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STUDENTS' UNDERSTANDING OF ELECTRONICS LABORATORY AT STIP

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***Abstract*— Electronic lesson is one of the subject at Engineering Department of STIP. This subject is mandatory according to IMO Model Course 7.04 and 7.02. This subject is delivered more with practice which is 67% while theory is 33%. This research aims to describe the Electronics laboratory understanding of Engineering Students of STIP regarding laboratory equipment and its functions. This research was carried out at STIP, among 133 students of the Engineering Department, batch 62. The instruments used in this research were tests and questionnaire sheets. The results of this research are that the Electronic laboratory understanding of students at Engineering Department of STIP is influenced by several aspects, including the aspect of interest in electronics activities which 88.72% of students agree and 12.03% strongly agree. Another aspect that influences is the aspect of knowing the conditions of electronics practicum activities in the laboratory where the results 16.54% of students agree and 4.51% disagree. Followed by the time aspect of practicum implementation where the results 87.22% of students agree and 13.53% strongly agree. Then aspects of preparation and implementation of electronics practical activities where the results 93.98% of students agree and 4.51% strongly agree and 2.26% disagree. Lastly is the report and practicum evaluation aspect where the results 93.98% of students agree and 4.51% strongly agree.**

Keywords—Electronics laboratory, Engineering students, practical activities

I. INTRODUCTION (*HEADING 1*)

Vocational education is higher education that supports the mastery of certain applied skills, including diploma education programs that are equivalent to academic education programs.

According to Billet vocations are product of individuals experiences and interest, that are, in some ways, person dependent constrain the human capacities required to undertake those activities" [1]. Vocations are attractive products or services and are personal experiences that cause others to depend on or need them, leading to being called or invited to perform a job.

The Maritime Science College, hereinafter referred to as STIP, is an organizer of academic and/or vocational education programs in the field of Maritime Science, where the vocational learning process places more emphasis on providing direct experience to develop competencies. The students of the STIP are referred to as students. Vocational education places more emphasis on practical learning, whether conducted in simulators, laboratories, or workshops, making it more effective and engaging in increasing students' interest in learning. Learning must fully engage the students. (active learning). Active learning can be implemented by lecturers by realizing a learning process that provides opportunities for students to engage in process skills, including: searching, discovering, concluding, and independently communicating various understanding, values, and experiences needed. All of those things were done during the practical activities. Studying electronics becomes less optimal if it is not supported by real experiences for students, one of which is practical work.

There are four important reasons why practical activities can stimulate learning motivation according to the research of Hariyatmi, et al. [2]. First, practicals can stimulate learning motivation. Second, practicals develop basic skills in conducting experiments. Third, practicals serve as a platform for learning the scientific approach. Fourth, the practical sessions support the lesson material.

Practical training is one of the learning methods that can foster curiosity, activity, creativity, innovation, and honesty in facing real-life problems. Through practical training, students acquire concrete understanding to complement the verbalistic theories obtained in class, develop scientific skills, instill and cultivate a scientific attitude, and enhance the students' motivation to learn. So that vocational students, who are prospective workers capable of establishing expertise and skills in their fields, ready to work and able to compete globally in the future, are required to have adequate understanding about electronic component equipment on ships.

Before carrying out practical activities, technical program students are usually first equipped with training activities to familiarize themselves with laboratory equipment. Introduction to laboratory equipment is important for workplace safety during practical work. Laboratory equipment can usually be damaged or even become dangerous if not used according to procedures [3]. The reason why it is important to introduce laboratory equipment is so that students know how to use the equipment properly and correctly, thereby minimizing procedural errors in equipment usage as much as possible.

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In general, the function of each tool has been provided, as it is not possible to explain all functions when conducting practical work in the laboratory. To facilitate the understanding of laboratory equipment that can be used for a relatively long time and in good condition, adequate maintenance and storage are required [4]. For that reason, it is important that students, who are essentially future seamans, especially in the engine department, must know and understand the names and specifications of the equipment. Not only that, the students must also understand how the tool works and its principles.

Kertiasa states that etymologically the word laboratory comes from the Latin word meaning place of work and in its development, it retains its original meaning, but specifically for scientific research purposes [5].

The school laboratory is a place or institution where students learn and conduct experiments (investigations) and so on related to science. Thus, laboratory activities (practicals) are an integral part of the teaching and learning activities in electronics.

Hudha (2011) states that laboratories are built on a full awareness that learning in laboratories holds an important position in education, because in order to achieve multi-dimensional goals in the learning process, adequate learning strategies are required. One of the learning strategies that is considered to encompass three domains simultaneously (cognitive, affective, and psychomotor) is laboratory learning. Theoretically, the existence of laboratories is expected to support activities centered on the development of certain skills, including process skills, motor skills, and the formation of a scientific attitude, particularly the development of interest in conducting investigations, research, and a deeper study of nature.

Laboratory activities can help students in studying science by sharpening their understanding of concepts/theories of understanding, and also help to develop their understanding of the nature of science and its methods, as well as knowing how to apply science. Laboratory activities can also stimulate the development of analytical and critical thinking skills, and generate interest in science.

Maknun expressed the opinion of Sund & Trowbridge (1973) which states that there are five skills that students can acquire after learning science through practical work, namely the skill of acquiring, the skill of organizing, the skill of creativity, the skill of manipulation, and the skill of communication. In general, laboratory equipment can be classified into two categories: (1) Consumable equipment, which refers to laboratory equipment that is used once and then discarded or can also be single-use, breakable, or easily breakable. This category includes glassware, glass tubes, rubber tubes, filter paper, chromatography paper, and others; (2) Non-consumable equipment, which refers to laboratory equipment that can be used continuously and is not single-use. This category includes gas burners, vacuum pumps, microscopes, electronic equipment, etc. It is advisable to store microscopes and electronic equipment separately [6].

According to the research results by Hiva Safar, et al. (2020), it is concluded that prioritizing effective laboratory medicine teaching to medical students at the right time should be considered in the medical school curriculum for implementation. Meanwhile, according to the research results of Natalia Kristiani Lase (2021), (1) the understanding of biology education program students about laboratory equipment and its functions is relatively adequate and needs to be improved, (2) the results of the closed questionnaire given to students are (a) the aspect of interest in practical activities, 86.96% strongly agree and 13.04% agree, (b) the condition of the laboratory, 78.26% strongly agree and 21.74% agree that it needs improvement, (c) the timing of practical implementation and preparation for practical implementation, 100% of students agree that it is already good, (d) practical reports and evaluations, 76.09% of students agree that it is already good and 23.91% agree that it is sufficient. The same conclusion was drawn from the research by Ross J Molinaro, et al (2012), where the assessment only measured a small amount of understanding gained, and the improvement in understanding of 4th-year medical students who spent a short time studying medicine in the laboratory was very satisfactory.

Based on theories and previous research findings, as well as the initial survey results from the research team, it was found that there is still a problem with the low scores in the Post-Prala Maritime Skills Exam for the Engineering Program at the STIP in the electronics subject, as shown in the table below.

TABLE 1. POST-PRALA MARITIME SKILL EXAM RATES OF ENGINEERING STUDENTS BATCH 62 (source: PUKP, 2023)

No	Students	date of exam	Students number	Average Scores	
				Maintenance and repair of electrical and electronic equipment	Electrical, Electronic, Control System at the Operational Level
1.	batch 62, 1st wave	Nov 7, 2022	75	63	70
2.	batch 62, 2nd wave	June 19, 2023	58	44,22	68.79
Total			133	53,61	69,4

The initial survey data shows that the average class scores for the electronics subjects based on the IMO Model Course 7.02 and IMO Model Course 7.04 indicate that there are 2 (two) subjects being tested, namely maintenance and repair of electrical and electronic equipment and electrical, electronic, control system at the operational level, which still fall into the categories of sufficient and moderate scores. For the average class score in the subject of maintenance and repair of electrical and electronic equipment, it falls into the sufficient category (grade point < 60), and for the average class score in the subject of electrical, electronic, control system at the operational level, it falls into the moderate category (>60 – 70). It can be concluded that the practical activities of students in the technical program at the Maritime Academy regarding understanding of laboratory equipment and its functions are not yet optimal. Based on the background description above, if this condition is allowed to continue, it is feared that the understanding of students in the

technical program at the STIP regarding laboratory equipment and its functions will not be sufficient to meet the standards of vocational school graduates.

Based on the description of the background and problem identification above, the research team formulated the research problem of what extent do students understand the electronics laboratory equipment at the STIP. The urgency of this research is based on the background description above, to avoid conditions where the understanding of engineering study program students at STIP regarding understanding of electronics laboratory equipment and their functions is not optimal and is deemed insufficient to fulfill them as vocational school graduates.

II. Literature Review

Understanding is the result of knowing, and this occurs after a person perceives a certain object. Understanding or cognitive is a very important domain for the formation of a person's actions [7].

According to Hermina TS et al, the factors that influence the level of understanding include: (1) Level of Education, that is an effort to provide understanding so that there is an increase in positive behavioral changes. (2) Information, that is a person who has more sources of information will have broader understanding. (3) Culture, that is the behavior of humans or groups of humans in fulfilling needs, which includes attitudes and beliefs. (4) Experience, that is something that someone has experienced will add understanding about something informal in nature [8].

In the Great Dictionary of the Indonesian Language [9], a laboratory is defined as a place for conducting experiments. (penyelidikan dan sebagainya). Schools, as educational institutions, are required to have supporting facilities and infrastructure for the learning process in order to achieve educational goals. According to Richard Decaprio, translated by Dion Yulianto (2013:16), a laboratory is a place where a group of people conduct various research activities, observations, training, and scientific testing as an approach between theory and practice from various disciplines.

A laboratory according to PERMENPAN III/2010 is an academic support unit in an educational institution, in the form of closed or open rooms, permanent or mobile, systematically managed for testing, calibration, and/or limited-scale production activities, using equipment and materials based on certain scientific methods, in order to carry out education, research, and community service.

According to Sukarso (2007:123), the functions of the laboratory are (1) Laboratory as a learning resource, as a source for solving problems or conducting experiments. Various issues related to learning objectives consist of 3 domains, namely: the understanding domain, the attitude domain, and the skills/affective domain. (2) Laboratory as a method of learning, within the laboratory, there are two methods of learning, namely the experimental method and the observational method. (3) Laboratory as an educational facility or a medium for the learning process. The laboratory consists of a room equipped with various apparatus under different controllable conditions, especially equipment for conducting experiments.

Indicators that must be present in assessing the level of laboratory utilization as a learning resource according to Zikrika (2015:17), (1) Frequency of laboratory use. (2) Completeness of tools and materials available in the laboratory. (3) Suitability of the material with the tools available in the laboratory. (4) Sufficient time allocation for practical activities.

Electronics is a branch of science and technology that deals with the processing and control of electric currents using electronic components. Electronics involves the study of the properties and behavior of electrons in various systems, as well as the design, manufacture, and maintenance of electronic devices such as circuits, components, and electronic equipment. The field of electronics encompasses various topics, including electrical circuits, integrated circuits, microprocessor and microcontroller systems, wireless communication, signal processing, optoelectronics, instrumentation, and much more. Electronics also includes an understanding of electronic components such as resistors, capacitors, inductors, transistors, and various types of semiconductors.

In everyday life, electronics are very important in various fields, including telecommunications, computers, industry, automotive, household appliances, control systems, medical equipment, and many more. The development of electronics also contributes to the discovery and development of new technologies such as smartphones, computers, navigation systems, audio and video systems, and other electronic devices that we use daily.

In the past few decades, electronics have advanced rapidly with the introduction of technologies such as integrated circuits, increasingly smaller and more powerful microprocessors, sophisticated wireless networks, and wearable electronic devices. Electronics continues to evolve and garner significant attention in efforts to enhance the efficiency, reliability, and capabilities of electronic devices.

Relevant previous research can help the upcoming study become more systematic and better by considering the issues and findings from earlier studies. Here is the review of previous research:

A. Hiva Safar, et al. [10]

With the research title "Understanding of Laboratory Medicine in Medical Students." From the research results, it was concluded that prioritizing effective laboratory medicine teaching to medical students at the right time should be considered in the medical school curriculum for implementation.

B. Natalia Kristiani Lase [11]

With the research title "Analysis of Biology Education Students' Understanding of Laboratory Equipment and Its Functions at IKIP Gunungsitoli." The research results indicate that (1) the understanding of biology education

students about laboratory equipment and its functions is relatively adequate but needs improvement, (2) the results of the closed questionnaire given to students are (a) interest in practical activities, with 86.96% strongly agreeing and 13.04% agreeing, (b) the condition of the laboratory, with 78.26% strongly agreeing and 21.74% agreeing that it needs improvement, (c) the timing of practical activities and preparation for practical activities, with 100% of students agreeing that it is already good, (d) practical reports and evaluations, with 76.09% of students agreeing that they are already good and 23.91% agreeing that they are adequate.

C. Ross J Molinaro, et al (2012)

With the research title "Teaching Laboratory Medicine to Medical Students: Implementation and Evaluation." It is concluded that the assessment only measures a small amount of understanding acquired, and the improvement in understanding of 4th-year medical students who spent a short time studying medicine in the laboratory is very satisfactory. Method

The location for the research and observation on Student's understanding of Electronics Laboratory was conducted from January 2024 to March 2024, for a duration of 3 months. Research was held at STIP, located on Jl Marunda Makmur, Cilincing, North Jakarta. STIP organizes education equivalent to D IV and Vocational Master's degrees. The D IV program consists of 3 study programs, namely Nautical, Engineering, and Maritime Transportation and Port Management. In this research, the object of study is the students of the Engineering Program.

In this research, to obtain and find data, it is obtained from two data sources, namely (1) Primary Data which is data collected directly by the research team from the main source according to Sugiyono [12]. The primary data in this research includes: open-ended questionnaires and closed-ended questionnaires to respondents. (2) Secondary Data which is data published or used by organizations or companies that are not processed by them according to Sugiyono. In this research, the data was obtained from written documents held by the Maritime Science College, including the Sailor Proficiency Exam scores and data related to the electronics laboratory, both in hard copy and soft copy.

Data Collection Techniques consists of (1) Questionnaire, which is the most commonly used tool for collecting primary data. The questionnaires used are in the form of open-ended and closed-ended questionnaires. (2) Documentation, refers to the collection of both primary and secondary data as a basis for conducting the analysis. Sampling Techniques, according to Sugiyono (2019) Saturation Sampling is a sampling technique where all members of the population are made into a sample. The sampling technique in this study uses Saturation Sampling, where the entire population in this study is made into a sample.

The data collection methods used need to be supported by actual data. Therefore, in collecting the data, data collection techniques are used in the form of (1) Method of Approach, This research uses a descriptive approach, where data from interviews with students who have conducted learning in the electronics laboratory will be presented. The data used are primary data, which are data obtained directly by the researcher. (2) Data Collection Techniques, Data was obtained by conducting interviews with students who have undergone training in the Electronics laboratory.

The method used in the implementation of the research is descriptive research. Descriptive research is conducted to determine the value of independent variables, whether one variable or more, without making comparisons or linking one variable with another. This research is an effort to answer the questions from the questionnaire distributed by the research team.

The subjects of this research are the Engineering students at the batch 62 of STIP, totaling 133 individuals. The research was conducted at the Electronics Laboratory, Kalangie Building, Maritime Academy.

The subjects of this research are students who have completed the electronics course. In addition, the students have also completed internship in the 5th and 6th semesters within a period of 1 (one) year on board. In addition, the students have completed the Maritime Skill Examination (UKP).

The object of this research is the competence of students in laboratory practical activities, especially regarding laboratory equipment and its functions, which are measured with the provided instruments. The research instrument consists of tests and questionnaires. The testing method involves providing 3 (three) types of essay questions (open-ended questions) to gain a deeper understanding of the students' understanding about the equipment and its functions.

This questionnaire aims to explore the students' interest in laboratory practical activities, understand the conditions and situation in the laboratory, the time allocated for electronics practical learning in the laboratory, the preparation and implementation of practical activities, as well as the reporting and evaluation.

III. Results and Discussion

To determine the students' interest in practical activities, their opinions on the conditions of practical activities in the laboratory, the effectiveness of electronic practical learning time in the laboratory, the preparation and implementation of practical activities, as well as practical reports and evaluations, the research team has distributed a questionnaire with 30 questions and answer choices using a Likert scale to all 133 students of the batch 62 of the Engineering Program.

The results of the questionnaire analysis answered by the students can be seen in the table below.

TABEL 2. RESULTS OF STUDENTS QUESTIONNAIRE ABOUT STUDENTS' UNDERSTANDING OF ELECTRONIC LABORATORY AT STIP

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No	Aspects	Statement Value				Percentage (%)			
		1	2	3	4	1	2	3	4
1.	aspects of interest in electronics practicum activities			354	64			88,7	12,03
2.	understand the conditions of electronics practical activities in the laboratory		12	318	88		4,51	79,7	16,54
3.	electronics practical learning time in the laboratory			348	72			87,2	13,53
4.	preparation and implementation of electronics practical activities		6	375	24		2,26	94	4,51
5.	report and evaluation of electronics practice		18	375			6,77	94	

Based on the students' responses to the test, it can be determined that the number of basic electronics laboratory equipment known by the students varies greatly. The equipment available in the electronics laboratory was answered by the students, such as electronic components consisting of resistors, transistors, capacitors, inductors, and diodes. Additionally, the students could also identify the practical tools available in the basic electronics laboratory, such as digital and analog multimeters, oscilloscopes, DC power supplies, breadboards, jumpers, soldering irons, steam blowers, soldering stands, and solder suckers. In this case, not all students respond the same way. This shows that the students' understanding is very varied. However, from all the responses given, it can be concluded that the students of the technical program are still unable to identify the equipment in the basic electronics laboratory and understand its functions accurately.

The information obtained is divided into five important points, namely based on the first aspect, interest in electronics practical activities, where the majority of students agree and strongly agree with the utilization of practical activities in the laboratory, with the highest percentage of agreement at 88.72%, followed by strong agreement at 12.03%. Students feel that practical activities are important to carry out, although sometimes they are still confused when connecting classroom material with practical material.

The second aspect is to understand the condition of electronics practical activities in the laboratory, which includes an assessment of the laboratory conditions such as the cleanliness of the laboratory space, the comfort level of the laboratory space, the completeness of laboratory equipment, the quality of laboratory equipment, the availability of basic electronic components for practicals, the suitability of laboratory use with the field of study, the availability of laboratory regulations, the presence of laboratory cleaning staff, and the safety level of laboratory facilities and infrastructure.

In this study, 79.7% of students agreed that the condition of the basic electronics laboratory in the Technical Program is in ideal condition, 16.54% of the students strongly agreed, and the remaining 4.51% still believe that the condition is less than ideal.

The third aspect is another factor that affects the timing of the practical session. This aspect contains questions about the implementation of practicals according to the schedule from the Technical Program and class hours according to the schedule from the Technical Program. Students agree that the timing of the practical sessions went well at 87.22%, and the rest expressed an even better opinion, strongly agreeing at 13.53%. The fourth factor influencing the practical sessions is the preparation and execution of the electronics practical activities. This is in line with Adisendjaja (2010), who stated that the implementation of practical work can proceed well if thorough preparation is carried out. The aspects of preparation and implementation include a not-too-long practice preparation and the practice implementation running according to the practice scenario. Research results show that students agree by 93.98%, and strongly agree by 4.51%. However, on the other hand, there are still some students who feel that the preparation and implementation of electronics practical activities are lacking by 2.26%. The fifth aspect that influences students' understanding about the electronics laboratory in the Technical Program is the practical reports and evaluations. Based on the analysis of the questionnaire, which consists of questions about practical activities running according to schedule and the RPS from the study program, as well as the condition of practical facilities being good and ready to use. Research results show that students agree by 93.98%, and strongly agree by 4.51%.

IV. CONCLUSSIONS

The understanding of the electronics laboratory among students in the Nautical Study Program at the Maritime Science College is influenced by several aspects, including the aspect of interest in electronics activities, where the analysis results show that 88.72% of students agree and 12.03% strongly agree. Another influencing aspect is the understanding of the conditions of electronics practical activities in the laboratory, where the analysis results show that 16.54% of students strongly agree and 4.51% disagree. This is followed by the aspect of the timing of practical activities, where the analysis results show that 87.22% of students agree and 13.53% strongly agree. Then, the aspect of preparation and implementation of electronics practical activities, where the analysis results show that 93.98% of students agree and 4.51% strongly agree, with the remaining 2.26% disagreeing. Finally, the aspect of reporting and evaluation of practical activities, where the analysis results show that 93.98% of students agree and 4.51% strongly agree.

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