

Comparative Study of Laboratory Management: Study Case of Ujung Pandang State Polytechnic and Makassar Merchant Marine Polytechnic

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Abstract—The laboratory role is huge in determining the quality of education because the laboratory produces proud scientific works, which other institutions cannot make. To get quality universities, laboratories are a priority. The laboratory is an integral part of the academic field. Laboratory management needs to be aligned with educational planning (programs and budgets). This research was carried out at the Ujung Pandang State Polytechnic (PNUP) and the Merchant Marine Polytechnic (PIP) Makassar. This research method is a comparative research type. Data collection techniques used are observation, interviews, and documentation. The method of analysis was using quantitative descriptive analysis. The results show that the Ujung Pandang State Polytechnic has a laboratory with laboratory management that is very concerned about the curriculum/module/syllabus, which is updated regularly. Comparing management laboratory includes a) understanding and access freely the modules for students, b) online laboratory schedule, c) the ratio of teachers according to the Higher Education standard of 1 : 8. For Laboratory Management at the Ujung Pandang State Polytechnic using the SOP for practicum implementation managed by a laboratory technician who has a certificate for the use of laboratory equipment. Some technicians are always available at the laboratory. The ideal laboratory to consider the ratio between the area of the laboratory room and the number of practitioners, the balance between teachers and students, the proportion of equipment, facilities, room conditions, and the equipment used condition.

Keywords—comparative; management; laboratory

I. Introduction

Laboratory is an integral part of the academic field (not part of the household or administration), so laboratory management needs to be planned in line with academic planning (programs and budgets) [1]. The role of the laboratory is very large in determining the quality of education because the laboratory produces proud scientific works, which cannot be produced by other

institutions. In order to obtain quality universities, laboratories are a priority [1].

Laboratory management is the ability and special skills to carry out an activity in the laboratory, either with other people or through other people in achieving certain goals [2]. The management of the laboratory contains the management of the laboratory as a place for practicum which in detail consists of tools and chemicals, laboratory infrastructure, and the process of implementing the practicum. The function of management is as a series of reasonable activities that have been determined and have an interdependence relationship between one another [3].

As a consideration for carrying out a comparative management study at the Ujung Pandang State Polytechnic (PNUP) and the Makassar Merchant Marine Polytechnic (PIP) in mid-August 2019, the Ministry of Research and Technology released the results of the clustering of universities in Indonesia. This assessment applies to two categories, namely Non-Vocational Colleges (universities, institutes, high schools) and Vocational Colleges (polytechnics, academies) [4].

The assessment parameters are very complex, covering the performance of inputs to *outcomes* of each university. From the results of the clustering, the State Polytechnic of Ujung Pandang was included in the top ten Colleges (Polytechnics) Vocational for the 2019 Best Version of Higher Education (Dikti) [5]. This is the reason why our team is interested in conducting research in PNUP and PIP Makassar.

In this study, it takes samples from laboratories at the PNUP which we consider the same as the laboratories at the PIP Makassar, namely the Electrical Machinery Laboratory and the High Voltage Laboratory, in the Mechanical Engineering Study Program, Department of Energy Conversion. Electrical and Electronics laboratory and Workshop for mechanical engineering study program.

Based on the background of the problem above, the formulation of the problems that will be discussed in this study can be formulated as follows:

1. What is the operational management of the laboratory?
2. What are the details of the activities of each laboratory management device?
3. What is the ideal laboratory design?

II. Research Methodology

A. Framework

Based on the research focus that has been described in the problem formulation, the type of research that will be used is the type of comparative research. The framework of this research is shown in Figure 1.

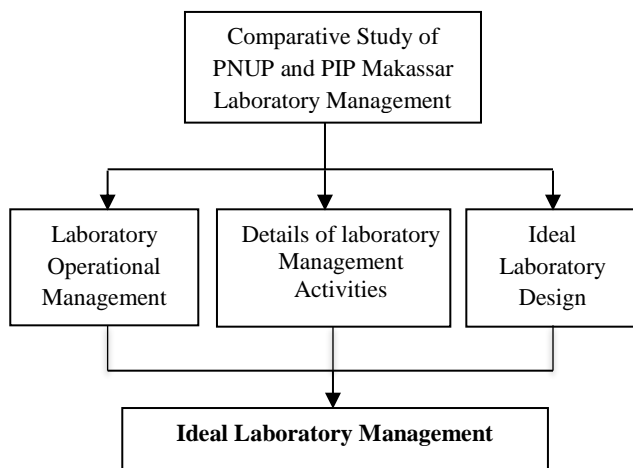


Figure 1. Framework of thoughts

In this case the population and sample used to support data collection techniques in the Observation study of laboratory management are employees (Heads of Laboratories including technician) and lecturers who carry out practical guidance at the Ujung Pandang State Polytechnic visited.

B. Location and Time of Implementation

The study locations are in leading polytechnics in Indonesia, including the top 10 best vocational universities (Polytechnics) according to Directorate General of Higher Education, namely the Ujung Pandang State Polytechnic (PNUP) as a comparison and the Merchant Marine Polytechnic (PIP) Makassar. This research is planned for 2 (two) months starting in July to September 2020.

III. Results and Discussion

A. Results

In collecting data from the State Polytechnic of Ujung Pandang we only collected data for the Energy Conversion Study Program and the Mechanical Engineering Study Program because we considered that it represented a laboratory that we considered the same as the one at the PIP Makassar, which is almost the same as the Laboratory under the Engineering Study Program, namely the Electrical and Electronic Laboratory.

Table 1. Number of Students in the Mechanical Engineering Department using the Laboratory Facilities

No.	Degree	Study Program	Number of Students
1	Diploma 3	Mechanical	144
2	Diploma 3	Automotive	92
3	Diploma 3	Heavy Equipment	48
4	Diploma 3	Energy Conversion	144
5	Diploma 4	Energy Generation	96
6	Diploma 4	Manufacturing	96
7	Diploma 4	Mechatronics	92

From the results of a visit to the Ujung Pandang State Polytechnic which we visited with the Research Team, we obtained data on the management of the Laboratory that we surveyed at that time was a Laboratory under the Mechanical Engineering Study Program, namely: Department of Energy Conversion at the Electrical Machinery Laboratory and High Voltage Laboratory. Quality Management of the Ujung Pandang State Polytechnic Education System (PNUP) is the Energy Conversion Engineering Study Program, implementing vocational education based on the Indonesian National Qualifications Framework (KKNI) [6]. With a learning content of 60% practice and 40% theory taken during the 6 semesters of lectures as well as accredited quality

assurance, the learning process fulfills the link n match criteria with the industrial world in its field. The laboratories under the Energy Conversion Engineering study program are:

1. Mechanical Laboratory
2. Energy Conversion Laboratory
3. Electrical Energy Conversion Laboratory
4. Basic Physics Laboratory,
5. Power Electronics and Control of Integrated Electrical Transmission and Distribution Laboratory.

Quality Management of Makassar Merchant Marine (PIP) is implementing vocational education marine based on the Indonesian National Qualifications Framework (KKNI) [7]. With a learning content of 60% practice and 40% theory taken during the 8 semesters of lectures as well as accredited quality assurance, the learning process fulfills the link n match criteria with the industrial world in its field. The laboratories under the Engineering and nautical study program in PIP Makassar was shown in Tables 2, 3 and 4.

Table 2. Number of Students of Semester IV Engineering Study Program PIP Makassar using Simulator and Laboratory

No.	Degree	Study Program	Number of Students
1	Diploma 4	Technical	269
2	Diploma 4	Nautical	
3	Diploma 4	Marine and Port Management	

Table 3. Number of Simulators and Laboratories in under PIP Makassar Nautical Study Program

No.	Name of Simulator and Laboratory	Description
1.	Language Laboratory	3 Study Program
2.	Programs Seaman Ship Laboratory	
3.	Multimedia Laboratory	
4.	Deck Mode Laboratory	
5.	Navigation Laboratory	
6.	Physic Laboratory	2 Study Program
7.	Programs chart Room Laboratory	
8.	Arpa Simulator Radar	
9.	Computer Laboratory	3 Study Program

Table 4. Number of Simulators and Laboratories in under PIP Makassar Technical Study Program

No.	Name of Simulator and Laboratory	Description
1.	Electrical & Electronic Laboratory	
2.	Fire Fighting Laboratory	
3.	Gas Turbine Simulator	
4.	Full Mission Bridge Simulator	
5.	Chemistry Laboratory	
6.	LCC & LGP Classroom Simulator	
7.	KAKL Laboratory	

B. Discussion

In collecting data from the State Polytechnic of Ujung Pandang we only collected data for the Energy Conversion Study Program and the Mechanical Engineering Study Program because we considered that it represented a laboratory that we considered the same as the one at the PIP Makassar, which is almost the same as the Laboratory under the Engineering Study Program, namely the Electrical & Electronic Laboratory.

Table 5. Comparison data of laboratory management

Assessment items	Energy Conversion Laboratory	Electrical & Electronic Laboratory
Curriculum/ Module/ Syllabus	<ul style="list-style-type: none"> • Update every four years • The module was provided for learners 	<ul style="list-style-type: none"> • Update every 4 years, • There are modules provided for students
Lab Usage Schedule.	<ul style="list-style-type: none"> • It has the schedule, management system (online and offline), and Check out online • SOP was provided for practicum, lecturers, and technician 	<ul style="list-style-type: none"> • It is a schedule, management system (offline) • there is SOP for Practicum Implementation • Practicum directly handled by the lecturer in charge of the course, there is no laboratory and technician working in duplicate
Ratio of lecturer and Students	<ul style="list-style-type: none"> • The ratio refers to standard of Higher Education for Engineering and Non-Engineering programs, namely 1 : 8 (fat) 1 : 14 (thin) 	<ul style="list-style-type: none"> • The ratio refers to standard of Higher Education for Engineering and Non-Engineering programs, namely 1 : 8 (fat) 1 : 14 (thin)
Equipment versus Ratio	<ul style="list-style-type: none"> • 1 Job or Practicum title = 2 supervisors • The ratio is calculated for 1 Equipment maximum that uses 4 Persons • Scheduling of tool use 	<ul style="list-style-type: none"> • 1 Job of Practicum needs 2 supervisors. But it has not gone according to schedule, at the time of the practicum it is only supervised by one lecturer, there are no institutions • The ratio is calculated for 1 Equipment maximum that uses 10 people • Scheduling of equipment usage
Type of Equipment	<ul style="list-style-type: none"> • Equipment is functioning well, 	<ul style="list-style-type: none"> • Equipment works well, although

	although there are some who are old.	some are old. According to the Learning Objectives, the amount is adequate) belonging to PIP, HIBAH, PNBP and Pure Rupiah (RM)
HSO Equipment	<ul style="list-style-type: none"> • Not optimal, • It has already prepared. • Installed at a prepared and easily accessible point. 	<ul style="list-style-type: none"> • Not yet maximized, has been prepared. • Installed at a prepared and easily accessible point
room conditions	<ul style="list-style-type: none"> • Quite spacious and available facilities, • Clean and bright 	<ul style="list-style-type: none"> • Spacious enough and facilities available, • Clean and bright
Condition of Equipment is	<ul style="list-style-type: none"> • Good function • 20% needs repair, but it is still working. • It was performed routine maintenance and continuous evaluation 	<ul style="list-style-type: none"> • Good function • 30% needs repair, but it is still working. • There is no routine maintenance and no continuous evaluation

By looking at the data we got when conducting research and after analyzing it, it can be concluded that to manage a good laboratory or simulator, a laboratory management is needed in the form of a series of activities including planning, organizing, administration, arrangement and security. The process of laboratory management so that laboratory activities can be carried out effectively and efficiently and produce outputs that are in accordance with the expectations of the PIP Makassar and meet the 2010 STCW Amendment, IMO Model Course 7.04, IMO Model course 7.02, simulator in the Train the Trainer and Assessor simulators, IMO Model course 6.10, laboratories and simulators are used for competency testing both theoretical and comprehensive practice of training participants by academics/lecturers. Therefore, the simulator is a practical tool according to the competency test method, namely as a tool that simulates the workings of the operating system of machinery equipment on board.

Good laboratory management activities include updated curriculum, modules and syllabus both offline and on line, schedule for laboratory use and SOPs for practicum implementation, availability of lecturers,

laboratories and technicians who have certificates in the use of practicum tools, and do not work in duplicate will facilitate the course of the practicum so that the expected results will be maximized. Laboratory Management is one of the essential factors in engineering and technical education. Quality of engineering education program is always valued both in teaching and learning in the classroom as well as laboratory activities and management besides other related activities such as internship [8].

It also needs to be taken into account in managing laboratories and simulators is the ideal laboratory design when it takes into account the ratio between the area of the laboratory room and the number of practitioners, the ratio between teachers and students, the ratio of equipment, facilities, room conditions and the condition of the equipment used.

The study of comparative is also using to compare the performance of the FLC and ANFIS as a control in order to keep stability of the output power of the zeta converter [9] and playback converter [10].

IV. Conclusion

From the results of this research, it was concluded as follow:

1. Ujung Pandang State Polytechnic has a laboratory that has laboratory management that pays great attention to the curriculum/module/syllabus which is updated regularly, there are modules for students that are easy to understand and can be accessed freely, Lab Usage Schedule. Which can be accessed online, the ratio of teachers according to the higher education standard is 1:8.
2. For Laboratory Management at the Ujung Pandang State Polytechnic, the SOP for practicum implementation is managed by a laboratory technician who has a certificate for the use of laboratory equipment and there are technicians who are always present at the laboratory.
3. The ideal laboratory design is to take into account the ratio between the area of the laboratory and the number of practitioners, the ratio between teachers and students, the ratio of equipment, facilities, room conditions and the condition of the equipment used.

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