Jurnal Dinamika Vokasional Teknik Mesin
Vol. 09, No. 1, April 2024, pp. 51-68
https://journal.uny.ac.id/index.php/dynamika/issue/view/73616
ISSN: 2548-7590, DOI: 10.21831/dinamika.v9i1.73616

The Comparison of Block Learning with Traditional Learning in Developing Three Competency Aspects of Mechanical Engineering Students

Widarto, Jarwopuspito, Dwi Rahdiyanta, Aris Eko Wibowo, and Unaga Indera Djati
Department of Mechanical Engineering Education, Faculty of Engineering
Universitas Negeri Yogyakarta, Indonesia

Article Info

Article history:

Received Apr 01, 2024
Revised Apr 25, 2024
Accepted Apr 27, 2024
Published Apr 30, 2024

Keywords:

Block learning
Block scheduling
Block teaching
Intensive delivery method
Machining practices

ABSTRACT

Three aspects of student competency consisting of knowledge (cognitive), skills (psychomotor), and attitude (affective). This study aims to compare the achievement of basic machining competencies in block system learning and traditional learning. This study used a quantitative descriptive approach. The method was a quasi-experimental method with posttest only control group design, with the block system treatment in the experimental group and the traditional or regular learning in the control group. The experimental group consisted of 75 students from the Applied Bachelor Degree of Mechanical Engineering Study Program (Diploma 4), and the control group consisted of 66 students from the Bachelor Degree of Mechanical Engineering Education Study Program as the control group. Research data was obtained from the post-test scores for the Machining Theory course and the final scores for Basic Machining Practices. Descriptive statistics show that students' competency achievements in the knowledge aspect in block learning are less good than in traditional learning. However, student competency achievements in the skills and attitude aspects in the block learning system are better than in traditional learning. Although further statistical tests are needed to measure the differences and significance between the two learning modes, these results have provided an illustration of the weaknesses of block learning in theoretical and conceptual learning. Therefore, educators need to apply innovative learning strategies to overcome these weaknesses.

Corresponding Author:

Widarto
Department of Mechanical Engineering Education, Faculty of Engineering
Universitas Negeri Yogyakarta
55281 Sleman, Yogyakarta, Indonesia
Email: widarto@uny.ac.id

INTRODUCTION

As mandated by the Indonesian National Qualifications Framework (INQF), the graduates of applied bachelor’s (Diploma 4 or D4) are required to achieve equivalent competencies as those who hold a bachelor’s (Strata 1 or S1). The minimum competencies of both levels of education are equivalent to INQF level 6. The competencies include three aspects: (1) affective, which is reflected in the quality of faith, piety, morals including having noble character, good personality, and aesthetic competence; (2)

cognitive, which refers to the capacity to think and the intellectual ability to explore, develop and master science and technology; and (3) psychomotor, which is defined as the ability to develop technical skills, practical skills and kinesthetic competence (Widarto, 2017). In other words, the competencies should cover affective aspects (work attitudes), cognitive aspects (knowledge), and psychomotor aspects (skills).

Even though the applied bachelor and bachelor study programs have equal academic load, there are two major differences in terms of the courses proportion required to complete. At the applied bachelor's degree, 70% of the learning process is allocated for practices or practicums, while 30% is directed for theories. In contrast, the courses proportion offered at the bachelor study program is the opposite to that of applied bachelor. The proportion of courses is designed in such a way because the applied bachelor study program focuses on producing graduates who can demonstrate skills in solving technical problems in the workplaces. The emphasis on practices aims to support specific skills in accordance with the technological development in the industry. Therefore, achieving skills through practical learning type courses for D4 graduates is a fundamental requirement. On the other hand, undergraduate students are required to achieve academic or cognitive aspects so there are more courses on theoretical learning.

Practical learning requires sufficient infrastructure and facilities. Adequate infrastructure and facilities are needed to support the implementation of high-quality learning to achieve the goals of vocational education (Bhebhe & Nxumalo, 2017). The availability of facilities for practices should also be relevant with the expected outcomes. When the tools, machinery, and tasks assigned to the students match the demands of the workplace, vocational education can be considered successful (Prosser & Quigley, 1950). Practices are one of the most important factors in developing D4 students' competency, including technical, analytical, and managerial competencies. In contrast, lack of practices in terms of quality or quantity could negatively impact the competencies of the students. If vocational education lacks the infrastructure and learning tools that support academic and technical improvements, the students may become less competitive in the workplace (Suyanta et al., 2019).

Additionally, most applied bachelor (Diploma 4) study programs in Indonesia are established through the transformation of Diploma 3 study program. The D4 study program at Yogyakarta State University (YSU) was also established according to the modified system in 2018. This change allows YSU to manage the learning process in the D4 study program. In early 2023, Yogyakarta State University had a reform in its status, transitioning from Public Service Agency of Higher Education to Public University with Legal Entity. This transformation resulted in the establishment of the Faculty of Vocational Studies. Thirteen study programs, previously distributed across several faculties such as Engineering (8 study programs), Economics (3 study programs), Sports Sciences (1 study program), and Education (1 study program), have now been centralized under Faculty of Vocational.

The Diploma 4 study programs at the Faculty of Vocational, specifically the Mechanical Engineering Diploma 4 Study Program, are experiencing a transition period. This study program, which was originally under the supervision of the Faculty of Engineering, is now managed by the Faculty of Vocational. The transition period is marked by several challenges. The most significant challenge which has a direct impact on learning activities is the availability of practicum facilities which is still not fully available in the Faculty of Vocational. The current available facilities to support learning activities have not met the required standards. Practical learning in metal machining workshops and labs mostly utilizes the resources owned by Faculty of Engineering at the central campus buildings in Karangmalang. Based on the preliminary observation conducted, there are multiple challenges associated with implementing learning practices in the metal machining workshops.

The first issue is the metal machining workshop's overloaded capacity. Many students, consisting of eight groups of undergraduate students and eight groups of D4 students, use the workshop simultaneously. This results in an inconvenient learning process that does not fulfill the standards in metal machining workshops. The ideal standard of providing one machine per student could not be achieved. Another concern is related to the mobility of students. They are required to have classes in two distant locations. The learning practices for metal machining are held by the Engineering Faculty in Karangmalang while the theoretical courses are held at the Faculty of Vocational Studies in Wates. The distance between the locations is approximately 36 kilometers, with an estimated travel duration of one hour.

In accordance with the problem identification stated above, this study attempted to determine the effectiveness of the block system on the learning process of the Basic Machining Practices for students of the D4 Mechanical Engineering study program at Faculty of Vocational Studies, Yogyakarta State University. The regular learning system has been continuously applied and so far, has shown to be able to develop students' competencies. From the issue explained above, the identified problems are: (1) The lack of practical learning facilities for students of D4 Mechanical Engineering study program of Faculty of Vocational, YSU; (2) The inadequacy of the regular system in accommodating the students' need in the Basic Machining course learning process; (3) The overburdened capacity of the metal machining workshop.

Based on these problems, the D4 Mechanical Engineering Study Program applies a schedule block system in practical learning of Basic Machining Practices. The Block Learning System is also called Block Teaching or Block Mode Teaching or Block Model Teaching or Block Scheduling or Intensive Delivery Method which is carried out by adjusting the number of learning periods and combining learning hours. The block system schedule is used to organize a rotation system of theoretical and practical learning activities, especially in the use of practical learning facilities, such as laboratories, workshops, studios, kitchens, gardens, swimming pools, simulation rooms (GIZ, 2018). Through the implementation of the block system, it is hoped that students can use the facilities effectively. Block scheduling is an arrangement of teaching and learning activities that is structured in such a way as to enable students to have optimal study time and assistance when learning a particular competency (GIZ, 2018). The aim of this system is so that all required material can be delivered effectively while producing learning outcomes that are in line with curriculum demands.

The block system is the organization of study time by accumulating longer periods of time in class on certain subjects (Zepeda, 1999). Scheduling through a block system allows learning to be condensed into several smaller meetings with a longer duration, thereby allowing greater flexibility in learning activities. Although the course time is shorter compared to traditional courses, classes are held more frequently and are longer in duration (Wlodkowski & Ginsberg, 2010). This learning method has quite a long time, it can take a whole day, several weeks, and even a weekend (Davies, 2006). Students take courses one by one without reducing the number of study hours to achieve competency. Another characteristic of block learning is that students do not take several cource simultaneously but take cource one at a time (Tatum, 2010). In a regular or traditional teaching system, learning is usually held once a week. Meanwhile, the block system allows learning to be carried out in one full day or more until all the material is studied according to the curriculum.

The calculation of learning time is as follows. The regular system or traditional teaching utilizes 16 meetings over 16 weeks in one term. The calculation of face-to-face learning is that one meeting consists of 6 lesson hours x 50 minutes so the total learning hours in one term is 16x3x2x50=4,800 minutes. When the learning process is transformed into the block system, the face-to-face learning is set to 6 meetings only. One meeting consists of 12 lesson hours x 50 minutes so the total learning hours total will be 6x12x50=3,600 minutes. The next four meetings starting from meeting 13 to meeting 16 focus on theories and reports writing, and these are conducted through online class. The calculation of the learning time is 6 lesson hours x 50 minutes, so the total learning hours is 4x6x50= 1,200 minutes. Thus, the total number of face-to-face meetings for regular system lectures = 4,800 minutes is the same as the block system (3,600 + 1,200 minutes = 4,800 minutes). This calculation is based on the accumulated number of lecture hours according to the syllabus and lesson plans of the Basic Machining Practices.

Based on the background of the problem and identification of the problems mentioned previously, the problem can be formulated as follows: (1) How are the differences in post-test scores on machining theory and concepts (aspects of knowledge) between the experimental group that applies block learning compared to the control group that applies regular or traditional learning?; (2) How are the differences in practice scores (aspects of skills and work attitudes) between the experimental group that applies block learning compared to the control group that applies regular or traditional learning?

The block system has several advantages, including: (1) providing sufficient time for students to study the material in depth (Marshak, 1998); (2) giving students more study time to cover the required learning material (Suwati, 2008); (3) allows teachers sufficient time to complete lesson plans and to examine and re-evaluate practice and allows for in-depth activities, such as individual student projects, peer collaboration, and face-to-face work between teachers and students (O'Neil, 1995). Several previous studies also show that learning with a block system can improve student learning achievement. Research conducted (Mattox et al., 2005), revealed that there was a significant increase in the mathematics achievement scores of sixth grade students enrolled in five secondary schools who switched from a traditional schedule to a block schedule. Meanwhile, research conducted (Majid et al., 2011) shows that learning outcomes with a block release schedule are more effective than with block hours. Other research has also examined the impact of the block model of teaching on students who fail certain subjects, showing that these students then pass unit exams with results that are much higher than the results of their first attempt with traditional teaching methods (Klein et al., 2019).

Previous research shows that the block system has been widely applied and researched. However, research to date has not revealed whether there are significant differences and similarities between the block system applied at the D4 level, especially Mechanical Engineering at the Vocational Faculty of YSU, which has learning material that is theoretical and conceptual (knowledge), as well as practical (skills and work attitude). It can be said that there is no clear picture of the differences between block learning and regular or traditional learning, especially when viewed from theoretical and conceptual learning needs, as well as practical learning needs. This research seeks to reveal new and significant information about the application of the block system in basic machining learning for Diploma 4 students.

METHOD

This research uses a descriptive quantitative approach to investigate the effectiveness of the block system on the Basic Machining Practices for students of the Applied Bachelor of Mechanical Engineering Study Program at Vocational Faculty of Yogyakarta State University. The research process was conducted by selecting the samples which consisted of two groups. The first group was the experimental group which used the block system, and the second group was the control group which used the regular system. This was carried out to determine the differences between the two groups and to see whether the students were well-prepared and knowledgeable about their learning practical process. An analysis was conducted on the post-test scores of Machining Theory and the Basic Machining Practices scores according to the job sheets. The post-test score reflected the students' competences in the knowledge aspect while the score from the practical learning reflected the achievement of technical competences (motor skills) and work attitudes.

Quasi-experiments were utilized to obtain data that reflect the information acquired from experiments in situations when it was not feasible to control and/or modify all relevant variables. (Arikunto, 2019). The quasi-experimental design used in this research is a post test only control group design as illustrated in Figure 1.

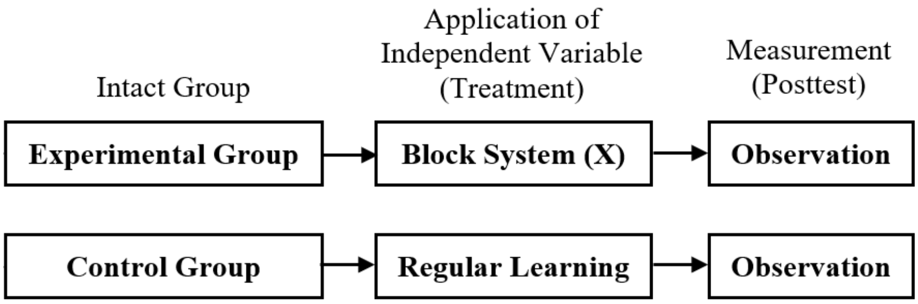

Figure 1. Post-test Only Control Group Design

The independent variable in this research was the application of the block system in learning Basic Machining Practices. The dependent variable of this research was the results of the Basic Machining Practical learning results of students from the D4 Mechanical Engineering Study Program, Faculty of Vocational, YSU in terms of three indicators: knowledge, skills, and attitudes. The knowledge aspect indicator was obtained from the post-test score in Machining Theory course. The skill and attitude indicators were obtained from the practice scores of four jobs, namely Straight Turning, Step Turning, Bolt, and Eccentric Turning. The attitude aspect was not evaluated through direct observation, but the score was obtained from the assessment, particularly from the process assessment which accounted for 20% of the overall score. The control variables were the duration of learning hours, types of tasks in the job sheet, machines, and practical equipment used for practices. The summary of research variables and data collection instruments can be seen in Table 1.

Table 1. Research Variables and Data Collection Instruments

Independent Variable	Dependent Variable	Instrument
Block system	Knowledge	Posttest
	Skills dan attitude	Job-sheet assessment

The population in this research was students who enrolled in Basic Machining Practices, consisting of students from D4 Mechanical Engineering Study Program of Faculty of Vocational and Mechanical Engineering Education of the Undergraduate program. The research population is presented in Table 2.

Table 2. Research Population

Study Programs	Study Groups	Number of Students	Total
Applied Bachelor of Mechanical Engineering	G	25	75
	H	29	
	I	21	
Undergraduate of Mechanical Engineering Education	A	33	66
	B	33	

The sampling technique in this research was a saturated sampling technique. Saturated sampling is a sample selection technique where all members of the population are selected as the sample. In other words, all students from the D4 Mechanical Engineering Study Program and undergraduate students from the Mechanical Engineering Education Study Program who enrolled in Basic Machining Practices were selected as the samples. The research samples were 75 students from the D4 Mechanical Engineering Study Program as the experimental group and 66 students from the Mechanical Engineering Education Undergraduate Study Program as the control group. The difference in sample size in the experimental group and the control group has no impact on the results of statistical calculations because the data analysis used is descriptive statistics. Descriptive statistics is a technique used to describe data that has been collected as it is without the intention of making general conclusions or generalizations. (Sugiyono, 2019).

The data in this research was obtained by carrying out a post-test and assessing students' practical learning performance. The post-test is given at the end of the semester exam for the Machining Theory course and contains knowledge and understanding of Machining theory. The final exam consists of 80 questions with five alternative answer choices. The post test questions are given in the form of a Google Form, while the data on skills and attitude aspects is in the form of a learning practice assessment sheet. The assessment sheet refers to the Basic Machining practice worksheet used in each even term.

The validity of a research instrument is the extent to which the instrument can measure what it is designed to measure (Robson & McCartsn, 2011). In addition, instrument reliability is the ability of the instrument to what extent it provides consistent measurement results with the same value (Cohen et al., 2018). The validity of the research instrument in the form of final exam questions for the Theory of Machining course and assessment sheets for the Basic Machining Practice course was not specifically tested. However, both instruments have been consistently used, evaluated, and continuously improved every semester. Therefore, the validity and reliability of this research instrument is guaranteed.

The data was analyzed using descriptive analysis to describe the data in the form of post-test scores and practical learning assessment scores. Descriptive statistics were used to present the data obtained from the data collection. Descriptive statistics refers to statistics used to analyze data by describing or illustrating the data that has been collected. The data obtained consisted of post-test scores and practical learning assessment scores on Straight Turning, Step Turning, Bolts, Eccentric Turning. The data presented was in the form of maximum score, minimum score, mode (Mo), median (Md), mean (Me), variance (S^2) and standard deviation (Sd). The results of the post-test and the practical learning assessment between the experimental group and the control group were then compared and analyzed.

RESULTS AND DISCUSSION

From the research conducted, the post-test scores and the students’ practical learning scores in the experimental group and the control group were obtained. The subjects of this research included 75 students from the Applied Bachelor of Mechanical Engineering as the experimental group and 66 students from the Undergraduate of Mechanical Engineering Education as the control group. The results of this research are divided into post-test scores (1) Machining Theory, and (2) Basic Machining

Practices which includes Straight Turning, Step Turning, Bolt Turning, and Eccentric Turning. The posttest score processed using Microsoft Excel are as follows.

Machining Theory

The post-test score of Machining Theory was divided into two categories: experimental group data and control group data. For the experimental group, the lowest score obtained was 18, the highest score was 78, the mean (average) score was 43.226, the median score was 44, the mode was 52, the variance was 137.501, and the standard deviation was 11.726. For the control group, the lowest score obtained was 40, the highest score was 82, the mean (average) score was 59.575, the median score was 59, the mode was 54, the variance was 138.524, and the standard deviation was 11,769. The distribution of the post-test scores can be seen in Table 3.

Table 3. Frequency Distribution of Machining Theory Posttest Scores

No.	Range Interval	Frequency		Relative Frequency		Category
		Experimental Group	Control Group	Experimental Group	Control Group	
1	18-30	12	0	16%	0%	Fail
2	31-43	25	6	33%	9%	Low
3	44-56	29	25	39%	38%	Sufficient
4	57-69	8	19	11%	29%	Good
5	70-82	1	16	1%	24%	Excellent
	Total	75	66	100%	100%	

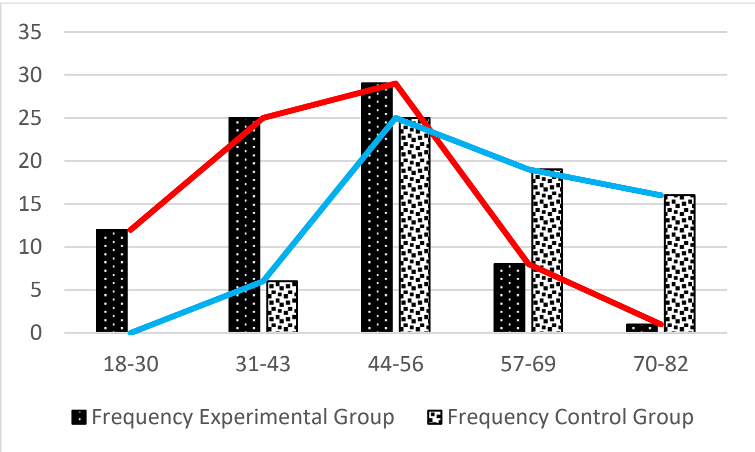

Figure 2. Frequency Distribution of Machining Theory Posttest Scores

Basic Machining Practices

The basic machining practices scores for straight turning were divided into the data of the experimental group and control group. For the experimental group, the lowest score obtained was 62, the highest score was 96, the mean (average) score was 80.826, the median score was 80, the mode was 80, the variance was 55.621, and the standard deviation was 7.458. For the control group, the lowest score obtained was 57, the highest score was 95, the mean (average) score was 77.651, the median score was 79, the mode was 88, the variance was 94.322, and the standard deviation was 9,712. The distribution of the practical learning scores for straight turning are presented in Table 4.

Table 4. Frequency Distribution of of Straight Turning Practical Scores

No.	Range Interval	Frequency		Relative Frequency		Category
		Experimental Group	Control Group	Experimental Group	Control Group	
1	57-64	1	5	1%	8%	Fail
2	65-72	11	15	15%	23%	Low
3	73-80	27	19	36%	29%	Sufficient
4	81-88	22	22	29%	33%	Good
5	89-96	14	5	19%	8%	Excellent
	Total	75	66	100%	100%	

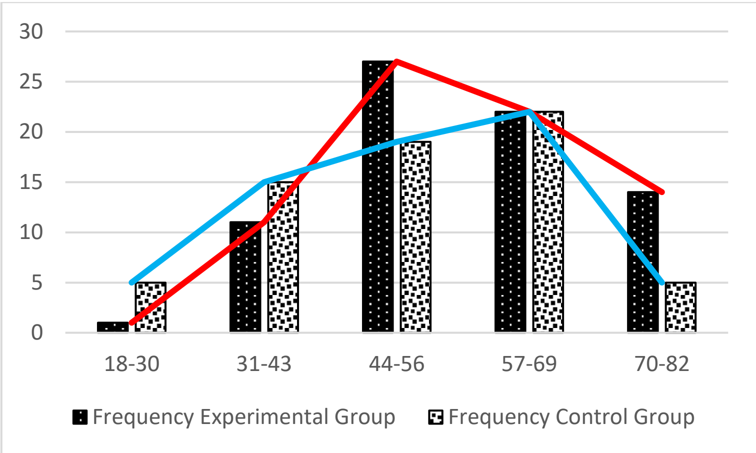

Figure 3. Frequency Distribution of Straight Turning Practical Scores

The Basic Machining Practices scores for step turning consisted of data for the experimental group and the control group. For the experimental group, the lowest score obtained was 70, the highest score was 92, the mean (average) score was 78.96, the median score was 78, the mode was 77, the variance was 34.795, and the standard deviation was 5.726. For the control group, the lowest score obtained was 51, the highest score was 94, the mean (average) score was 76.742, the median score was 78, the mode was 75, the variance was 71.609, and the standard deviation was 8.462. The table below shows the distribution of the practical learning scores for step turning.

Table 5. Frequency Distribution of Step Turning Practical Scores

No.	Range Interval	Frequency		Relative Frequency		Category
		Experimental Group	Control Group	Experimental Group	Control Group	
1	51-59	0	4	0%	6%	Fail
2	60-68	0	2	0%	3%	Low
3	69-77	35	24	47%	36%	Sufficient
4	78-86	29	30	39%	45%	Good
5	87-95	11	6	15%	9%	Excellent
	Total	75	66	100%	100%	

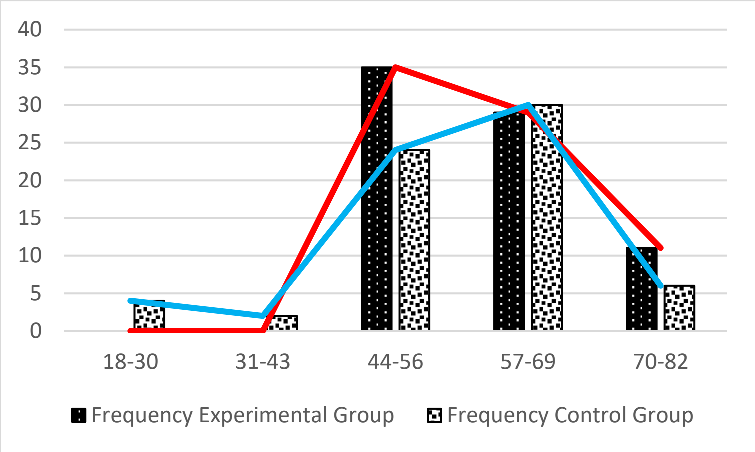

Figure 4. Frequency Distribution of Step Turning Practical Scores

The basic machining practices scores for bolt making were divided into two categories: data for the experimental group and the control group. For the experimental group, the lowest score obtained was 50, the highest score was 97, the mean (average) score was 79.466, the median score was 80, the mode was 80, the variance was 57.927, and the standard deviation was 7.611. For the control group, the lowest score obtained was 65, the highest score was 95, the mean (average) score was 82.09, the median score was 82, the mode was 81, the variance was 53.283, and the standard deviation was 7.299. Table 6 shows the distribution of practical learning scores for bolt making.

Table 6. Frequency Distribution of Bolt Turning Practical Scores

No.	Range Interval	Frequency		Relative Frequency		Category
		Experimental Group	Control Group	Experimental Group	Control Group	
1	50-59	1	0	1%	0%	Fail
2	60-69	2	2	3%	3%	Low
3	70-79	31	16	41%	24%	Sufficient
4	80-89	35	34	47%	52%	Good
5	90-99	6	14	8%	21%	Excellent
	Total	75	66	100%	100%	

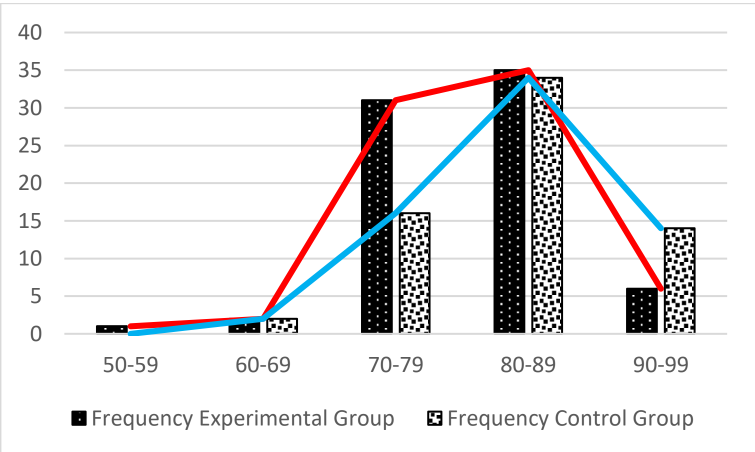

Figure 5. Frequency Distribution of Bolt Turning Practical Scores

The basic machining practices scores for eccentric turning were divided into two categories: data for the experimental group and the control group. For the experimental group, the lowest score obtained was 50, the highest score was 88, the mean (average) score was 74.226, the median score was 74, the mode was 70, the variance was 45.529, and the standard deviation was 6.747. For the control group, the lowest score obtained was 50, the highest score was 95, the mean (average) score was 75.121, the median score was 75, the mode was 75, the variance was 126.508, and the standard deviation was 11.247. Table 7 shows the distribution of practical learning scores for eccentric turning.

Table 7. Frequency Distribution of Eccentric Turning Practical Scores

No.	Range Interval	Frequency		Relative Frequency		Category
		Experimental Group	Control Group	Experimental Group	Control Group	
1	50-59	2	2	3%	3%	Fail
2	60-69	3	15	4%	23%	Low
3	70-79	53	28	71%	42%	Sufficient
4	80-89	17	9	23%	14%	Good
5	90-99	0	12	0%	18%	Excellent
	Total	75	66	100%	100%	

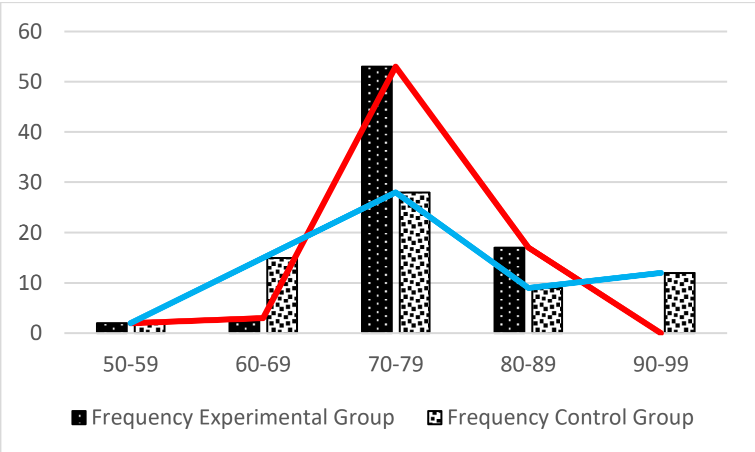

Figure 6. Frequency Distribution of Eccentric Turning Practical Scores

The Technical Teaching Factory Guidebook (GIZ, 2017) explains that a block schedule is an arrangement of teaching and learning activities designed to provide students with optimal learning and mentoring time while studying a specific competency. The block schedule organizes the rotation system of theoretical and practical learning activities, especially in terms of using practical learning facilities (such as laboratories, workshops, studios, kitchens, gardens, ponds, and simulation rooms according to the area of expertise) to ensure continuous learning. The concept of continuous learning means that practical learning activities can be carried out continuously within a specified time until students achieve the competency needed. Through the block schedule, theoretical and practical learning can be conducted in sufficient time to achieve competency mastery. For example, 1 week of practice (1P) and 1 week of theory (1T) are adjusted to the curriculum and expertise and integrated with character education (soft skills) for students, such as honesty, confidence, discipline, responsibility, tolerance, and cooperation.

The learning situation in a block schedule is as follows: (1) one learning group is divided into several smaller groups, with each group taking turns studying different subjects in a specified period in parallel; (2) each student uses one piece of equipment during practice (this does not mean that schools have to provide the same amount of equipment as the number of students); (3) educators/instructors can provide more optimal guidance. For example, if a learning group consists of 32 students, it can be divided into several smaller groups, with the number of groups depending on the types and number of productive subjects in each area of expertise. Each learning group might consist of 3-4 students.

Aspects to consider when preparing a block schedule are as follows. (1) Learning hours: This relates to the allocated study time based on the academic calendar and the time required to achieve competency. (2) Subjects: This pertains to the material studied by students over a certain period. (3) Rotation: This involves the arrangement of practical learning time for students in groups (one learning group is divided into several smaller groups, and each group studies different subjects over a specified period in turns). (4) Equipment: This concerns the efficiency and optimization of practical equipment while maintaining the rule that each student will practice using one piece of equipment. (5) Number of Educators/Instructors: This relates to the responsibilities of educators/instructors in guiding the learning process.

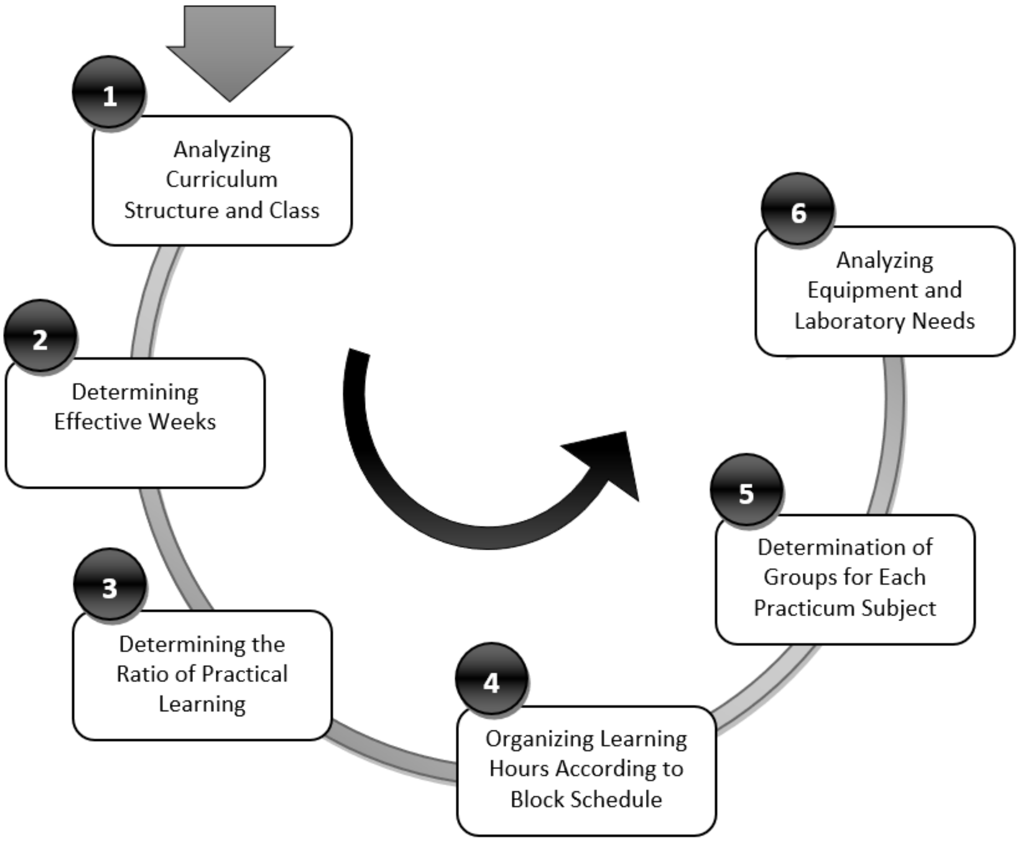

Figure 7. Steps for Preparing a Block Schedule

The steps for preparing a block schedule are illustrated in Figure 7. A more detailed explanation for each step in preparing the block system schedule is as follows.

Step 1: Analyzing the Curriculum Structure and Learning Hours

This involves conducting a simple analysis of the curriculum structure by comparing the number of theoretical learning hours with practical learning hours for each competency. Aspects to consider include: (1) Number of learning groups, (2) Number of students per learning group, (3) Number of learning time weeks, (4) Number of lathes machine, and (5) Number of milling machines.

Step 2: Determining Effective Weeks (Academic Calendar)

Determining the number of effective weeks in one year can be done by considering all activities including mid-term Exams, field studies, and end-term exams by referring to the academic calendar set by the University. The number of effective weeks in one term is 16 weeks.

Step 3: Determining the Ratio of Practical, Theoretical, and Field Learning

To determine the ratio of theoretical learning to practical learning, the results of the curriculum structure analysis results in Step 1 can be considered. For example, if a 1:1 ratio is determined, then the learning activities will be divided into 1 week for theoretical learning followed by 1 week for practical learning.

Step 4: Organizing Learning Hours According to Block Schedule

Organizing the learning hours involves determining the number of learning hours that will be used as a reference for creating the block schedule. For example, if the ratio is determined as 1 week of practice and 1 week of theoretical learning, then the allocation of 2 lesson hours for theoretical subjects in the curriculum structure must be multiplied by 2 (to meet the allocation requirements in the curriculum).

Step 5: Determining Groups per Practical Learning Subject

Determining the groups or sections per practical learning subject involves considering the time needed for students to achieve competency and adjust it according to the availability of required facilities and infrastructure. The next step is to create a practical learning group schedule by referring to the number of practice sessions for each subject that have been organized. This schedule is arranged based on the student's ID number and the type of practical lesson in such a way that each student gains learning experience with different students in specific practical lessons. This is also aligned with the work situations and culture in the business/industry world (such as working in groups, in shift systems, etc.).

Step 6: Analyzing Equipment and Laboratory Needs

It is important to consider the 1:1 ratio between students and equipment (the number of equipment should equal the number of students in the practical group) when analyzing the equipment and laboratories needs. Each skill competency requires a certain minimum amount of equipment that must be provided to ensure that the learning process can run effectively. The availability of equipment must be determined in advance (see Step 1). However, for schools that are just starting a teaching factory, the block schedule created can help determine the minimum equipment needed for specific practical learning subjects. Thus, using the block schedule, the number of equipment does not need to match the total number of the student because the schedule has been arranged in parallel for several types of practices simultaneously using different equipment.

These results suggest that the block system in practical learning is an effective method for teaching practical skills to students. Previous research (Wibowo, 2010) showed that both the proficiency of lecturers in organizing the implementation of learning with the block system and the implementation of learning with the block system affected the effectiveness of learning. A study conducted by the Ministry of Education and Culture (Sumantri et al., 2017) revealed that there are several things that affect the effectiveness of learning: (1) The experience of partner institutions/industries in receiving and organizing the implementation of Industrial Practice (IP) for students; (2) The practical proficiency in conducting IP and campus-based learning; (3) The experience of fieldwork practice in carrying out IP and the fieldwork experience with campus-based learning; and (4) The management of vocational education by organizing the implementation of learning using the block system. Research conducted at ATK Polytechnic (Nurwantoro & Nugroho, 2017) also showed that practical, critical, and communication behavior in Basic Metal Machining Theory learning influences the effectiveness of learning and the implementation of learning with the block system affects the effectiveness of learning.

Table 8. Research Conclusion

No.	Aspect	Score Source	Score		Category	Conclusion
			Experimental Group	Control Group		
1	Cognitive	Machining Theory & Concepts	43,23 (D)	59,58 (C)	Lower	Not Effective
2	Psychomotor dan Affective	Straight Turning	80,83 (A-)	77,65 (B+)	Higher	Effective
		Step Turning	78,96 (B+)	76,74 (B+)	Equal	
		Bolt Turning	79,47 (B+)	82,09 (A-)	Lower	
		Eccentric Turning	74,23 (B)	75,12 (B)	Equal	

The research results obtained from the post-test scores and the final practical learning scores in the Basic Machining course are as follows. (1) the post-test scores of the experimental group had an average (mean) of 43.23 (D) while the control group had an average (mean) of 59.58 (C). Therefore, the result of the experimental group was lower compared to the control group. (2) The experimental group had an average (mean) score of 80.83 (A-), while the control group had an average (mean) score of 77.65 (B+) in the Straight Turning assessment so there was a slight difference in the score. (3) In terms of the Step Turning, the experimental group had an average (mean) score of 78.96 (B+) while the control group had an average (mean) score of 76.74 (B+). Therefore, there was no significant difference in the scores between the two groups. (4) The experimental group had an average (mean) score of 79.47 (B+) while the control group had an average (mean) score of 82.09 (A-) in Bolt. This shows that there was a slight difference in scores between the two groups. (5) Finally, in the practical assessment of the

Eccentric Turning, the experimental group had an average (mean) score of 74.23 (B) while the control group had an average (mean) score of 75.12 (B). Thus, there was no difference in scores between the two groups. A summary of the differences in scores between the two groups and the conclusions can be seen in Table 8.

The research results describe that the block system learning is effective in practical learning for skill acquisitions, but not for theoretical and conceptual learning. These results are in line with previous research which states that the block model of teaching may have better effects on subjects that require a lot of skill acquisitions rather than conceptual learning (Murray et al., 2020). This condition is partly caused by the difficulty of students remembering information and theoretical and conceptual material in depth in a short time due to the block scheduling system. This reason may make sense because theoretical learning for cognitive purposes is different when compared with courses that train more psychomotor and affective skills. Even previous research, for example, also stated that some researchers found that students may have difficulty remembering information from courses when they skip the material for a semester (Morris, 2022). Block system learning is less beneficial for students because students must complete assessments in a shorter time after passing the block period. This is different from practical learning which uses non-test assessment techniques carried out in parallel during practical learning such as performance observation, attitude observation, and product quality assessment of work results. Block teaching provides its own challenges for students, especially in completing assessments (Nerantzi & Chatzidamianos, 2020).

Another cause of this condition is the implementation of active learning strategies. For example, previous research suggests that block systems need to involve the use of active learning strategies (Klein et al., 2019; Sinnayah et al., 2019; Houseknecht et al., 2020). In this case, students learn psychomotor and affective aspects actively and collaboratively by practicing product making directly in basic machining practical courses. These results may be in line with previous findings which reported that the effectiveness of block system learning is due to its contribution in providing a learning environment to build cooperation and a sense of belonging. Block system learning provides a learning environment that allows students to build collaboration both between students and with teachers and builds a sense of belonging, so that a practical learning community is formed (Winchester et al., 2021). It appears that block system learning creates more focused opportunities for active participation and collaborative learning because the same students will be together for a longer period (Nerantzi & Chatzidamianos, 2020). Other research also shows that block system learning is more suitable for practical learning than theoretical learning. As it has been reported that smaller classes, workshop-based active learning, produces better student outcomes than large lecture-based lectures (Ferreri & O'Connor, 2013; Kokkelenberg et al., 2008).

In summary, this shows that learning with a block system can be an effective approach in learning Basic Machining practices. This approach allows for deeper understanding and focus and provides students with more intensive practical experience. Overall, the block system is considered effective and efficient for application in Mechanical Engineering learning, especially practical learning. However, educators need to consider the view that learning will be more efficient if students are given rest time between learning sessions (Fenesi et al., 2018). Adjusting and optimizing time and material management is necessary to overcome fatigue and boredom that students may experience. This is important to pay attention to, as stated by teachers in previous research that short break durations have a negative impact on student learning (Yalar & Yelken, 2009).

CONCLUSION

Descriptive statistics show that students' competency achievements in cognitive aspects (knowledge) which include machining theory and concepts in block learning are less good than in traditional learning. Some of the obstacles that may be the cause include students' difficulties in remembering in-depth theoretical and conceptual information in a short time, the challenge of facing short assessments after the block period, and the failure to implement active and collaborative student learning strategies in the block system for theoretical and conceptual learning. It is necessary to apply innovative learning strategies to overcome these obstacles. Although further statistical tests are needed to measure the differences and significance between the two learning modes, these results have provided an overview of the weaknesses of block learning in theoretical and conceptual learning. On the other hand, students' competency achievements in the aspects of skills and work attitudes in the block learning system are more encouraging than in traditional learning. From descriptive statistics it appears that block learning is compatible with practical learning. This result is driven by several factors such as practical learning which is basically active and collaborative, non-test assessment techniques which are carried out in parallel during practical learning (performance observation, attitude observation, and assessment of the quality of work products), and the time interval between practice is not too long so that skills training and work attitude habituation are more intensive. Management of learning time and rest time is needed to overcome fatigue and boredom that students may feel.

ACKNOWLEDGMENT

We would like to express our deepest gratitude to all parties who have contributed to the completion of this research article. Special thanks to the student respondents, and the Dean of the Faculty of Engineering, Yogyakarta State University for their invaluable support for this research. This study can be realized with financial support from the Faculty of Engineering, Yogyakarta State University in 2023 through contract number: T/10.19/UN34.15/PT.01.02/2023.

REFERENCES

Arikunto, S. (2019). *Prosedur Penelitian*. Rineka Cipta.

Bhebhe, S., & Nxumalo, Z. G. (2017). Teaching and learning practical subjects in primary schools in Swaziland: The case of a school in the Hhohho region. *IOSR Journal of Humanities and Social*

Science, *22*(02), 66–74. https://doi.org/10.9790/0837-2202046674

Cohen, L., Manion, L., & Morrison, K. (2018). *Research Methods in Education* (8th ed.). Routledge. https://doi.org/10.4324/9781315456539

Davies, W. M. (2006). Intensive teaching formats: A review. *Issues in Educational Research*, *16*(1), 1–20. http://www.iier.org.au/iier16/davies.html.

Fenesi, B., Lucibello, K., Kim, J. A., & Heisz, J. J. (2018). Sweat So You Don't Forget: Exercise Breaks During a University Lecture Increase On-Task Attention and Learning. *Journal of Applied Research in Memory and Cognition*, *7*(2), 261–269. https://doi.org/10.1016/j.jarmac.2018.01.012

Ferreri, S. P., & O'Connor, S. K. (2013). Redesign of a Large Lecture Course Into a Small-Group Learning Course. *American Journal of Pharmaceutical Education*, *77*(1), 13. https://doi.org/10.5688/ajpe77113

GIZ. (2017). *Panduan Teknis Teaching Factory*. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

GIZ. (2018). *Modul Teaching Factory, Persiapan dan Implementasinya*. Depdikbud.

Houseknecht, J. B., Bachinski, G. J., Miller, M. H., White, S. A., & Andrews, D. M. (2020). Development, Effectiveness of the active learning in organic chemistry faculty workshops. *Chemistry Education Research and Practice*, *21*(1), 387–398. https://doi.org/10.1039/c9rp00137a

Klein, R., Kelly, K., Sinnayah, P., & Winchester, M. (2019). The VU way: The effect of intensive block mode teaching on repeating students. *International Journal of Innovation in Science and Mathematics Education*, *27*(9), 47–59. https://doi.org/10.30722/IJISME.27.09.004

Kokkelenberg, E. C., Dillon, M., & Christy, S. M. (2008). The effects of class size on student grades at a public university. *Economics of Education Review*, *27*(2), 221–233. https://doi.org/10.1016/j.econedurev.2006.09.011

Majid, D. A., Mukhadis, A., & Poerwanto, E. E. (2011). Pengaruh Model Penjadwalan dan Motivasi Berprestasi terhadap Hasil Belajar Perawatan Sepeda Motor Siswa SMK. *Jurnal Teknologi Dan Kejuruan*, *34*(1), 34–48.

Marshak, D. (1998). Key Elements of Effective Teaching in Block Periods. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *72*(1), 55–57. https://doi.org/https://doi.org/10.1080/00098659809599387

Mattox, K., Dawson, R. H., & Queen, J. A. (2005). The Effect of Block Scheduling on Middle School Students' Mathematics Achievement. *NASSP Bulletin*, *89*(642), 3–13. http://www.bwgriffin.com/gsu/courses/edur7130/readings/Mattox_et_al_2005.pdf

Morris, R. C. (2022). BLOCK SCHEDULING AND ITS GIFT OF TIME: A COMPREHENSIVE REVIEW. *Educational Planning*, *29*(2), 61–77.

Murray, T., Barkat, I., & Pearlman, K. (2020). Intensive mode screen production: An Australian case study in designing university learning and teaching to mirror "real-world" creative production processes. *Media Practice & Education*, *21*(1), 18–31. https://doi.org/10.1080/25741136.2019.1644842

Nerantzi, G., & Chatzidamianos, G. (2020). Moving to Block Teaching during the COVID-19 Pandemic. *International Journal of Management and Applied Research*, *7*(4), 482–495. https://doi.org/10.18646/2056.74.20-034

Nurwantoro, & Nugroho, A. R. (2017). *Pengaruh Sistem Blok Praktik terhadap Kompetensi Mahasiswa Jurusan Teknologi Pengolahan Kulit Politeknik ATK.*

O'Neil, J. (1995). Finding time to learn. *Educational Leadership*, *53*(3), 11–15.

Prosser, C. A., & Quigley, T. (1950). *Vocational Education in a Democracy*. American Technical Society.

Robson, C., & McCartsn, K. (2011). *Real World Research*. John Wiley & Sons Ltd.

Sinnayah, P., Rathner, J. A., Loton, D., Klein, R., & Hartley, P. (2019). A combination of Paramedic, active learning strategies improves student academic outcomes in first-year bioscience. *Advances in Physiology Education*, *43*(2), 233–240. https://doi.org/10.1152/advan.00199.2018

Sugiyono. (2019). *Metodelogi Penelitian Kuantitatif, Kualitatif, dan R&D*. Alfabeta.

Sumantri, D., Subijanto, Siswantari, Sudiyono, & Warsana. (2017). *Pengelolaan Pendidikan Kejuruan: Pengembangan Sekolah Menengah Kejuruan (SMK) 4 Tahun* (Subijanto & Y. Jakaria (eds.)).

Suwati. (2008). *Sekolah Bukan untuk Mencari Pekerjaan*. Pustaka Grafia.

Suyanta, Prianto, E., Ismara, I., Fitrihana, N., Syauqi, K., Wardoyo, S., Marwanti, Darmono, Siswantoyo, Wijaya, A., & Dwandaru, W. (2019). Facility standards of vocational schools: comparison of existing and modern facility designs. *Journal of Physics: Conference Series*, *1273*(1), 012048. https://doi.org/10.1088/1742-6596/1273/1/012048

Tatum, B. C. (2010). Accelerated Education: Learning on the Fast Track. *Journal of Research in Teaching*, *3*(1), 35–51.

Wibowo, T. Y. (2010). *Implementasi Pembelajaran Semi Block System sebagai Upaya Meningkatkan Kualitas Praktik Kayu Kelas XI TKK Program Keahlian Bangunan SMKN 5 Surakarta*.

Widarto. (2017). *Model Pembelajaran Cooperative Learning on Project Work*. Pustaka Pelajar.

Winchester, M., Klein, R., & Sinnayah, P. (2021). Block teaching and active learning improves academic outcomes for disadvantaged undergraduate groups. *Issues in Educational Research*, *31*(4), 1330–1350. https://www.iier.org.au/iier31/winchester.pdf

Wlodkowski, R. J., & Ginsberg, M. B. (2010). *Teaching Intensive and Accelerated Courses: Instruction That Motivates Learning*. Jossey-Bass.

Yalar, T., & Yelken, T. Y. (2009). Liselerde blok ders uygulamasının incelenmesi. *Eğitim Fakültesi Dergisi*, *22*(1), 263–278. https://dergipark.org.tr/tr/download/article-file/153366

Zepeda, S. J. (1999). Arrange Time into Blocks. *Journal of Staff Development*, *20*(2 (spring)), 26–30. https://eric.ed.gov/?id=EJ588848