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Management of Machining Practice Learning Industrial Product Based

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Abstract

The development of vocational practice learning must adapt to the needs of contemporary industry competencies. Vocational practice learning innovations must be carried out appropriately, systematically by taking into account the needs of the environment. The selection of the right learning model affects the process, learning outcomes, and student learning experience. This study aims to analyze the process of learning industrial product-based machining practices. The research approach used an experiment with a static group comparison design. The design of this study used two groups consisting of an experimental group and a control group. The experimental group is the group that gets treatment using industrial product-based practical learning, while the control group uses practical learning based on assignment job sheets. The choice of the two groups was done randomly. Each group consists of 20 respondents. The research respondents were students of the Department of Mechanical Engineering Universitas Negeri Semarang who met the requirements and had passed the Machining Process 1 course. The results revealed that there were differences in the process of implementing the learning practice of industrial product-based machining and learning the practice of machining based on job sheet assignments. The difference in the learning process between the two groups is about the process of giving apperception and motivation, mastery of learning materials, implementing learning strategies, choosing the application of learning resources or learning media, involving students in learning, and closing learning activities.

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INTRODUCTION

Learning as a process must be designed, developed, and managed creatively, dynamically, by applying a multi-dimensional approach to create an atmosphere and learning process that is conducive to students. As a system, learning is planned, implemented, and evaluated systematically so that learners can achieve learning goals actively, effectively, and innovatively. Vocational practice learning innovations should be built and developed in line with the needs of the industry to obtain an appropriate learning model according to student characteristics and competency needs as expected by the industry. Practical learning innovation is an effort to develop a learning process using methods, approaches, facilities, an atmosphere that supports the achievement of predetermined learning objectives, and is expected to improve the quality of the process and measurable, systematic, and sustainable results.

Lack of innovation in vocational practice learning because the curriculum used is still stagnant, thus building a stigma in students that the learning model used does not need to be adjusted. Changes in the vocational education curriculum need to change and be dynamic in line with technological advances that allow competencies to continue to change and tend to increase. Changes to the vocational education curriculum are carried out by aligning competencies with industry in a systematic, measurable, and sustainable manner through predetermined stages. The curriculum developed and its implementation must be in line with the needs of industry competencies and involve other stakeholders (Finch & Crunkilton, 1999). In principle, the alignment of the curriculum is carried out constructively by considering the steps for learning achievement to gain student learning experiences in achieving the expected goals (Kuhn & Rundle, 2009).

Aligning the curriculum with industry is done well, it has an impact on the development of learning models that are tailored to the needs of the industry and the characteristics of students with an approach to the principles of vocational education. The principles that must be met in implementing vocational education are that: 1) vocational education will be effective if the teacher has had successful experience in applying skills and knowledge to the operations and work processes to be carried out; 2) vocational education will be efficient if the teaching methods used and personal relationships with students consider the characteristics of these learners; and 3) Vocational education will be effective only to be given where the training tasks are carried out in the same manner, tools and machines as those prescribed in the workplace (Prosser & Quigley, 1959).

Learners are lacking in innovating vocational practice learning because the industry learning experience they have is still lacking, both industrial apprenticeships, certification of productive skills, collaborative learning. This learner experience has an impact on the development of vocational education learning innovations to improve the learning experience and performance of students. New, more innovative learning experiences facilitate the development of the characteristics and learning experiences of students (Leung and McGrath, 2010). The success of vocational education learning is determined by the selection of the appropriate learning model according to industry needs, oriented to the needs of work experience, and student performance. Therefore, learners must be able to create interesting learning experiences to bring students to learn well. The learning experience of students is increasingly challenging if the work is done relevant to industry needs (Hadgraft, R., 2017). Effective industrial learning develops theoretical and practical knowledge in a real production environment with a didactic, integrative, and technical orientation (Baena, et al., 2017). Collaborative industrial learning encourages students to work together to solve problems through complex technological developments, think critically, and understand the practical application of production management principles (Selim, et al., 2016).

The learning implementation of industrial product-based machining practices uses several stages, such as alignment, conceive, design, implement, evaluation). The Alignment stage is the first and most important step in learning industrial product-based machining practices. The success of this stage is determined in aligning needs with industry. Alignment determines the types of products to be fabricated by considering the learning objectives to be achieved, the resources that are owned by both parties, the learning implementation model, and strengthening workplace culture. The Conceive stage is a step to strengthen the understanding of the implementation of the learning practice of industrial product-based machining for students, learners, and practical implementing elements. In the next conceive step, learners form study groups and help students discuss determining industrial products to be designed and manufactured. Guiding learners get the best choice from various alternative products initiated by each study group. The design stage is a step in designing products and learning activities. At this stage, learners help students discuss dividing work so that members have responsibility for the work, and help determine the time for completing the work that is their respective responsibility. Learners ensure that the design is by the product to be produced. Mentoring and supervision from educators are needed so that implementation is by the predetermined design and time.

The Implement stage is the most important step in fabricating a product that has been designed. This stage determines whether the product is successfully made and functions according to the design. Students need a lot of time to solve problems if the product is not functioning properly. Learners provide motivation and direction so that students don't give up quickly. Assistance and supervision are needed so that implementation is by the predetermined design and time. The evaluation stage is the final stage of learning through the assessment of the process and the final product that has been made according to the plan. Process assessment is carried out by communicating process performance in front of other study groups. Process assessment as feedback to get constructive inputs for the development of subsequent learning. Product assessment is carried out to measure conformity with the product being designed. The assessment uses instruments that have been made by involving industry. Based on the above problems, the research focuses on the management of industrial product-based learning in the implementation of machining practices learning activities. Analysis of the learning process using criteria: giving perceptions and motivation, mastery of learning materials, implementing learning strategies, implementing learning resources or learning media, involving students in learning, and closing the learning process.

METHODS

The research approach used this type of experiment. The research design used a static group comparison design, consisting of an experimental group and a control group. An experimental group is a group of research respondents who are given treatment using a product-based learning model of machining practices and a control group is a group of research respondents who are given the treatment of a job sheet-based machine learning model. The selection of the two research groups used a random technique. Respondents amounted to 40 students who were divided into the control group and the experimental group.

Research respondents were students of the Department of Mechanical Engineering, Semarang State University, who met the Mechanical Practice 2 course. The respondents had met the requirements to take and pass the Mechanical Practice course 1. The technique of taking respondents for each group was using simple random sampling. Respondents were taken randomly from 40 students. Random selection was also carried out to determine the experimental group and the control group.

The research data collection technique used a questionnaire. The learning activity instrument uses criteria such as: giving perceptions and motivation, mastery of learning materials, implementing learning strategies, applying learning resources or learning media, involving students in learning, and closing the learning process.

The data analysis technique used the Mann Whitney U Test and descriptive statistics. The Mann Whitney U test is used to analyze differences in the learning process of machining practices using industrial product-based learning with job sheet assignment-based machining practices. Descriptive statistics are used to analyze research variables based on the learning implementation criteria used. Descriptive data interpretation results are as shown in Table 1.

Table 1. Data Interpretation

Interpretation	Percentage (%)
Very good	76-100
Good	51-75
Less good	26-50
Bad	0-25

RESULTS AND DISCUSSION

Perception and motivation activities in learning use several criteria, including preparing class activities and learning tools, conveying learning objectives, motivating students. Table 2 shows that the use of industrial product-based learning for activities to prepare class activities and learning tools increased by 53.85% compared to job sheet-based learning assignments. Activities of delivering learning objectives using industrial product-based learning increased by 30.16% compared to job sheet-based learning assignments. Motivating to focus on learning using industrial product-based learning increased by 79.17%.

Table 2. Apperception and motivation

Activity	Experimental group		Control group	
	Percentage (%)	Interpretation	Percentage (%)	Interpretation
Preparation of Class Activities and Learning Devices	80	Very good	52	Good
Delivery of Learning Objectives	82	Very good	63	Good
Motivating to Focus on Learning	86	Very good	48	Less good

The criteria for giving apperception and motivation for product-based learning using industrial product-based learning have very good qualifications. Table 3. shows the U value of 8.000 and the W value of 218.000, if converted into a Z value the result is -5.244. The Sig or P-value is 0.000 <0.050. If the P-value <critical limit 0.050, it can be concluded that there is a difference in the provision of perception and motivation between the industrial product-based machining practice group and the job sheet-based learning assignment. The difference between the two groups is in the criteria for preparing class activities and learning tools, delivering goals, and motivating learning.

Table 3. Apperception and motivation test resul
Test Statistics [a]

	Apperception and motivation
Mann-Whitney U	8.000
Wilcoxon W	218.000
Z	-5.244
Asymp. Sig. (2-tailed)	0.000
Exact Sig. [2*(1-tailed Sig.)]	0.000[b]

a. Grouping Variable: Group

The results showed that the ability to deliver the subject matter in industrial product-based machining practices increased by 20.29% compared to using job sheet assignment-based learning. The ability to relate the subject matter to science and technology, relevant knowledge, and real-life in learning industrial product-based machining practices has increased 34.85%, while the ability to answer questions on industrial product-based learning has increased by 56.37% compared to based learning assignment job sheets. Overall, the mastery of the material in teaching and learning activities by learning industrial product-based machining practices has very good qualifications. The research results are as shown in Table 4.

Table 4. Mastery of Learning Materials

Activity	Experimental group		Control group	
	Percentage (%)	Interpretation	Percentage (%)	Interpretation
Ability to Deliver Learning Material	83	Very Good	69	Good
The ability to relate to science and technology, relevant knowledge, and real-life	89	Very Good	66	Good
Ability to Answer Questions	86	Very Good	55	Good

Table 5. The results of the mastery test of learning materil
Test Statistics [a]

	Mastery of Learning Materials.
Mann-Whitney U	33.500
Wilcoxon W	243.500
Z	-4.553
Asymp. Sig. (2-tailed)	0.000
Exact Sig. [2*(1-tailed Sig.)]	0.000[b]

a. Grouping Variable: Group

The results of the Mann-Whitney U test show that the U value is 33.500 and the W value is 243.500 when converted to a Z value, the value is -4.553. The Sig or P-Value is 0.000 < 0.050. If the P-value < critical limit 0.050, there is a significant difference in the mastery of the material in learning industrial product-based machining practices with job sheet-based learning assignments. The differences are shown in the activity of the ability to deliver learning material, the ability to relate lessons to science and technology, the knowledge that is relevant to real life, and the ability to answer questions.

Based on Table 6. The results obtained that the accuracy of implementing the learning strategy of industrial product-based machining practices increased by 71.43%, the ability to grow positive activities had increased by 70.21%, and growing soft skills in learning activities increased by 63.46% compared to job sheet-based learning assignments. Overall, the application of industrial product-based learning strategies is very well qualified.

Table 6. Application of Learning Strategies

Activity	Experimental group		Control group	
	Percentage (%)	Interpretation	Percentage (%)	Interpretation
The accuracy of implementing the strategy	84	Very Good	49	Less Good
Fostering positive activities	80	Very Good	47	Less Good
Cultivate soft skills	85	Very Good	52	Good

Table 7. The test results of the application of learning strategies
Test Statistics [a]

	Application of Learning Strategies
Mann-Whitney U	8.000
Wilcoxon W	218.000
Z	-5.244
Asymp. Sig. (2-tailed)	0.000
Exact Sig. [2*(1-tailed Sig.)]	0.000[b]

a. Grouping Variable: Group

The test results of the application of the learning strategy obtained a U value of 8.000 and a W value of 218.000, these values were converted to a Z value of -5.244. The Sig or P-value is 0.000 < 0.050, if the P-value is < the critical limit of 0.050, then there is a significant difference in implementing the industrial product-based machining practice learning strategy with job sheet-based learning assignments. The difference is in the accuracy of implementing learning strategies, fostering positive activities, and fostering soft skills in learning activities.

Table 8. The Use of Learning Resources or Learning Media

Activity	Experimental group		Control group	
	Percentage (%)	Interpretation	Percentage (%)	Interpretation
Selection of learning sources or media	82	Very Good	49	Less Good
Skills in using learning resources and media	81	Very Good	43	Less Good

Table 8 reveals that the selection of learning resources or learning media in industrial product-based machining practices increased by 67.35% and skills using sources or media increased by 88.37% compared to learning machine-based job sheet assignments. The utilization of learning resources or media in teaching and learning activities using industrial product-based learning fulfills very good qualifications.

Table 9 shows that the U value is 6.000 and the W value is 216.000, if converted into a Z value, the amount is -5.510. Sig value or P-value is 0.000 < 0.050 if the P-value is < critical limit 0.050, there is a significant difference between industrial product-based learning and job sheet-based learning assignments in utilizing learning resources and learning media.

Table 9. Test Results Use of learning resources or learning media

Test Statistics [a]

	Users of learning resources or learning media
Mann-Whitney U	6.000
Wilcoxon W	216.000
Z	-5.510
Asymp. Sig. (2-tailed)	0.000
Exact Sig. [2*(1-tailed Sig.)]	0.000[b]

a. Grouping Variable: Group

Activities to foster active participation through interaction in the learning of industrial product-based machining practices increased by 38.98% compared to job sheet-based learning assignments. Openness in responding to students increased by 26.56%, and activities to foster critical thinking, cooperation, creative and communication attitudes increased by 38.00% when compared to job sheet-based learning assignments. The involvement of students in industrial product-based learning has very good qualifications. These results are as shown in Table 10.

Table 10. Student involvement in learning

Activity	Experimental group		Control group	
	Percentage (%)	Interpretation	Percentage (%)	interpretation
Fostering Active Participation through Interaction	82	Very Good	59	Good
Openness in Responding to Students	81	Very Good	64	Good
Fostering critical thinking, cooperation, creativity, and communication	85	Very Good	62	Good

The result of the difference test shows that the U value is 26.000 and the W value is 236.000. The result of the conversion of this value to the Z value is -4.857. The Sig or P-value is 0.000 < 0.050, if the P-value is < the critical limit of 0.050, then there is a difference between groups in using industrial product-based machining practice learning with job sheet-based learning assignments. The differences exist in the ability to foster active participation through interaction, the openness of teachers in responding to activities, and fostering critical thinking, collaboration, creativity, and student communication.

Table 11. Test results for the Involvement of Students in Learning
Test Statistics a

	Involvement of students in learning
Mann-Whitney U	26.000
Wilcoxon W	236.000
Z	-4.857
Asymp. Sig. (2-tailed)	0.000
Exact Sig. [2*(1-tailed Sig.)]	0.000[b]

a. Grouping Variable: Group

The criteria for closing learning consist of conducting final reflections involving students, conducting written or oral evaluations, and follow-up learning. The final reflection on learning industrial product-based machining practices increased by 26.98%, conducting written or oral evaluations had an increase of 23.08%, and follow-up learning activities increased by 69.39% when compared to using job sheet-based assignment learning. These results are as shown in Table 12.

Table 12. Closing Learning

Activity	Experimental group		Control group	
	Percentage (%)	Interpretation	Percentage (%)	Interpretation
Student Involvement in Reflection	80	Very Good	63	Good
Conduct a Written or Oral Evaluation	80	Very Good	65	Good
Follow Up Learning	83	Very Good	49	Less Good

The U value is 17.000 and the W value is 227.000 when converted to a Z value of -5.020. The Sig or P-value is 0.000 < 0.050, because of the P-value < the critical limit of 0.050, there is a significant difference between closing learning activities in industrial product-based machining practices and job sheet-based learning assignments. These results are as shown in Table 13.

Table 13. Results of the Close Learning test
Test Statistics [a]

	Closing Learning
Mann-Whitney U	17.000
Wilcoxon W	227.000
Z	-5.020
Asymp. Sig. (2-tailed)	0.000
Exact Sig. [2*(1-tailed Sig.)]	0.000[b]

a. Grouping Variable: Group

The results of the research above indicate that there are differences in the management of learning practices for industrial product-based machining with job sheet-based learning assignments. Differences in management exist in the activities of perception and motivation, mastery of subject matter, implementation of learning strategies, utilization of learning resources or learning media, the participation of students, and activities to end learning. Learning industrial product-based machining practices can stimulate the thoughts, feelings, attention, and abilities, or skills of students. This learning is also holistic, interactive, scientific, contextual, effective, collaborative, learner-centered, and oriented to contemporary competencies. Motivation has an impact on academic performance, the higher the motivation, the better the achievement level of academic performance. The ability of educators to identify the right learning model has an impact on increasing the motivation of students (Daniel, et al., 2019). Learning using industrial projects increases the motivation of students to be more professional, directs work to the application of developing knowledge and technology, involves many inter-disciplinary disciplines, and has stronger self-direction (Mills & Treagust, 2003). Project diversity requires a lot of competences from various scientific disciplines, so that students can increase knowledge and development of complex technology, solve problems and think critically, and collaborate with teams for other types of work (Mitchell, et al., 2017).

Product-based learning models have good potential to increase the interest and involvement of students in mastering subject matter, encourage and empower students to increase their responsibility in learning, and allow students to actively ask questions and provide feedback to teachers (Park, 2003; Jolanta & Asta, 2015). Creative and innovative vocational learning models develop innovative thinking, technical problem-solving skills, foster creativity, critical thinking, and transfer of technical skills (Wu & Wu, 2020). The involvement of educators in designing, organizing, implementing, and evaluating learning activities keeps students motivated and participates in every activity. Teacher involvement in learning activities is a challenging task to improve learning performance and learning achievement. The learning achievement of students is always directly proportional to the involvement of teachers in designing, organizing, and evaluating learning (Joshi, et al., 2019).

The accuracy in choosing a learning model helps improve the learning experience and competence of students in completing education. The success of education is determined by how educators choose and apply the right learning model (Asfani, et al., 2016). The use of effective and efficient learning strategies improves the learning experience of students. Ineffective and efficient learning strategies have an impact on the implementation of teaching and learning activities (Biwer, et al., 2020). Learning resources are an important element of obtaining maximum and easy to understand learning outcomes. The use of media and learning resources in industrial product-based learning can stimulate learning motivation to increase experience and understanding of learning innovations. The right approach and method in learning can increase motivation in developing the understanding and value of education (Gregoriou, 2019).

CONCLUSION

Management of learning industrial product-based machining practices can be concluded as follows:

1. There are significant differences in the provision of perception and motivation in the implementation of learning practices for industrial product-based machining with job sheet-based learning assignments.
2. There is a significant difference in material mastery in the implementation of learning practices for industrial product-based machining with job sheet-based learning assignments.
3. There are significant differences in the application of industrial product-based machining practice learning strategies and job sheet-based learning assignments.
4. There are significant differences in the selection and application of learning resources for the implementation of learning practices for industrial product-based machining with job sheet-based learning assignments.
5. There is a significant difference in the involvement of students in the implementation of learning practices for industrial product-based machining with job sheet-based learning assignments
6. There is a significant difference in the activity of closing the learning practice of industrial product-based machining with job sheet-based learning assignments.

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