include communication, technical design, material quality, material content, and learning strategies. The following results of teacher assessment can be seen in table 4.

**Table 4.** Teacher assessment results

Assessment Aspects	Score	Category
Communication	3,25	Worthy
Technical Design	3,11	Worthy
Quality of Material	3,00	Worthy
Fill in the Material	3,42	Very decent
Learning strategy	3,00	Worthy
Mean	3,15	Worthy

The results of the assessment by the teacher in table 4 obtained a score for the communication aspect of 3.25 included in the feasible category. The assessment on the technical design aspects obtained a score of 3.11 included in the feasible category. An assessment of the material quality aspects obtained a score of 3.00, including the feasible category. The assessment on the mastery content aspect obtained a score of 3.42 including in the very feasible category. The assessment of the learning strategy obtained a score of 3.00 included in the feasible category. The overall results of the assessment aspects by the teacher obtained an average score of 3.15 with a decent category.

The trial was conducted in two stages. The first stage of the field trial was limited to 6 students as respondents. As for the large field trial, an assessment of 28 students as respondents was conducted. The results of the assessment from a limited field trial by 6 students can be seen in table 5.

**Table 5.** Limited field test assessment results

Assessment Aspects	Score	Category
Display	3,16	Worthy
Text	3,00	Worthy
Ease	3,03	Worthy
The benefits	2,79	Worthy
Mean	2,99	Worthy

The results of the limited field trials seen in Table 5 obtained an average score for the display aspect of 3.16 included in the feasible category. An assessment of written / text aspects obtained an average score of 3.00 including the feasible category. Assessment of the aspects of convenience obtained an average score of 3.03 included in the feasible category. Assessment of the aspects of benefits obtained an average score of 2.79 included in the feasible category. The overall aspects of the results for the assessment of limited field trials obtained an average score of 2.99 so that the interactive learning media making oblique gears can be said to be feasible. Furthermore, the results of a broad field trial assessment can be seen in Table 6.

**Table 6.** Results of area field test assessments

Assessment Aspects	Score	Category
Display	3,33	Very decent
Text	3,27	Very decent
Ease	3,45	Very decent
The benefits	3,15	Worthy
Mean	3,30	Very decent

The results of extensive field trials seen in table 6 obtained an average score for the display aspect of 3.33, including the very feasible category. An assessment of written / text aspects obtained an average score of 3.27 including the very feasible category. Assessment of the aspects of convenience obtained an average score of 3.46 included in the very feasible category. Assessment of the aspects of benefits obtained an average score of 3.11 included in the feasible category. The results of all aspects for the evaluation of large field trials obtained an average score of 3.30 so that the learning media can be said to be suitable for use in the learning process.

After all the development stages have been carried out, the next step is the final stage, which is the disseminate stage. Products that have gone through expert validation, teacher assessment, and also trials then enter the disseminate stage which is also called the deployment stage. Learning media is packaged in the form of Compact Disk (CD). The CD was then distributed on a limited basis to Vocational High School 2 Depok Sleman schools on metal fabrication and manufacturing engineering competencies.

The form of learning media products making oblique gear with a milling machine developed using Adobe Flash software in its application. This learning media contains the theory of tilt gears, the process of making tilt gears, video tutorials for making tilt gears, and practice exercises. Interactive learning media for making oblique gear with this milling machine with “.exe” format with a total file size of 152 MB. This learning media can be run on all types of computers that use Windows operating systems such as Windows XP, Windows 7, Windows 8, and Windows 10. Recommended computer specifications have a minimum of 2GB RAM capacity to maximize when operating the learning media.

To reproduce interactive learning media making slanted gears with a milling machine is very easy. Steps to multiply this learning media simply copy all the files in the folder then paste them to the new storage destination. And to start the operation, just click the file format “.Exe” without having to install it first. After that the initial display of learning media will immediately appear which can then be used for the learning process.

#### 4. Conclusions

Interactive learning media for making oblique gear material with a milling machine has been successfully developed. The method used in the development of instructional media is a 4D development model consisting of 4 stages. These stages are defining stage, designing phase, developing phase and dissemination stage. The research was conducted at the State Vocational High

School 2 Depok Sleman with the subject matter of research material experts, media experts, teachers, and students of class XI Metal Fabrication and Manufacturing Engineering. The data collection model uses observation, interviews, and questionnaires. The data analysis technique used is quantitative descriptive technique. The results of the product from the development of interactive learning media making oblique gears with a milling machine format ".exe" with a file size of 152 MB.

In the research and development of learning media, an assessment of the feasibility of learning media is carried out by material experts, media experts, teachers and students. The assessment results from the material experts get a score of 3.04 included in the feasible category. Rating from media experts get a score of 3.64 included in the category very feasible. Assessment by the teacher gets a score of 3.15 included in the feasible category. For the assessment of students carried out in two stages, the first is limited field trials to get an average score of 2.99 included in the feasible category. Then the broad field trials obtained an average score of 3.30 included in the very feasible category. So that it can be concluded interactive learning media making sloping gear material with a milling machine can be said to be feasible to use.

There is a need for further development of this learning media by adding a variety of animations in 3D to illustrate / visualize the existing material. This research only produces learning media software that is suitable for use in the learning process so that further research is expected to do further research to determine the effect of the use of this learning media on student learning achievement.

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