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Article

Feasibility of Laboratory Facilities and Infrastructure in the Machining Practice Course in the Mechanical Engineering Education Study Program

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ABSTRACT

This study aims to assess *the feasibility* of laboratory facilities and infrastructure in supporting the implementation of machining practice courses in the Mechanical Engineering Education Study Program. This study uses a qualitative descriptive method with data collection techniques through direct observation, interviews, and documentation with source triangulation, technique triangulation, and time triangulation. The results of the study indicate that in general the lathe laboratory has met the eligibility standards according to Permendiknas No. 40 of 2008. However, there are still shortcomings such as the limited number of machines, lack of measuring instruments, and the need for regular maintenance of equipment. Laboratory facilities are considered adequate, but not yet ideal to support effective and efficient practicum activities. Therefore, an active role is needed from lecturers and faculty in evaluating, maintaining, and developing facilities. In addition, institutions are also advised to review the practicum schedule so that laboratory utilization is more optimal and equitable for all students.

Keywords: *Feasibility, Laboratory, Machining Practice, Facilities, Infrastructure, Mechanical Engineering Education.*

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INTRODUCTION

College is an education that organizes higher education. Higher education is an activity that can produce an educated person, higher education consists of professional and academic education. In the world of education there are many obstacles in the learning process, including the facilities used in learning activities. Especially for educators at universities in Indonesia, one of which is Sriwijaya University, where the university there is the Faculty of Teacher Training and Education where this faculty has one of the Study Programs that really needs facilities and infrastructure, namely the Mechanical Engineering Education Study Program (PTM). (Indrajit et al, 2020)

Mechanical Engineering Education is one of the study programs at the Faculty of Teacher Training and Education, Sriwijaya University, which is a vocational education where there is one practical course that really needs facilities and infrastructure that are categorized as suitable for use, namely the lathe machining practice course. Where in the Mechanical Engineering Education Study Program, facilities are needed. adequate because it has an effect towards learning . (Siregar et al., 2020)

Facilities and infrastructure are tools or parts that have a very important role for the success and smoothness of a process, including in the scope of education. Facilities and infrastructure are facilities that must be met to provide convenience in organizing an activity even though they have not been able to meet the facilities and infrastructure properly. (Nurmadiah, 2018) . The availability of facilities and infrastructure for practical learning in the Mechanical Engineering Education Study Program, in addition to being a motivation for each student, is also an important factor in achieving the planned learning objectives. With

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adequate laboratory facilities and infrastructure and management the laboratory that Good And well maintained can be aspect Supporter to help the practical learning process and can make a big contribution to progress student And produce graduate of Which competent in his field each each. If all That want to happen so readiness Workshop facilities and infrastructure in the Education Study Program Mechanical Engineering must be relevant.

The laboratory is one of the means to improve the quality of education and support practical learning activities to prepare and develop skills and creativity in facing the world of work. really . By Because That, To create an educator who has *skills* , is qualified and skilled, adequate facilities and infrastructure are needed in Mechanical Engineering Education, requiring laboratory facilities according to standards.

Laboratories play an important role in vocational education because they serve as a means to develop students' practical skills. Through laboratories, students can practice using equipment and machines according to industry standards so that their skills are better prepared to be applied in the workplace. In addition, laboratories also help students understand theoretical concepts through direct practice, so that the gap between theory and practice can be minimized. These practical activities not only improve technical competence, but also hone soft skills such as cooperation, critical thinking, problem solving, and communication and time management skills. In addition, laboratories can be simulated to resemble a real work environment so that students can experience firsthand the dynamics of the industry, including the application of work safety standards. Laboratory practice also encourages students to experiment and innovate, forming creative and adaptive mindsets. This is important so that they are better prepared to face challenges in the workplace. By practicing in the laboratory, students can learn from mistakes without great risk, thereby reducing the possibility of errors when working in a real industrial environment. Adequate practical experience will increase the competitiveness of vocational education graduates and make them more competent and ready to enter the workforce.

The Mechanical Engineering Education Study Program of Sriwijaya University has several campuses where the learning process takes place according to the courses. Practices at the Indralaya Mechanical Engineering Education workshop include the following courses: Welding Techniques, Bench Work, Plate Work, Heat Treatment, Casting, etc. While practices at the KM5 Palembang Mechanical Engineering Education workshop include: Machining Practices and Fitting Practices.

In this case, the researcher focuses the research on the lathe machining laboratory related to the management of facilities and infrastructure. Especially on the problem of inadequate equipment in the laboratory, so that the learning process is not running optimally. From the results of observations that have been carried out through interviews with mechanical engineering education students who have taken machining practice courses, and observations in the mechanical engineering education machining laboratory *feasibility* means And infrastructure Which there is in laboratory lathe machining mechanical engineering education, namely the limited number of machines and equipment used for practical work compared to the number of students which tends to be greater, in addition, the learning media used is also still lacking so that learning is less conducive and optimal because it is not in accordance with the feasibility of facilities and infrastructure in lathe machining practice.

Therefore, researchers are interested in researching the feasibility of standard facilities. And infrastructure workshop on eye studying practice machining in Program Education Studies Technique Machine. According to (Karunia, 2016) Feasibility is defined as a certain condition that is considered appropriate, of course to achieve this condition, standardization is needed which is used as a reference to assess something so that it can be said to be appropriate or not.

Researcher evaluate standard the become important factors in the learning process, especially practical learning, therefore through this research it is hoped that in the future the machining laboratory will receive support and attention to become more appropriate and in

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accordance with the standards of machining practice facilities and infrastructure in higher education.

METHOD

Research that discusses *the feasibility* of laboratory facilities and infrastructure in Eye Studying Practice Machining in Program Studies Education Technique Machine This is a qualitative descriptive study. Qualitative research is more suitable for the type of research that studies social phenomena from the perspective of its participants, as well as the conditions and situations of the research object.

According to Sugiyono (2017:9) the qualitative research method is a research method Which used For researching on condition object Which natural, (as opposed to an experiment) where the researcher is the key instrument.

This research was conducted in the Mechanical Engineering Education study program, precisely in the KM 5 machining laboratory on Jl. Alang Alang Lebar, Palembang City, South Sumatra, Faculty of Teacher Training and Education, Sriwijaya University. This data collection technique and instrument aims to collect data relevant to the research objectives using interview methods, observations, documents and archives, visual materials, and audio-visual recordings. Interviews were conducted with several informants, including one of the lecturers in the Mechanical Engineering Education study program at Sriwijaya University, in order to obtain accurate data.

Next, an analysis is carried out data results interview And documentation Which in the form of data qualitative. The data that collected through interview, observation and results studies documentation since the research was conducted, was immediately recorded and analyzed by compiling and grouping existing data, starting from data reduction, data presentation, and data conclusions.

FINDINGS AND DISCUSSION

The results of this study are described based on data obtained through interviews, observations, and documentation. Interviews were conducted with several informants, including one of the lecturers in the Mechanical Engineering Education study program at Sriwijaya University, in order to obtain accurate data.

The discussion in this study contains an analysis to find out about the achievement of facilities and infrastructure that have not been met in the lathe machining laboratory of the Mechanical Engineering Education Study Program. The data from this study can be used to find out the condition or suitability of the lathe machining laboratory facilities and infrastructure based on the standards that have been set according to PERMENDIKNAS No. 40 of 2008. Data analysis is carried out by describing each item that is described regarding what has been obtained or what has not been achieved.

The Level of Adequacy of the Lathe Work Area Infrastructure in the Lathe Machining Laboratory in the Mechanical Engineering Education Study Program

Description of the lathe machining laboratory taken from observation data.

Area of Lathe Machining Laboratory

According to the data obtained, the area of the lathe machining laboratory, for the total area of the laboratory is 192 m2 which is divided into several areas, namely the lathe work area and the milling machine work area. In PERMENDIKNAS No. 40 of 2008, for the lathe work area the minimum area is 64 m2 with a capacity of 8 students, so each student has a work area of 8 ^{m2}.

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Table 1. Results of Work Area Infrastructure Research Machine Lathe Based on Observation Data Results

No	Type	Standard	Observation Results	Category	
				Worthy	Not feasible
1.	Working area of the lathe	Lathe working area ± 64 m2 / 8 students	Lathe working area ± 96 m^2 Capacity 10 students ± 80 m^2 with the calculation 64 m^2 / 8 students = 8 m^2 / 1 student, while for 10 students 64 m^2 + 16 m^2 = 80 m^2, while for a capacity of 20 students 80 m^2 x 2 = 160 m^2 So for a capacity of 20 students, the working area of the lathe used is ± 160 m^2		✓
2.	work area machine lathe	work area machine lathe ± 8 m^2	± 6 m^2		✓
3.	Capacity participant educate	Amount students 8 to 10 students	20 students		✓
4.	Area to student ratio	Ratio per student 8 m^2	Ratio for 10 students ± 9.6 m^2 with the area is approximately 96 m^2, while For capacity 20 students about 4.8 m^2 with calculation $\frac{96}{10}$= 9.6 m^2 so for 20 students $\frac{9,6}{10}$= 4.8 m^2 So For capacity 20 students about 4.8 m^2		✓

From the data obtained for wide work area laboratory machine Mechanical Engineering Education Study Program For its vastness Already Good or worthy but with wide the that's really not efficient for amount students who have one internship about 20 students, so can concluded for wide room laboratory machining lathe in Mechanical Engineering Education Study Program Still not enough Good or in condition No worthy.

Storage Room and Instructor

Table 2. Research Results on Infrastructure of Storage Space and Instructors Based on Observation Data Results

No	Type	Standard	Observation Results	Category	
				Worthy	Not feasible
1.	Large storage space and instructor work area of lathe machine	Lathe work area storage space ± 48 m^2	16 m^2		✓
2.	Width of space storage	Space sheet storage ± 6 m^2	4 m^2		✓

From the data obtained can concluded For wide room storage and work area instructor machine lathe in the laboratory machining lathe in Mechanical Engineering Education Study Program still very lacking or No worthy If compared according to PERMENDIKNAS No. 40 of 2008.

Lighting

According to the observation data, the lighting system in the lathe machining laboratory consists of two types: natural lighting and artificial lighting. The natural lighting is considered adequate, as there are approximately 16 windows in the laboratory. For artificial lighting, electric lights are used, with a total of 24 lights, each with a capacity of 40 watts.

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These lights are distributed across two areas: the lathe machine work area and the milling machine work area.

Table 3. Results of the Research on the Lighting System for Lathe Machining Laboratories

No	Type	Standard	Observation Results	Category			
				C	TC	L	TL
1.	Amount lamp /watt	100 to 200 watts	12 lamps with a capacity of 1 lamp 40 watts With the calculation 40 x 12 = 480 watts	✓		✓	

From the data obtained, it can be concluded that the lighting system for the lathe machining laboratory of the Mechanical Engineering Education Study Program is of good or decent quality.

Ventilation

According to the observational data obtained, there is no ventilation system in the laboratory. Although the laboratory is equipped with air conditioning (AC), a proper ventilation system should be present, especially in the lathe machining laboratory. This indicates a lack of conformity with PERMENDIKNAS No. 40 of 2008 concerning ventilation systems.

Floor

From the data obtained the floor in the laboratory machining lathe Already fulfil existing standards the floor used That use mixture sand, stone and cement. Can be seen existence conformity between PERMENDIKNAS No. 40 of 2008 concerning floor.

Eligibility Level Means Work Area Laboratory Machine Lathe

Furniture in the Lathe Machining Laboratory

Chair

From the results of the research data obtained for the chairs used by students or those in the lathe machining laboratory in the Mechanical Engineering Education Study Program, according to quantity, it is sufficient or adequate and for quality it is also very good or adequate, the chairs in the lathe machining laboratory from the quantity are 20 chairs according to the number of students who are doing practicums.

Table

According to the data obtained by researchers for furniture such as tables, for the quantity of tables in the pulp machining laboratory in the Mechanical Engineering Education Study Program, there are 3 long tables which are very lacking according to existing standards, but for the quality it is good or decent. So it can be concluded that the tables in the lathe machining laboratory from the quantity side are very lacking or not decent while from the quality side it is good or decent.

Storage Cabinet for Tools and Materials

From the results of the research data obtained for the storage cabinets for tools and materials in the lathe machining laboratory of the Mechanical Engineering Education Study Program, there are 1 iron cabinet, 1 glass cabinet and 2 long wooden shelves.

Table 4. Research Results on Laboratory Furniture Facilities for Lathe Machining, Mechanical Engineering Education Study Program

No	Type	Standard	Observation Results	Category			
				Quantity		Quality	
				C	TC	L	TL
1.	Number of students using 1 set of work chairs	1 set/ area	20 students , with amount chair 20	✓		✓	
2.	Number of students using 1 set of work desks	1 set/ area	20 students , with amount table 3		✓	✓	
3.	Number of instructors using 1 work seat	1 set/ area	4 instructors , with 4 chairs	✓		✓	
4.	Number of instructors using 1 work desk	1 set/ area	4 instructors with 4 tables	✓		✓	
5.	Student tool and material storage cabinet	1 set/ area	1 cabinet combined between lathe and milling machine		✓	✓	
6.	Storage cabinet for tools and materials for instructors	1 set/ area	1 cabinet combined between lathe and milling machine		✓	✓	

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From the table above, it can be concluded for the furniture of the lathe work area of the Mechanical Engineering Education Study Program. From these results, it can be further detailed about the furniture of the lathe machining laboratory. The discussion regarding the furniture of the lathe machining laboratory includes chairs, tables, student storage cabinets, chairs, tables, and instructor storage cabinets.

The chairs for students are made of iron and covered with foam on the seat, in terms of the number of chairs per area it is sufficient and has reached the minimum standard of around 15 to 20 students for 1 set of chairs. For the chairs available in the lathe machining laboratory are chairs used for the learning process before carrying out the practicum process. While for student tables do not meet the requirements or are not yet worthy according to the specified standards, seen from the quality aspect for chairs and tables are good or already decent while in terms of quantity, the chairs in the laboratory are sufficient and for the tables are not enough, do not meet the requirements.

The instructor chairs available have met the requirements. The division of 1 set of work chairs used by 1 instructor 1 chair. While the work desk for instructors with the division of 1 instructor 1 table has met the specified requirements and laptops or computers are also available.

The storage cabinets for tools and materials used by students are already adequate in terms of quality, but in terms of quantity they have not met the requirements. According to PERMENDIKNAS No. 40 of 2008, for storage cabinets for tools and materials for students, there is a minimum of 8 students, but the cabinets provided by the campus for storing tools and materials are 1 and there are 2 wooden arak. While for the storage cabinets for instructor tools and materials, there is 1 which contains student documents and so on.

Viewed as a whole, the furniture in the lathe machining laboratory in the Mechanical Engineering Education Study Program is good or adequate in terms of quality, while in terms of quantity, the furniture in the lathe machining laboratory is still not good or adequate, from student work desks, storage cabinets for tools and materials.

Equipment in the Lathe Machining Laboratory

Lathe

Based on the data obtained and supported by the research instrument, the lathe machines in the lathe machining laboratory of the Mechanical Engineering Education Study Program are 10 lathe machines, the number of students using the lathe machine is 1 lathe machine used by 2 students, while according to PERMENDIKNAS No. 40 of 2008 it shows that 1 student uses 1 lathe machine, then it can be concluded that the quantity of lathe machines in the lathe machining laboratory of the Mechanical Engineering Education Study Program is still lacking because the number of students who enter the practicum is approximately 20 students while the number of machines is 10 lathe machines, while the quality of the lathe machines in the lathe machining laboratory is already very good or worthy

Head Stock

From the data obtained through observation and supported by research instruments, the fixed headstock *on* the lathe is seen in terms of quality as good or suitable, seen in terms of quantity, the fixed headstock in the lathe machining laboratory is good, sufficient or suitable.

Chuck

According to the data obtained through observation of the chuck *on* the lathe in the lathe machining laboratory, there are two types of chucks, the first is a three-jaw chuck and the second is a four-jaw chuck. In terms of quality, both the three-jaw chuck and the four-jaw chuck are good or adequate, while in terms of quantity, the three-jaw chuck and the four-jaw chuck are also good, sufficient, or adequate.

Drive Motor

The lathe drive motor in the lathe machining laboratory of the Mechanical Engineering Education Study Program, in terms of quality, is good or adequate, and in terms of quantity, it is also sufficient or adequate.

Emergency Stop Button

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In terms of quality, the emergency stop button on the laboratory lathe machine for lathe machining has no problems and is of good quality, and the quantity is also sufficient.

Handle or Lever

with the handle or lever on the laboratory lathe for lathe machining. In terms of quality, it is good or suitable for use. In terms of quantity, it is sufficient and there are no problems.

Sledge

From the data obtained through observation and interviews, there are 3 slides on the lathe, the first is the upper slide, the second is the cross slide and the third is the base slide. In terms of quality, the quality of these three slides is good but some are damaged. For the upper slide, there is 1 damaged slide, for the cross slide there are 3 damaged slides, and for the base slide there are 3 damaged slides.

Tool Post

Tool posts in the lathe machining laboratory, if viewed from the quality, the condition of the tool posts is good or suitable for use, but there are also some that need maintenance and the quantity is also good, sufficient.

Lighting Lamp

The lighting on the lathe is seen from the quality aspect as good or adequate and there are no problems.

Tail Stock

In terms of quality, the loose heads in the lathe machining laboratory are quite good or already suitable, but there are also some that need maintenance, for the number of loose heads there are approximately 10 according to the existing machine and for those that need maintenance or are damaged there are 3.

Machine Base

The lathe base in the lathe machining laboratory has no problems in terms of quality, and the quantity is in accordance with the number of existing machines.

Axis

There are 2 shafts in a lathe, the first is the transformation shaft and the second is the carrier shaft, seen from the quality of the shafts in the lathe, there are no obstacles or are suitable for use, both the transformation shaft and the carrier shaft.

Foot Brake

In terms of the quality of the foot brakes on the laboratory lathes, there are no problems or they are in a condition suitable for use, while in terms of quantity, it is according to the number of existing lathes.

Chisel

The chisels used by Mechanical Engineering Education students for turning use cutting chisels and facing chisels, in terms of quality, the chisels used by students are good or suitable for use, and in terms of quantity, they are sufficient and suitable for use.

Measuring Instrument

Measuring tools aspects seen from the micrometer, vernier calipers are measuring tools used by students during the turning process, seen from the quality aspect, the measuring tools in the lathe machining laboratory and used by students when doing practicums are very good and according to existing standards for both micrometers and vernier calipers.

Table 5. Results of Equipment Facilities in the Lathe Machining Laboratory of the Mechanical Engineering Education Study Program

No	Type	Standard	Observation Results	Category			
				Quantity		Quality	
				C	TC	L	TL
1.	Machine lathe	1 set/ student	10 machines lathe with damaged 3 so the good ones are 7, while students using 7 machines lathe about 20 students		✓	✓	
2.	Head Stock	1 set/ machine	10 according to the number of machines, all of them are good quality	✓		✓	

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No	Type	Standard	Observation Results	Category			
				Quantity		Quality	
				C	TC	L	TL
3.	Clamp						
	Clamp jaw 3	1 set/ machine	10 according to the number of machines with good quality all	✓		✓	
	Clamp jaw 4	1 set/ machine	10 according to the number of machines with good quality all	✓		✓	
4.	Drive motor	1 set/ machine	10 according to the number of machines with good quality all	✓		✓	
5.	Emergency stop button	1 set/ machine	10 according to the number of machines with good quality all	✓		✓	
6.	*Handle* or lever	1 set/ machine	10 according to the number of machines with good quality all	✓		✓	
7.	Sledge						
	Sledge on	1 set/ machine	10 damaged 1 becomes 9 in good condition		✓	✓	
	Sledge latitude	1 set/ machine	10 damaged 3 become 7 in good condition		✓	✓	
	Base sled	1 set/ machine	10 damaged 3 become 7 in good condition		✓	✓	
8.	Tool post						
	Standard tool post	1 set/ machine	10 damaged 1 becomes 9 in good condition		✓	✓	
	Adjustable tool post	1 set/ machine	10 damaged 1 becomes 9 in good condition		✓	✓	
9.	Light light	1 set/ machine	10 according to amount machine	✓		✓	
10.	Head off *(tail stock)*	1 set/ machine	10 damaged 3 become 7 in good condition		✓	✓	
11.	Machine base	1 set/ machine	10 according to the number of machines with good quality all	✓		✓	
12.	Axis						
	Axis of transformation	1 set/ machine	10 according to the number of machines with good quality all	✓		✓	
	Carrier shaft	1 set/ machine	10 according to the number of machines with good quality all	✓		✓	
13.	Foot brake	1 set/ machine	10 according to the number of machines with good quality all	✓		✓	
14.	Chisel						
	Cutting chisel	1 set/ machine	1 student 1 chisel	✓		✓	
	Facing chisel	1 set/ machine	1 student 1 chisel	✓		✓	
	Thread chisel	1 set/ machine	1 student 1 chisel	✓		✓	

Instructional Media

Learning media used in the laboratory machining Mechanical Engineering Education Study Program use screen with tool help projector There are also other learning media such as jobsheet and module, then can concluded for learning media in the laboratory machining lathe it's very good, look at it from aspect quality it's very good and seen from aspect quantity is also already Enough or Already worthy.

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Table 6. Learning Media for Lathe Machining Laboratory, Mechanical Engineering Education Study Program

No	Type	Standard	Observation Results	Category			
				Quantity		Quality	
				C	TC	L	TL
1.	Whiteboard	1 set/ area	There is 1 screen as usual used during the learning process For replacement board write	✓		✓	
2.	*Job Sheet*	1/ student	1/ student	✓		✓	
3.	Teaching module	1/ student	1/ student	✓		✓	

From the table on can described more detailed return about quality board write, board writing available in the laboratory machining Mechanical Engineering Education Study Program lathe, various types screen with quality Good.

Other Equipment for Lathe Machining Laboratory, Mechanical Engineering Education Study Program

Contact Box

The aspects assessed regarding the contact box in the lathe work area, from the observation data that has been carried out, the contact box in the lathe work area has met the requirements and is of good quality.

Rubbish Bin

The quality aspect of the trash bin in the lathe work area, from the observation data that has been carried out, the trash bin in the work area of the Mechanical Engineering Education Study Program has met the specified requirements and is of good quality.

Table 6. Research Results of Other Equipment for the Lathe Machining Laboratory, Mechanical Engineering Education Study Program

No	Type	Observation Results	Research Scale	Category			
				Quantity		Quality	
				C	TC	L	TL
1.	Contact box	Minimum 4 pieces/area 26 contact boxes, while 20 contact boxes are connected to NCB	13 contact boxes, while 10 contact boxes are connected to NCB	.		.	
2.	Place rubbish	Minimum 1 piece /area	3 places rubbish	.		.	

Table 7. Overall Results of Achievement of Facilities and Infrastructure of the Lathe Machining Laboratory of the Mechanical Engineering Education Study Program

No	Objects Study	Category
1.	Laboratory building machining lathe	Not feasible
2.	Furniture laboratory machining lathe	Worthy
3.	Equipment laboratory machining lathe	Worthy
4.	Instructional Media	Worthy
5.	Other equipment for lathe machining laboratory	Worthy

The overall results regarding the facilities and infrastructure of the machining laboratory in the Mechanical Engineering Education Study Program can be described as follows: based on the established standards, the facilities are considered to meet the required conditions and are deemed adequate. However, in terms of infrastructure, the conditions have not yet been met and are therefore considered inadequate.

CONCLUSIONS

Based on the results of the study on the feasibility standards of the machining laboratory facilities and infrastructure in the Mechanical Engineering Education Study Program, the lathe machining laboratory is declared feasible based on PERMENDIKNAS No. 40 of 2008, but requires an increase in the number of lathes, an increase in the completeness of facilities and infrastructure, and maintenance of existing tools and materials. The condition of the facilities and infrastructure is mostly in good condition and suitable for use for learning,

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although several lathe units require routine maintenance. In general, the laboratory has provided most of the facilities and infrastructure according to standards, but the number still needs to be increased to meet learning needs optimally.

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