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Student Learning Needs in Basic Machining Practices in the Department of Mechanical Engineering Education

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ABSTRACT

This research was conducted in order to answer problems in terms of learning basic machining practices where increasingly advanced technology requires the use of equipment and teaching materials that are increasingly advanced as well to form student competencies needed by the world of work. This study aims to determine the needs of students in learning basic machining practices at the Department of Mechanical Engineering Education FT UNY. The research method used is descriptive quantitative using a free description questionnaire in the form of Google Form as a data collection instrument. The population of this study were the 1st year students of the Mechanical Engineering Education study program, while the sample was the 33 students of 1st year students at Mechanical Engineering Education study program who were taking basic machining practice courses. The results of the research showed that 100% of students stated that it needs improvement on workshop facilities and infrastructure, 33.3% of students stated the needs to increase the skills and abilities of lecturers, 36.4% of students stated the needs of the skills and abilities of technicians, and 42.4% of students stated the needs of improvement on teaching materials. In conclusion, students need improvement in various aspects of learning, even though some students are satisfied with their current learning.

Keywords: Basic Machining, Mechanical Engineering, Needs Analysis, UNY

INTRODUCTION

The progress of the era characterized by the industrial revolution caused many changes in various sectors. Developments that are occurring now have shifted many working principles from manual work to mechanical assisted work, therefore it directly affects the number of workers since some kinds of jobs have been replaced by machines [1]. Many things can be done using machines, one of which is in the world of production/manufacturing [2]. Machining is a production/manufacturing process using conventional and modern machine tools by utilizing the relative movement that occurs between the chisel and the workpiece to produce a product that conforms to the specified geometric shape [3].

Basic Machining is a practical course in the Mechanical Engineering Education study program in Faculty of Engineering Universitas Negeri Yogyakarta. Basic machining course learn about the use of conventional machines, which are related to learning in the Mechanical Engineering Education study program FT UNY which focuses on learning to use conventional lathes, although it also touches on the use of conventional milling machines. Conventional basic machining such as lathes and milling are the basic tools of more developed and advanced machining which must be studied first because all the basics of machining are found in lathes and milling machines [4]. By learning the basics of machining through learning to use lathes and milling machines, students can master more complex machining in the future because the working systems of more modern complex machining are almost the same as those in conventional machining.

A lathe is a conventional machine tool that has many uses and functions, including being used to cut, slash, drill, and form other mechanical parts [5]. A lathe is a conventional machine tool that utilizes a cutting system using high-speed steel cutting tools [6]. The lathe machine's working system utilizes rotational speed as power to make cuts with a stationary cutting tool being cut on a workpiece that rotates at a certain speed [7]. Conventional lathes require higher accuracy in their operation because the system is not yet fully automated, so the individual operator's ability is very necessary to avoid mistakes when operating them [8]. Lathe machining competency is categorized as basic competency before the use of more sophisticated and fully automated machines.

Learning basic machining such as lathe machining is a very important thing to learn because it can improve students' skills. This is in line with what was stated by [9] that learning basic machining using a lathe can improve hand skills and build feeling in operation so that it can increase reflexes and sensitivity towards machines. Another explanation put forward by [10] emphasizes that basic machining must always be studied because it can improve students' skills so that in the future they can compete in a very

advanced and modern world of work. Basic machining can also always be carried out by educational institutions because the costs of organizing it are not as expensive when compared to learning using more modern machines such as CNC machines or machines that are operated automatically [11]. Even though machining competency looks very basic to learn, if you don't master it well it will be difficult to fully understand the manufacturing concept because one of the manufacturing processes that needs to be mastered is machining [12].

The learning process is greatly influenced by the existence of teaching materials. Teaching materials place a significant role of the learning process, whether in the form of objects or intangibles materials [13]. Teaching materials are in the form of a set of learning tools such as materials, methods, limitations and learning evaluation which are arranged systematically to achieve learning objectives [14]. Teaching materials are an explanation of the contents of the syllabus which are presented in a form that is easier for educators and students to understand, usually in the form of books, modules, job sheets, or other forms [15]. Teaching materials are also often referred to as teaching materials where the content is taken from several learning sources that are relevant to the learning objectives and arranged systematically [16].

The teaching materials used in learning greatly influence the level of students' understanding. In relation to practical learning, the use of tools and materials during practical learning greatly influences the increase in students' competence and abilities. This is in accordance with what was stated by [17] that teaching materials cannot be separated from the learning process because teaching materials are used as a tool for planning, implementing and evaluating learning activities so that the planned competency achievements can be achieved. Teaching materials can be used as a guide in carrying out learning activities so that they can be directed towards achieving learning objectives [18]. Another explanation by [19] focuses on the importance of using teaching materials in learning because teaching materials are compiled from various sources so that the knowledge conveyed becomes broader and more complex by using only one teaching material.

In relation to learning basic machining practices, the teaching materials needed are not only theoretical teaching materials, but also exemplary teaching materials, such as the use of equipment and technology in learning. The explanation given by [20] emphasizes the importance of using teaching materials in learning lathe machining practices in the form of Work Preparation Sheets to direct students to achieve learning goals and expected competencies. Teaching materials in practical learning can also be in the form of video tutorials as additional information to provide students with before operating the machine [21]. It is also important to use teaching

materials in practical learning involving students with disabilities so that basic machining competencies can also be obtained evenly according to each individual's limitations and abilities so that they can be directed according to the required learning portion [22].

Research regarding the analysis of students' learning needs in basic machining practices in the Department of Mechanical Engineering Education, Faculty of Engineering, Universitas Negeri Yogyakarta is very important to carry out because basic machining practical learning in this department have to be developed, especially in terms of teaching materials. The increasing needs of the world of work due to developments over time also force learning models to be improved to suit the demands of the world of work. This research was conducted to find out what kind of teaching materials are suitable and needed by students of the department in learning basic machining practices. This research was also conducted to find out what teaching materials have been developed to meet students' needs in learning basic machining practices. With this research, it is hoped that policy makers, especially department administrators and curriculum teams, can determine the direction of developing teaching materials to suit students' needs in learning basic machining practice.

This study differs from previous research, which generally focused on infrastructure limitations, media format innovation such as e-modules or web-based learning, and general teaching media development. In contrast, this research specifically investigates the content and type of teaching materials required by students to support hands-on learning in conventional machining practices, particularly lathe and milling operations, which has not been comprehensively addressed in earlier studies.

The similar research has been carried out several times in other practical learning. Research conducted by [23] shows that there are limited practical tools in the Mechanical Engineering Education Department Universitas Pendidikan Indonesia workshop which creates queues for machine use during practical learning, so it is necessary to increase the number of practical machines to meet the metal forming practical learning needs of the students. Other research conducted by [24] shows that there is an increase in the number of students each year but this is not accompanied by the addition of lecture buildings which results in a buildup of classes which results in many conflicting course schedules so that the addition of new lecture buildings is needed to meet students' needs in learning. Research conducted by [25] shows that lecturers and students need learning media that can detail the learning material and can provide a more detailed visualization of the work process and present it in a real way.

Research conducted by [26] shows that good learning depends on appropriate media and teaching materials, such as web-based learning for vocational students which is in line with current developments. Other research by [27] shows that to improve the quality of learning, especially theoretical learning, it is necessary to develop teaching materials that suit current needs, namely in the form of E-Modules because they can be accessed anytime and anywhere without having to carry printed books which is thick and heavy. Other research conducted by [28] shows that there are several basic needs for students taking thesis proposal courses to support their competence, including proposals, writing scientific reports, manuscript conventions, citing and plagiarism, scientific terminology, scientific sentences, and scientific presentations. Research conducted by [29] also shows that students need teaching materials that are flexible, easy to understand, reliable, practical, and have easy access to information, so a module oriented towards project-based learning was prepared.

RESEARCH METHOD

The method used in this research is a quantitative descriptive research method. Quantitative descriptive is a research method that uses numbers as an approach in describing, depicting and explaining a phenomenon being studied [30]. The population in this study were students from the 1st year of Mechanical Engineering Education Study Program, while the sample in this study was the 1st year students from the Mechanical Engineering Education study program who were taking basic machining practice courses in the even semester 2023/2024, totaling 33 students.

The data collection instrument used was a questionnaire prepared in the form of a Google Form. The data collection technique used was by distributing questionnaires in the form of a Google Form to students who were used as research samples. The questionnaire is in the form of free description, therefore the students able to fill in the questionnaire according to how they feel. Students fill in answers and responses to several statements in the questionnaire.

Before distributing the questionnaire, the instrument underwent validity testing using content validity and construct validity. The content validity was checked by expert reviewers in the field of Mechanical Engineering Education to ensure that the questions align with the research objectives, while the construct validity was evaluated by performing a statistical test to see whether the items on the questionnaire effectively measured the constructs they were intended to measure. To ensure the reliability of the questionnaire, Cronbach's Alpha was used, with a value above 0.7 indicating acceptable reliability for use in the research. The data obtained from students is mixed in form so it is necessary to reduce data, namely grouping

data based on certain characteristics which will later be made into several large groups of data. This group of data is then given an assessment in the form of a percentage which will later be used as reinforcement for the results of this research.

The data analysis was carried out using descriptive quantitative methods, namely by calculating the frequency and percentage of student responses in each category, so that patterns and general tendencies could be identified and interpreted in the context of the research. The data is presented in the form of diagrams with several explanations so that it is easy to read and understand.

To clarify the sequence of research activities, the research flowchart is shown in Figure 1.

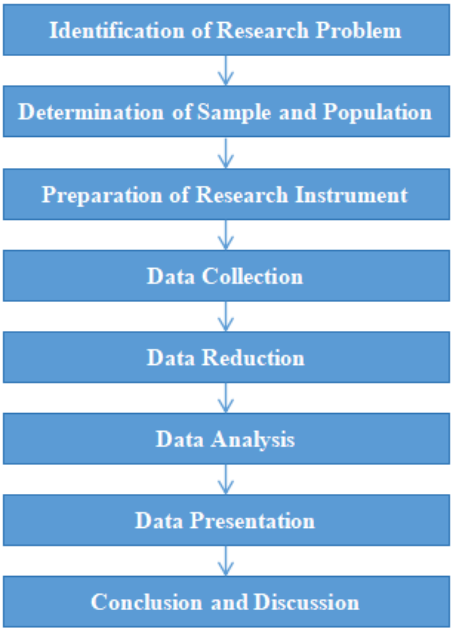

Figure 1. Research flowchart

Table 1 is a grid of statements in the questionnaire.

Table 1. Questionnaires grid

No	Indicator
1	Need for updating workshop facilities and infrastructure
2	Need for increasing the skills and abilities of lecturers
3	Need for increasing the skills and abilities of technicians
4	Need for updates to the teaching materials used

RESULT AND DISCUSSION

This research involved 33 students as respondents to fill out a data collection questionnaire regarding student learning needs in basic machining practices in the Mechanical Engineering Education Department. Table 2 shows the distribution of students based on class division.

Table 2. Distribution of students as respondents based on class

Class	Number of Students	Percentage
A	15	45.5 %
B	7	21.2 %
C	11	33.3 %
Total	33	100.0 %

A recapitulation of research results obtained from analysis of data obtained through questionnaires is presented in Table 3.

Table 3. Recapitulation of analysis of research results

Indicator	Number of Respondents	
	Need	Enough
Need for updating workshop facilities and infrastructure	33	0
Need for increasing the skills and abilities of lecturers	11	22
Need for increasing the skills and abilities of technician	12	21
Need for updates to the teaching materials used	14	19

The data analysis presented in Table 3 regarding student learning needs in basic machining practices is described as follows.

Student Needs for Renewal of Workshop Facilities and Infrastructure

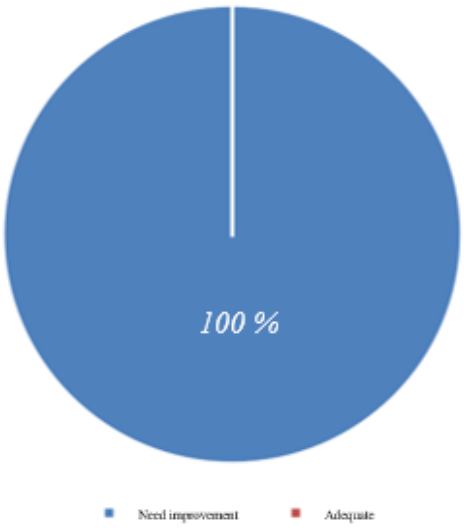

Figure 2. Diagram of student needs for renewal of workshop facilities and infrastructure

From the data presented in Table 3 and Figure 2, it can be explained that total 33 students or 100% of students who were used as respondents felt that they needed an update and improvement of facilities and infrastructure in the workshop. Renewing and improving workshop infrastructure includes the procurement of lathes that are more modern and younger in terms of age because the lathes in the workshop currently are old lathes so they often experience problems and break down, thus disrupting the process of learning basic machining practices. Each student who was supposed to use one lathe had to share the lathe with several people so that their work was hampered and took a long time to complete.

Equipment such as cutting tools, coolant fluids, work materials, measuring tools, and others need to be increased in number so that students do not need to take turns using the equipment and speed up the work process. Air circulation and production line also need to be updated to make them more neatly organized. Good air circulation will enhance the student comfortability and help to maintain the equipment. Meanwhile, implementation of production line paths will make it easier for operators and student to carry out activities in the workshop because the paths that are vulnerable and the paths that are safe to pass can be clearly distinguished. By recoloring these routes, it can reduce any potential dangers that occur in the workshop.

Equipment supporting Occupational Health and Safety (OHS) also needs to be updated. Students' need for Personal Protective Equipment (PPE) is important so it needs to be provided in adequate quantities so that each student gets one of their own. The PPE that needs to be updated is glasses and masks. This is in accordance with research conducted by [31], which shows a positive correlation between workshop facilities and infrastructure and students' learning outcomes in lathe machining subjects, where adequate workshop facilities provide better opportunities for students to achieve good learning outcomes.

Student Needs for Improving Lecturer Skills and Capabilities

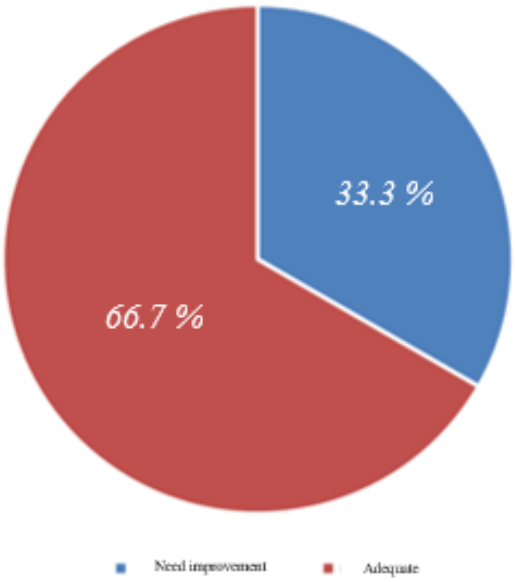

Figure 3. Diagram of student needs for increasing lecturer skills and abilities

From the data shown by Table 3 and Figure 3, 11 students or 33.3% of them stated that it needs an improvement of lecturer's skill and competence. This improvement includes lecturer and student interaction in the form of 2-ways interaction, the way lecturers deliver the materials, the way lecturers assist the students' practice, and the behavior of lecturers related to the lecturer attendance. Lecturers often leave practical classes because they have other needs so students have to study alone without anyone supervising them, which possibly lead to a danger if an accident occurs. Lecturers are also expected to be able to guide each student during practical learning so that student activities during the workshop are more focused. Lecturers often hand over or entrust classes to students who they feel are capable of guiding their friends because they have a vocational school educational background. This makes learning less effective in terms of competency achievement because of the peer learning model.

While, 22 students or about 66.7% respondent feeling satisfied with the lecturer performance in lathe machining practical. Students assess that the lecturer has explained the required material well. Lecturers also often motivate students to always be enthusiastic about participating in practical learning. Many students understand that lecturers often leave class due to many responsibilities outside of learning, such as research, service, and administrative management. Therefore, many students feel that lecturers frequently leaving class does not have a significant impact on learning, because learning can still be done with the help of

colleagues and technicians in the workshop. This is in line with a study conducted by [32], which highlights the importance of two-way interaction between lecturers and students in machining practice learning, where the implementation of the peer tutoring method can enhance students' competencies in attitude, knowledge, and skills.

Students Needs for Improving Technician's Skill and Competence

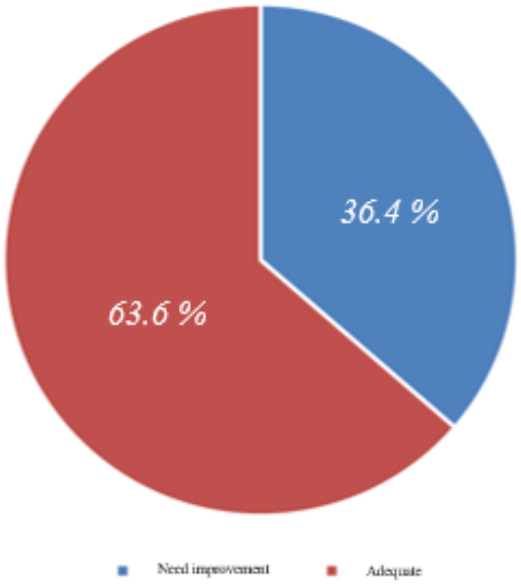

Figure 4. Students' needs for improving technician skill and competence

From the data presented in Table 3 and Figure 4, it can be explained that as many as 12 students or 36.4% of students who were used as respondents felt that they needed an increase in the skills and abilities of workshop technicians. This improvement includes improving the way technicians interact with students, the way technicians guide and explain material to students, the way technicians provide feedback on student activities, and the attitude of technicians, especially the discipline. Technicians sometimes provide feedback that is not what students expect, and does not eager to help students solve problems. Technicians are not fully standby at the workshop which sometime hinders students' work and leave students with no assistance. Meanwhile, as many as 21 students or 63.6% of students who were used as respondents were satisfied with the performance of technicians in the machining workshop. Some of them understand that technicians are often difficult to find because they have responsibilities and duties elsewhere.

Students assessed that the technicians had given their best in learning, starting from explaining and demonstrating tools and machines before use, providing direction during practical activities, providing motivation to students, and always being friendly during the learning process. These findings are consistent with previous research conducted by [33], who emphasized that the competence of workshop technicians significantly influences the quality of students' practical learning experiences. Their study found that effective technician support, including clear communication, timely feedback, and professional conduct, enhances student engagement and improves skill acquisition in technical education settings.

Students Needs for the Updated Teaching Materials

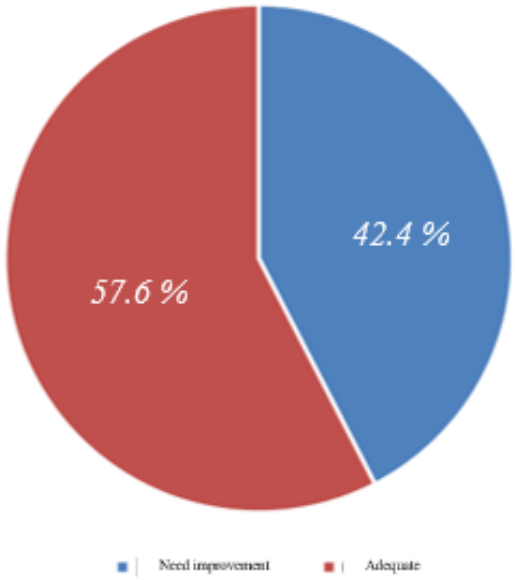

Figure 5. Students' needs for the updated teaching materials

From the data presented in Table 3 and Figure 5, it can be explained that as many as 12 students or 42.4% of respondents felt that there was a need for updating and providing teaching materials. The teaching materials include textbooks, new job sheets, new jobs, video tutorials and new practice materials. The textbook contains how to operate the machine, the PPE requirements used, how to repair the machine when damage occurs, and how to carry out machine maintenance. The job sheets and new jobs are jobs that are in line with current competency demands so that they can improve student skills. The video tutorial is a video on how to operate the machine, as well as how to maintain and repair the machine.

This update of teaching materials takes into account the increasingly complex needs and demands of work. Meanwhile, as many as 19 students or 57.6% of respondents felt satisfied and sufficient with the teaching materials currently used. The students assessed that the teaching materials used were complete and represented the competencies being taught. They assess that the teaching materials currently used and supported by the lecturers' ability to explain and guide are sufficient to help the learning process of basic machining practices run smoothly. Research conducted by [34] highlighted that continuous updating of textbooks and practical materials to match technological advancements and industrial needs is critical to maintaining the relevance of technical education programs. Without these updates, educational institutions risk providing outdated knowledge and skills, potentially hindering graduate employability. Therefore, integrating updated teaching materials is essential to ensure that students are better prepared for the dynamic demands of the modern industrial environment.

CONCLUSION

Learning is mandatory for all, including students. By studying, students can gain better knowledge and skills. Learning activities need several important aspects to support the learning participant. Based on the research that has been carried out, it can be seen that of the 33 respondents involved, 100% of respondents need some updates regarding machining workshop facilities and

infrastructure; 33.3% of respondents need some improvement in the skills and abilities of lecturers while 66.7% of respondents were satisfied with the performance of lecturers; as many as 36.4% of respondents needed some improvement in technician skills and abilities while 63.6% of respondents were satisfied with the performance of technicians; and as many as 42.4% of respondents felt there was a need to update teaching materials for practice while 57.6 % of respondents feel that the teaching materials currently used are sufficient. Based on the results of the research and data analysis that has been carried out, it can be concluded that the highest percentage of respondents is in the need for updating workshop facilities and infrastructure. Meanwhile, when looking at other aspects in terms of percentages, more respondents felt satisfied than respondents who felt they needed these aspects. However, with respondents who feel they need it, it is hoped that policy makers will be able to follow up on things that can be updated for better learning.

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