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Development Of Plate & Forging Work Instructions As Practicum Guidelines in the Department of Mechanical Engineering

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Abstrak

Pendidikan merupakan proses yang kompleks, berbagai permasalahan dalam proses pembelajaran perlu diselaraskan dan dimantapkan agar tercipta kondisi pembelajaran yang sesuai, sehingga diperoleh hasil belajar yang optimal. Untuk melengkapi komponen belajar dan pembelajaran di perguruan tinggi khususnya pada mata kuliah praktikum Plat & Tempa Jurusan Teknik Mesin Universitas Negeri Surabaya, diperlukan adanya media atau alat yang mampu merangsang pembelajaran secara efektif dan efisien, salah satunya dengan memanfaatkan instruksi kerja sebagai pedoman, khususnya pada mata kuliah berbasis praktikum. Penelitian ini menggunakan metode pengembangan. Model pengembangan yang digunakan adalah model prosedural yaitu model deskriptif yang menunjukkan langkah-langkah yang harus ditempuh untuk menghasilkan suatu produk. Sumber data diperoleh dari sumber literatur instruksi kerja pada mata kuliah praktikum Plat & Tempa yang telah digunakan, teknik pengumpulan data menggunakan metode angket dengan sampel mahasiswa yang sedang atau pernah mengikuti mata kuliah Praktek Plat & Tempa. Secara keseluruhan, nilai rata-rata dari mahasiswa yang menggunakan pengembangan bahan ajar instruksi kerja adalah 3,38 dari rentang nilai 4, yaitu berada pada kategori sangat layak dan dapat digunakan. Dengan adanya instruksi kerja ini diharapkan praktikan mampu menerjemahkan dari bentuk gambar dan tulisan hingga menjadi sebuah benda kerja, sehingga tercapai kemandirian dalam kegiatan praktikum Plat & Tempa.

Kata Kunci: Pembelajaran, pengembangan, instruksi kerja, praktek, plat & tempa.

Abstract

Education is a complex process, various problems in the learning process need to be aligned and strengthened in order to create appropriate learning conditions, so that optimal learning results are obtained. To complete the learning and learning components in tertiary institutions, especially in the Plate & Forging practicum course, the Department of Mechanical Engineering, State University of Surabaya, it is necessary to have media or tools that are able to stimulate learning effectively and efficiently, one of which is by utilizing work instructions as a guide, especially in subjects practicum based courses. This research uses the development method. The development model used is a procedural model, namely a descriptive model that shows the steps that must be taken to produce a product. Sources of data were obtained from literature sources of work instructions in the Plate & Forging practicum course that had been used, the data collection technique used the questionnaire method with a sample of students who were or had taken the Plate & Forging Practice course. Overall, the average score of students who use the development of work instruction teaching materials is 3.38 out of a range of 4, which is in the very feasible and usable category. With this work instruction, it is hoped that the practitioner will be able to translate from the form of images and writings to become a workpiece, so that independence is achieved in the Plate & Forging practicum activities.

Keywords: Learning, development, work instructions, practice, plating & forging.

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INTRODUCTION

The rapid development of science and technology requires every human being to have a tenacious and disciplined attitude in improving human resources. Education plays a very important role in improving human resources so that they can keep abreast of and not be left behind by developments and changing times.

Initially, research and development was applied to the industrial world, and was the spearhead of an industry in producing new products needed by the market. Nearly 4% of the cost is used for this research, even for certain fields such as computers and pharmaceuticals the allocation of costs can exceed 4% (*Borg, W.R. Dan Gall, M.D. (1989). Educational Research:...* - *Google Scholar*, n.d.). Meanwhile, in the social and educational fields, the role of research and development is still very small, namely less than 1% of the overall cost of education. This is considered to be one of the main reasons why progress in education has lagged behind compared to other fields. As stated by (*Borg, W.R. Dan Gall, M.D. (1989)*), "Unfortunately, R & D still plays a minor role in education. Less than one percent of education expenditures are for this purpose. This is probably one of the main reasons why progress in education has lagged for behind progress in other field".

According to (*Borg, W.R. Dan Gall, M.D. (1989). Educational Research:...* - *Google Scholar*, n.d.), "Educational research and development is a process used to develop and validate educational products", meaning that research and development is a process used to develop and validate educational products. The results of development research are not only the development of an existing product but also to find knowledge or answers to practical problems. (Sugiyono, 2013) argues that research and development methods are research methods used to produce certain products, and test the effectiveness of these products. To be able to produce certain products, needs analysis research is used (using survey or qualitative methods) and to test the effectiveness of these products so that they can function in the wider community, research is needed to test the effectiveness of these products (experimental methods are used).

Furthermore, (*Borg, W.R. Dan Gall, M.D. (1989). Educational Research:...* - *Google Scholar*, n.d.) stated that to carry out a needs analysis so that hypothetical products can be produced, basic research methods are often used. Then to test the hypothetical product, an experiment or action research is used. After the product is tested, it can be applied. The process of product testing with experiments is called applied research.

The resulting educational products can be in the form of specific curriculum for specific educational needs, teaching methods, educational media, textbooks, modules, educational staff competencies, evaluation systems, competency test models, classroom arrangements for specific learning models, production unit models, management models, employee development systems, payroll systems and others (Sugiyono, 2013). In line with this (*Metode Penelitian Pendidikan Sukmadinata - Google Scholar*, n.d.), argues that research and development (R&D) is a research approach to produce new products or improve existing products. The resulting product can be in the form of software or hardware. Software products such as programs for data processing, classroom learning, libraries or laboratories, or educational models, learning training, guidance, evaluation, management, and so on. While hardware products such as books, modules, learning aids in classes and laboratories, packages, or programs learning. Research and development is different from ordinary research which only produces suggestions for improvement, research and development produces products that can be used immediately.

The following are some relevant studies:

1. Research conducted by (Wulandari, 2019) entitled *The Effect of Implementing Tool Work Instructions on the Skills of Using Tools in the Tarbiyah and Teacher Training Faculty Laboratory of UIN Sunan Ampel Surabaya*. Based on the research results for the first observation, the following data were obtained: (1) 26.09% of students often applied tool work instructions when carrying out practicum in the laboratory, (2) 56.52% rarely, and (3) 17.39% Never. Most students rarely use tool work instructions, this is very likely to happen because the Tarbiyah and Teacher Training Faculty laboratory is relatively new, the

faculty building has just been renovated and the procurement of tools in the laboratory has also only started in mid-2016. After the equipment procurement was completed, the laboratory did not necessarily ready to use for practice. There are not many tool work instructions that have been prepared. Students who at the time of observation carried out more or more often used complicated tools were likely to use tool work instructions more often, while students who rarely or never even operated complex tools, tools that contained work instructions rarely used or even never knew work instructions. tool. In the second observation, data were obtained: (1) 2.17% of students were highly skilled in using practicum tools, (2) 39.13% of students were skilled in using practicum tools, (3) 45.65% of students were less skilled in using practicum tools , and (4) As many as 13.04% of students are not skilled at using practicum tools. This is because skills cannot be created at once, but are formed from repeated processes. This repeated process will form an experience that will be embedded in each individual which will turn into skills. Students rarely carry out practicum in the laboratory, causing low skills in using tools.

2. Research conducted by (Aisyah, 2016) entitled *The Relationship between Compliance with Work Instructions and Safe Behavior in Employees of the Mechanical Section of PT. Indo Acidatama Tbk, Kemiri, Kebakkramat, Karanganyar*. The study was conducted to analyze the relationship between compliance with work instructions and safe behavior among employees at the mechanical department of PT. Indo Acidatama Tbk, Kemiri, Kebakkramat, Karanganyar. This research method uses an analytic survey design with a cross sectional approach. Sampling using total sampling technique with a population of 30 respondents. Statistical test using Pearson Product Moment. The results of the correlation statistical test showed that the p value was 0.017 ($p < 0.05$) and the correlation value was 0.432, which means that there is a significant relationship with the moderate level of correlation between compliance with work instructions and safe behavior in employees of the mechanical department of PT. Indo Acidatama Tbk, Kemiri, Kebakkramat, Karanganyar. This study concluded that the more employees comply with work instructions, the safer the employee's behavior at work and vice versa.

3. Research conducted by (Adilah et al., 2015) entitled *Attitudes of Employees towards the Work System and Giving Work Instructions (Study on Employees of Hotel Umm Inn Malang)*. This study aims to formulate the problem in this study, namely how are the attitudes of employees towards the work system and work instructions at UMM Inn Hotel Malang. While the purpose of this study was to determine the attitude of employees towards the work system and work instructions at UMM Inn Hotel Malang. The research method used is quantitative descriptive research. The data source was obtained from UMM Inn Malang Hotel employees, with a total sample of 40 people. The validity test was carried out using product moment correlation, with a validity value ranging from 0.387 to 0.830. The reliability test used the alpha cronbach technique with a reliability result of 0.870. The results obtained are a high level of positivity (3.83) regarding employee attitudes towards the work system and work instructions at UMM Inn Hotel Malang. This shows that the continuity of the running of the UMM Inn Malang Hotel, namely between the attitudes of employees with the work system and work instructions, is in good synergy.

From the three studies mentioned above, the authors understand that it is important to make work instructions. Because with the development of this work instruction it is hoped that it can be a way out to attract students' attention, make students learn actively and independently in learning activities, be able to understand the material before starting practicum. As well as increasing students' memory of the material being studied.

METHOD

The method used in this research is the Research and Development method (*Borg, W.R. Dan Gall, M.D. (1989). Educational Research:...* - *Google Scholar*, n.d.) which has at least three things, namely 1. Bridging

the gap between the findings that occur in research and educational practice, one might say between basic research and applied research, 2. Finding, developing, and validating a product so that this research can be used to develop and improve the quality of education and learning effectively, 3. Testing one or more theories that underlie the birth of a product, whether the theory is effective means the product is effective, or the theory is irrelevant in the current era, the product is proven to be ineffective, maybe even the theory needs to be collaborated with other theories if the product is designed in a multidisciplinary manner.

Data collection was carried out from September to December 2022 at the Department of Mechanical Engineering, Surabaya State University with the research subjects being a number of students consisting of 2 classes, namely the TMA class of 15 students as the control class and the TMB class of 15 students as the experimental class.

In this study the researchers collected data by questionnaire and used a positive Likert scale, with 4 levels because in order to reduce the possibility of respondents answering the answer choices in the middle category if given a Likert scale with an odd level this applies to all assessments, both from experts and respondents (students). This assessment consists of several 3 aspects namely; appearance, presentation of the material, and the benefits of the work instructions themselves. Data was taken through a questionnaire using a Likert scale with four available answer choices which would be converted into scores with several value scales that had been made by the researcher based on the rating rating of each answer described in Table 1.

Table 1 - Categories of Assessment of Material Experts, Language Experts, and Students.

Rating	Description	Score
A	Agree	4
SA	Simply Agree	2
SD	Simply Disagree	3
D	Disagree	1

The next process is to explain the feasibility of the product. After the data is obtained, the next thing to do is to see the weight of each response, both from experts and from students who have filled out the questionnaire and calculate the average score, using the following formula:

$$X = \frac{\sum x}{n}$$

Which;

- X = Average score
- $\sum x$ = Total score of each
- n = Number of appraisers

Assessment of each aspect of the product developed uses a Likert Scale, where the product can be said to be feasible if the average of each assessment at least gets good criteria using calculations according to Sudjana (2001: 51) as follows:

$$P = \frac{f}{N} \times 100\%$$

Which;

- P = Percentage
- f = Score obtained
- N = Maximum score

After the average percentage value is obtained, then proceed with the designation of the quality predicate of the product made based on the Rating Scale measurement scale. Percentage includes quantitative criteria, the division of the scale only takes into account the range of numbers according to a predetermined size. The expected maximum condition is calculated at 100%. So, if the researcher uses the four categories according to the Likert scale above, then between the values of 0% to 100% are divided equally to produce an eligibility category consisting of 5 parts. The eligibility category can be seen in Table 2.

Table 2 - Eligibility Category based on Rating Scale.

Scale	Category	Percentage
5	Very Feasible	81%-100%
4	Feasible	61%-80%
3	Less Feasible	41%-60%
2	Not Feasible	21%-40%
1	Very Unworthy	0%-20%

RESULT AND DISCUSSION

Results

The work instructions developed in the study consist of 4 main topics, namely:

1. Kinds of Connection and Strengthening
2. Rivet Connection
3. Fitting
4. Elbow Round Funnel

After the work instructions were completed, they were then validated by 2 experts in their fields, namely lecturers from the Department of Mechanical Engineering, Faculty of Engineering, Surabaya State University.

The work instruction validation assessment includes 3 aspects, namely the appearance aspect, the material presentation aspect, and the work instruction usefulness aspect. These three aspects were assessed using a Likert scale with categories for each value being 1 (disagree), 2 (disagree), 3 (agree), 4 (strongly agree).

It is planned that in this research the data collection technique will be carried out using closed questionnaire data collection where the respondent only needs to put a checklist (√) in the answer column provided. The instrument in the form of a closed questionnaire was aimed at experts and was given to students who were participating in plate & forging practice as research subjects, totaling 30 students.

For student assessments, from the appearance aspect, an average score of 3.4 was obtained. Then from the aspect of presenting the material, the average score is 3.4. From the aspect of benefits obtained an average score of 3.35. Then the feasibility of the work instructions is calculated by converting it into a percentage.

Table 3 - Percentage of Feasibility Assessment of Students.

Aspect	Percentage	Category
Appearance	85%	Very Feasible
Presentation of material	84.9%	Very Feasible
Benefit	83.4%	Very Feasible

Overall, the average score of students who use the development of work instruction teaching materials is 3.38 out of a range of 4, which is in the very feasible category and can be used with slight revisions. Therefore, the teaching materials developed in this study were revised in terms of presentation of material and benefits, namely by adding quizzes, guessing pictures, improving the order of work instructions, according to the comments and suggestions given by students.

For the assessment of 2 expert lecturers in their fields, from the appearance aspect, a mean score of 3.54 (89.2%) was obtained. Then from the aspect of presenting the material, the average score is 3.6 (90%). From the aspect of the benefits obtained an average score of 3.35 (82.1%). Then the feasibility of the work instructions is calculated by converting it into a percentage.

Table 5 - Percentage of Feasibility Assessment from Lecturers.

Aspect	Percentage	Category
Appearance	89,2%	Very Feasible
Presentation of material	90%	Very Feasible
Benefit	82,1%	Very Feasible

Overall, the average score of the expert team validating the teaching materials and language developed was 3.49 out of a range of 4, which is in the very valid category and can be used with slight revisions. Therefore, the teaching materials developed in the study were revised in terms of material presentation and benefits, namely by adding practicum steps, adding 3-dimensional images, other learning support materials, and practicum guidelines in accordance with the comments and suggestions provided by the expert validator team.

Discussion

The learning outcomes of the teaching and learning process can be seen from the quality of the graduates produced. Thus an educator is required to be careful in choosing and applying teaching methods in order to obtain high quality graduates. Even so, the success of the process is not only based on learning methods but can be influenced by several other factors, one of which is learning media such as work instructions.

Work instructions are work mechanism documents that regulate in detail and clearly the sequence of an activity that only involves one function as a support for quality procedures or work procedures, in principle work instructions describe how one step in a procedure is carried out.

The delivery of practical learning material so far illustrates the role of the teacher who is more dominant using conventional methods, namely lectures and demonstrations with the media used are blackboards and practicum worksheets. The use of this method without the support of variations with the use of other learning media will be able to cause students' acceptance of material to be less efficient.

Likewise, problems related to the lack of sources of learning information and the lack of independence of students to learn which are inhibiting factors for achieving learning objectives will also affect student achievement. In addition, this problem is also caused by the awareness of independent learning that is still lacking among students, so the author tries to find a solution to this problem, namely by making a guideline that can be studied by students independently, namely in the form of work instructions. The use of work instructions is expected to assist students in learning so that it is easier to fully understand the practicum material.

With work instructions as a learning medium in the Plat & Forging practice course, it is hoped that it can increase the knowledge, understanding and academic achievement of students in the Plate & Forging practice in the Department of Mechanical Engineering, Faculty of Engineering, State University of Surabaya. From the description above it can be concluded that research and development contains several definitions as follows:

1. Research and development is research by providing treatment, starting with a need or problems that require solutions based on a certain theoretical framework;
2. Research and development are research methods used to produce certain products and test the validity and effectiveness of these products;
3. Research and development is a process or steps to develop a new product or improve existing products, so the process takes a relatively long time.

Most of the objectives of this research have been achieved, namely: (1) Producing teaching materials in the form of work instructions as a guideline for Plate & Forging Practice in the Mechanical Engineering Department, (2) Knowing the Feasibility of work instructions as a guideline for "Plat & Forging Practice" to support student practicum, (3) Knowing student responses or responses to work instructions as a guideline for "Plat & Forging Practice".

The benefits of this research can be used by several parties, namely as: (1) Guidelines for lecturers to improve the quality of learning, especially in the Plate & Forging Practice course, (2) Guidelines for technicians to increase knowledge and practicum procedures according to Standard Operating Procedure, (3) Guidelines and a guide for students in carrying out Plate & Forging practicum in accordance with the Standard Operating Procedure.

Although there is still much to be developed in the making of this work instruction, including: the instrument for material experts is in the form of a questionnaire for material expert responses/assessments to the material contained in the learning Work Instructions. The instruments used by material experts are based on the characteristics of Work Instructions which include: Self Instruction, Self Contained, Stand Alone, Adaptive and User Friendly. The results of the judicial review are used as a basis for revising and perfecting the work instruction material.

Thus, research and development is research to understand the urgent needs of a community or group of people, then carry out an in-depth study of the causes, as well as a study of relevant theories to address these causes, to then be used as a basis for developing a product. , validate, and test its effectiveness.

Making plate & forge work instructions is useful to support the learning process. Before being used, work instructions must be ensured that they are in accordance with the needs of students and in accordance with the learning outcomes of plate & forging courses. In the plate & forging course, students of the Department of Mechanical Engineering at Surabaya State University need a guide that can help them with information and materials about plates & forgings.

If in the relevant research above, it is presented only in a specific way towards an attitude and behavior of students and employees. So for plate and forging work instructions are presented as instructions to contain the steps of a workpiece manufacture carried out during practicum, where these steps are more complex and detailed than step by step and are measurable in each part of the workpiece to be made.

The development of this work instruction is still within the scope of the Department of Mechanical Engineering, State University of Surabaya, so it is necessary to carry out further research and development on a wider scale.

In this study there is still no validation aspect from the design team. Therefore, this work instructions can be further developed by requesting validation from a team of experts in the field of design.

In this study, 75% of jobsheet images still use 2D images. In the future, jobsheet images can be developed to use 3D images to make it easier for students to illustrate finished images with workpieces.

CONCLUSION

The use of work instructions in student learning is a learning activity that students can do independently. From the learning process students use Work Instructions have the following objectives 1) Increase the motivation and enthusiasm of students learning, 2) Overcoming the limitations of time, space, and sensory power, both learning participants and teachers/instructors, 3) Develop students' ability to interact directly with the environment and other learning resources, 4) Allows students to study independently according to their abilities and interests, 5) To find out how to make an object according to practicum procedures, 6) To increase skills in carrying out a procedure, 7) To know the basic guidelines in carrying out a procedure.

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