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Developing Module Handbook in Outcome-Based Education (OBE) Curriculum for Undergraduate Mechanical Engineering

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ABSTRACT

The development of the world of education is required to be more competitive and have quality following international standards, including the Mechanical Engineering Undergraduate Study Program. This study program continues to develop graduates who can compete globally. The stage that must be passed is to follow system standard Outcome-Based Education (OBE), which focuses on what students should have or should do in achieving graduation. In the OBE method, learning outcomes are carried out by an identification process and continued with an assessment process and learning methods adapted to these outcomes; it is one of the orientations of Merdeka Belajar Kampus Merdeka (MBKM). The main issues are that the study program still does not have a handbook module that follows the OBE curriculum. The aim of this research is to develop a module handbook that is adapted to the OBE curriculum and validated. This type of this study is development research using Research and Development (RnD) with a 4-D Models. This procedure is defined, designed, developed, and disseminated. The defined stage is the stage regarding the characteristics of learning activities. The design stages are media and formats used in module development. Develop stage purpose The goal of the development stage is to produce a final draft and the disseminate distribution of module development. The result of this study is that learning activities of the program's learning objectives are formulated into Program Learning Outcomes (PLO), and each handbook module has defined it. The design results are module handbook content according to the OBE curriculum. Two validators have validated the developed result with a percentage 89%, 88 % students readability validation and 83.32% lecturers readability validation. The readability test was carried out on 19 students and seven peer lecturers to see if the handbook module was appropriate. From these criteria, the module handbook is appropriate to be distributed. In order to support teaching during the COVID-19 pandemic, the distribution of the handbook module through the upload process to the website of the mechanical engineering department.

Keywords: *module handbook, outcome-based education, Research and Development (RnD), 4-D models, 4-Likert scale*

1. INTRODUCTION

The development of the world of education is required to be more competitive and have quality following international standards, including the Mechanical Engineering Undergraduate Study Program. This study program continues to improve to create graduates who can compete globally. The stage that must be passed is to follow the Outcome-Based Education (OBE) system standard. A learning system that has an

external orientation (Outcome-Based education) is a method that focuses on what students should have or should do in achieving graduation.

Outcome-Based education in engineering education aims to empower engineering students with essential characteristics required to switch themselves into the engineering profession as global and professional engineers. The research focuses on exploring the philosophical and theoretical basis of Outcome-Based education and challenges in implementing the OBE

framework in engineering education [1]. In the OBE method, learning outcomes are carried out by an identification process and continued with an assessment process and learning methods adapted to these outcomes. One of the central aspects of this learning process is the module handbook. A module handbook is a document issued by the university that includes all critical information about the courses in a study program. Part of the module handbook includes the total workload, content, time needed for the independent learning process and with teachers, references and media used in the learning process.

The critical factors for producing graduate students are qualified in their capability. In this case, Higher Education Institutions (HEIs) become the key to producing qualified graduates. Higher Education System certifies that on Law No 12 the Year 2012, one of the aims that should be fulfilled in HEIs is to produce graduates master Science and Technology to actualize national concern and increase national competitiveness. This implies that Higher Education Institutions become the location for students to learn soft skills and hard skills[2].

The policy of Merdeka Belajar Kampus Merdeka (MBKM) was launched by the Indonesian Minister of Education and Culture (now Republic of Indonesia Ministry of Education, Culture, Research, and Technology) in February 2020. The main objective of the Merdeka Belajar Kampus Merdeka is to give independence to Higher Education Institutions and produce quality graduates [3], [4]. This outcome is important to give opportunity for students graduates to be more competitive. Merdeka Belajar Kampus Merdeka is the first stage of High Education Institutions independency. The Indonesian Minister of Education and Culture (now the Republic of Indonesia Ministry of Education, Culture, Research, and Technology), Nadiem Makarim, suggested focusing on education outcomes [5].

The research of this study reported that Merdeka Belajar Kampus Merdeka's new policy aims to improve graduate workability. Based on the Minister of Education and Culture Regulation (now Minister of Education, Culture, Research, and Technology) No. 3/2020 on National Standards of Higher Education, this policy should be implemented by all Higher Education Institutions in Indonesia. In an arrange to prepare the implementation and based on the concept of quality graduates such as position, possession, and process. High Education Institutions have to prepare various activities so that they can be implemented successfully [6].

The curriculum is the core of education so it is necessary to carry out an ongoing evaluation in accordance with the development of science and technology. In learning activities, the curriculum is a plan that contains objectives, teaching materials, content, and guidelines for learning activities so that the objectives of

education can be achieved in accordance with the context of the Unitary State of the Republic of Indonesia. The curriculum is not only a formality but as an individual concept of nation and state [7]. At this time, especially in the Industrial Revolution 4.0 era, universities must pay close attention to the profile of graduates and the qualifications of learning outcomes so that there is a need for alignment in determining the profile of graduates into learning outcomes and subject learning outcomes. In responding to this, the definition of the curriculum should be as a document that is constantly changing where the courses may be the same, but the content of the curriculum must continually be refined, which shows one's competence in adapting to change (lifelong learning). Adapting to this gave rise to output-based education (OBE), which became one of the orientations of the independent learning curriculum [7].

Outcomes-Based Learning (OBE) has been used throughout the world at various levels. Countries that have used this method are Australia, South Africa, the UK, the USA, Hong Kong, Sri Lanka, Turkey, and China. The characteristics of OBE are the focus on learning outcomes that must be met until the end of the lesson, overall curriculum design to ensure the fulfilment of learning outcomes, using assessment to ensure each student has met the learning achievement criteria, and remediation and enrichment. OBE principles regarding Course Learning Outcomes (CPMK), where one of the facilities used is the handbook module. Modules are lecture materials in the form of a set of materials with a systematic, specific, precise, and exciting arrangement. The module's scope is in the form of lecture material content, sample questions, and test samples [8].

The preliminary review in Pakistan showed several factors and the importance of the educator section in formulating the curriculum, such as sustainable learning, encouraging the students, increasing knowledge from each other, and giving feedback. The review focused that OBE approaches show effects concerns in improving competencies. However, more studies with large sample size and strict methodology still need to be carried out [9]. OBE curriculum focuses on a definite results orientation, although implementation and development require experience and resources at both internal and external levels [10].

The study reported that OBE means have function effects on the communication skills of undergraduates. Based on this curriculum model, the educator stimulated the body and mind of students by improving teaching methods, optimizing the teaching structure, and creating a good teaching environment. At the same time, educators give inspiration and motivation to students to maintain the initiative and spirit in learning, increase learning confidence, upgrade communication skills and contribute to the progression of teaching quality in Guangdong Ocean [11].

In this study, the module handbook was made according to the OBE curriculum. Modules are lecture materials in the form of a set of materials with a systematic, specific, precise, and exciting arrangement. The module's scope is in the form of lecture material content, sample questions, and test samples [12].

The module handbook was made according to the OBE curriculum with the ASIIN standard template in this study. The development of this handbook module uses the 4D-Models approach. This research is a Research and Development (R&D) research using the Four-D Models approach, which includes Define, Design, Develop and Disseminate. Activities in this stage are preliminary analysis, student analysis, material analysis, task analysis, and specification of learning objectives. The purpose of the Design Phase is to produce a learning device design. The results at this design stage are called the initial draft (draft I). Activities at this stage are media selection, format selection, and initial design. Development Phase (Develop) The purpose of the development phase is to produce a final draft of a good learning tool. Activities at this stage are expert validation and readability test. Dissemination Stage, The purpose of this stage is to conduct validation tests on learning tools that have been tested and revised, then distributed to the field [13].

From the previous explanation, the main issue is that the study program still does not have a handbook module following the OBE curriculum. Lectures are still carried out using traditional learning methods where the topics taught are determined by the lecturer in charge of the course then on the topic, the outcomes are only identified, no handbook module matches the OBE in the Undergraduate Mechanical Engineering study program, and the handbook module in the Undergraduate Mechanical Engineering Education Program has not been validated. This research aims to develop a module handbook adapted to the OBE curriculum using Research and Development (RnD) research with a 4-D or Four-D Models, and the module handbook on Undergraduate Mechanical Engineering Study Program has been validated. Validation using the 4-Likert scale.

2. RESEARCH METHODS

2.1. Types of Research

This type of research is a type of development research because this research has the aim of developing and validating a product using the 4-Likert scale. In this case, the product is a module handbook for all courses in the Undergraduate Mechanical Engineering Education Study Program. The module handbook will be developed following the module handbook for the learning needs of the Undergraduate Mechanical Engineering Study Program. This research used Research and Development (R&D).

2.2. Research Procedure

This research has four steps, namely preparation, implementation, data analysis, and report. This type of research is Research & Development (R&D) and uses 4-D models. The development of the module handbook through four steps:

1. Define
Initial - final analysis which is the stage regarding the characteristics of learning activities in the Mechanical Engineering Undergraduate Study Program that uses the OBE curriculum and is in accordance with the Mechanical engineering Collaboration bureau (BKSTM) standard. Material analysis is the basis in the preparation of learning objectives. This material analysis is also useful in determining the parts of the material to be studied in learning.
2. Design
Media selection. The media used for developing this module handbook is in the form of a book consisting of a collection of handbook modules for all subjects in the Mechanical Engineering Undergraduate Study Program Format selection. At this stage, the researcher chooses a format for designing content, selecting learning strategies and learning resources that follow the principles, characteristics, and steps in accordance with the learning model used. In this study, according to the OBE and ASIIN templates. Initial design. They were first adjusted to the handbook module for the Mechanical Engineering Education Study Program.
3. Develop
The purpose of the development stage is to produce a final draft of a good learning tool. Activities at this stage are:
 - a. Expert validation. Two validators validated the results of the initial design (draft I), and the revision was used as the basis for improving learning tools to obtain draft II.
 - b. Readability Test. The readability test was carried out on 19 students and seven peer lecturers to see if the handbook module was appropriate.
4. Disseminate
The purpose of this stage is to conduct validation tests on learning devices that have been tested and revised, then distributed.

The data analysis techniques used in this study are as follows [14], [15] :

Expert validation analysis is carried out by:

- a. Calculating the validity score from the expert validators results using the formula:

$$\text{Validity} : \frac{\text{total validation score 2 validators}}{\text{max total score}} \times 100\% \quad (1)$$

Calculating the validity score from the students (readability)

$$\text{Validity} : \frac{\text{total validation score 19 students}}{\text{max total score}} \times 100\% \quad (2)$$

Calculating the validity score from the students (readability)

$$\text{Validity} : \frac{\text{total validation score 7 lecturers}}{\text{max total score}} \times 100\% \quad (3)$$

- b. The results of the validity of which the percentage is known can be matched with the criteria validity as presented :

Table 1. Module Handbook Validity Criteria

No	Score	Validity criteria
1.	85,01 - 100,00 %	Very appropriate (implementation)
2.	70,01 - 85,00 %	Appropriate (implementation)
3.	50,01 - 70,00 %	Fairly appropriate (Revision)
4.	01,00 - 50,00 %	Hardly appropriate (Change)

3. RESULTS AND DISCUSSIONS

3.1. Product Description

This product of research and development is the module handbook. It contains a systematic explanation of each subject taught in the mechanical engineering undergraduate study program. The handbook module produced has adapted the OBE curriculum. The number of courses and the load is in accordance with the MBKM curriculum. The module consists of:

- a. Module name
- b. Module-level, if applicable
- c. Code, if applicable
- d. Semester (s) in which the module is taught
- e. The person responsible for the module
- f. Lecturer
- g. Language
- h. Relation to curriculum
- i. Types of teaching and learning, class size, attendance time (hours each week each semester), forms of active participation, workload,
- j. Structured Assignment /practice self-assignment.
- k. Total workload
- l. Credit points requirements according to the examination regulations
- m. Recommended prerequisites
- n. Module objectives/intended learning outcomes
- o. Content
- p. Study and examination requirements and forms of examination
- q. Media employed
- r. Reading list

3.2. Product Validation

Data from the validation in this research consisted of two validators. According to OBE and MBKM curriculum, assessments are focused on content, display according to PLO (Program Learning Outcomes), CO (Course learning Outcome), and format.

Verbal data in the below form of criticisms, comments, and suggestions were tabulated to facilitate revision of the product.

Table 2. Verbal Data of Validators

Validator	
1.	a. Added learning models and methods used. b. The application of the method in the learning activity phase. c. Assessment techniques and strategies that are in accordance with learning to find out d. Student learning outcomes.
2.	There are some suggestions including: 1. Add the learning model column used 2. It is better to give attachments about assignments, mid-exam, final exam so that it can be seen the compatibility between the learning objectives and the questions given.

Table 3. Expert Validation and Empirical Validation

No	Expert Validator	Score
1.	Validator 1	72
2.	Validator 2	78
Total score		150
Max total score		168

Based on table 3, validator 1 gives the score of 72 and validator two is 78, and the total score is 150 while the maximum score is 168. The following calculation determines the percentage of eligibility:

$$\text{Validity} : \frac{\text{total validation score 2 validators}}{\text{maximum total score}} \times 100\% \quad (4)$$

$$\frac{150}{168} \times 100\% \quad (5)$$

$$: 89.28\%$$

From the calculation results and matched with the 4-Likert scale, the product of the handbook module is found to be 89.28%. It is indicated that the qualifications of this product are very appropriate (table 1) [14], [15] and

eligible to develop to final draft. This is in accordance with Arikunto opinion [16], [17].

3.3. Readability Test.

The readability test was carried out on 19 students and seven peer lecturers to see if the handbook module was appropriate.

Table 4. Students Validation

Student	Score
1	35
2	46
3	43
4	47
5	40
6	48
7	39
8	48
9	48
10	46
11	41
12	45
13	40
14	40
15	42
16	35
17	41
18	39
19	40
Total Score	803
Max Score	912

Based on table 4 percentage of eligibility is determined by the following calculation:

$$\text{Validity} = \frac{\text{total validation score 19 students}}{\text{max total score}} \times 100\% \quad (6)$$

$$: \frac{803}{912} \times 100\%$$

$$: 88 \%$$

Table 5. Lecturers Validation

Lecturer	Score
1	34
2	32
3	43
4	41
5	40
6	46
7	44
Total Score	280
Max Score	336

Based on the table 5 percentage of eligibility is determined by the following calculation:

$$\text{Validity} = \frac{\text{total validation score 7 lecturers}}{\text{max total score}} \times 100\% \quad (7)$$

$$: \frac{280}{336} \times 100\%$$

$$: 83.32 \%$$

From the calculation results and matched with the 4-Likert scale, the readability of the handbook module is found to be 88% validation from students and 83.32% from lecturers. It is indicated that the qualifications of this product are very appropriate and appropriate (table 1) [14], [15] and eligible for actual implementation. This is in accordance with Arikunto opinion [16], [17]. In order to support teaching during the COVID-19 pandemic, the handbook module is distributed by uploading it to the website of the mechanical engineering department. This link can be found at https://drive.google.com/drive/folders/1lrcNt2HRYgqdpGMcFB9xJyP2NOIXiL_M?usp=sharing

4. CONCLUSION

The module handbook is a concise handbook that is used as a support in the learning process, which contains an overview of the discussion topics in each course. The development of the handbook module is needed to facilitate students—the results obtained in this study module handbook follow the Outcome-Based Education curriculum. The module handbook for the undergraduate mechanical engineering study program has been validated with 89%, 88 % students readability validation and 83.32% lecturers readability validation. From these criteria, the module handbook is appropriate to be distributed. This process is called dissemination. In order to support teaching during the COVID-19 pandemic, the handbook module is distributed by uploading it to the website of the mechanical engineering department.

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Infusing Storytelling and Game Elements in Designing Instructional Media

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ABSTRACT

Storytelling and games have been utilized successfully in education to increase involvement and engagement. However, according to recent research, storytelling and games are not always appropriate to integrate into an instructional setting. Although considered enjoyable, it is not always evident how a storytelling session or game may help students learn or how it can be utilized in a class. The approach was used in creating the *Savior of the Kingdom Plantae* game, which assists in the learning of middle school Biology. In an ADDIE model, we used the 5/10 approach in the (analyze) design process of the instructional media. To gather more input in this exploratory study, we asked an expert in educational media design and five middle school students to try on the first version of the instructional media. The result from the expert and students showed a good remark during the validation level for both the story elements and the game elements in the media. All in all, as an initial project, the media design is considered good to be developed further.

Keywords: *Instructional media, Educational game, Storytelling, Educational Technology.*

1. INTRODUCTION

The term "storytelling" has a broad interpretation. Storytelling is described as the interactive art of revealing the parts and visuals of a tale via words and actions while inspiring the listener's imagination [1]. According to the approach, storytelling is done to promote engagement by fostering dialogue between storytellers and tale listeners [2]. In its most basic form, storytelling is the act of transmitting an event (or sequence of events) to an audience by words and/or physical movement [3].

Storytelling has been shown to be effective in developing students' cognitive (knowledge), affective (feeling), social, and cognitive (appreciation) aspects [4]. Storytelling engages students by reducing depersonalization, increasing motivation, enhancing cognition, and stirring emotion [4], [5]. According to Lisenbee and Ford, a proper story has five fundamental literary elements: location, topic, characters, plot, and conflict [6]. When these factors are addressed effectively, a narrative schema that aids understanding develops [7], and so storytelling is a useful technique to present knowledge and give learning assistance in an exciting and personal way [8].

Storytelling is also a trend in gaming. Some of the games are liked because of their plots and narrations. One of the famous storytelling games is Silent Hill II. This

game tells the story of James Sunderland, who searches for his wife after receiving a letter from her one year after her death. Another best storytelling game is Her Story, which tells its tale through player choice entirely told in a short video. Games that emphasize storytelling are more interactive than traditional video games. Storytelling can draw people in, immersing them in the world and lessons of the tale to be told [9].

In every game, there must be some important elements, so it can be said to be a good game. Several important elements must be in a game, including points, badges, and leader boards [10]. Basic elements in the game are points, levels, badges and high-score lists [11], performance graphs, meaningful stories, avatars, and teammates [12]. Based on that explanation, this initial study focuses on three elements, including points, levels, and badges.

In research across educational environments, the learning benefits of narrative and games have been ambiguous. Therefore, one of the recommendations is to make sure that the game objectives and the learning objectives are in sync. Because of a lack of clearly defined learning objectives and results, it is sometimes difficult to establish whether or not storytelling and games contribute to a student's learning.

2. METHOD

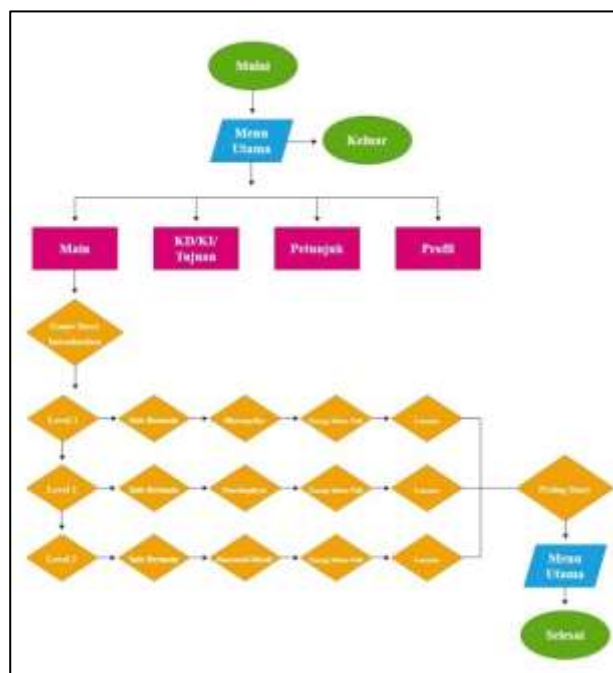
In this study, we applied the first two stages of the 5/10 method in the ADDIE model. The 5/10 is a method that provides guidelines for the design of a game-based multimedia with clearly defined learning goals and objectives and with a connection to the existing curriculum.

The first stage “analyze” consists of four steps; determine learning goals, analyze the learning materials and background, analyze existing teaching methods, analyze related educational games. The chosen subject is Natural Sciences – Kingdom Plantae topic in where the materials belong to learning facts category. In previous lessons, for the memorization process, the student’s activity focused on reading and doing exercises. This stage was done in a discussion with the class teacher involved. The result of this stage is the final draft for the lesson plan and the story plan.

At the second stage, "design," there were six steps involved; the first four steps, designing learning tasks, sequencing task classes, setting performance objectives, designing supportive information, are related to the plans for the lesson and the story.

The story planned for this game is presented through animation and narration, providing a background story so that students can understand the plot of the game. The designed storyboard tells a story of a king who must save the kingdom "Kingdom Plantae" from drought during the dry season by collecting the right plants for the kingdom. By doing the challenges, the player will collect scores and badges. When all the plants can be collected, it will rain so that the kingdom will be fertile again. The storyline in the game Savior of Kingdom Plantae has a structure that is in line with Diamantaki’s statement that basically, the storyline must have several components such as the beginning, setting, characters, incidents, and the climax of the story [13]. According to Kim, Lee & Lee, the storyline is the key element that can improve the quality of the game [14].

The last two steps in the second stage are: designing procedural information and designing challenges and levels. These two are related to the game design and are described in the map of the instructional media (see Picture 1.)



Picture 1. The map of the instructional media

The game elements included are points, levels, and badges. Points are given whenever the student can match the right plants based on their characteristics. (see picture 2). Different levels mean the different categories of plants. In the first design, we planned three levels (see Picture 3.) Badges are given when the students can reach specific scores (see Picture 4).



Picture 2. Points on game



Picture 3. Levels of the game



Picture 3. Badges on game

The data collection method used to validate the design is a questionnaire in the form of a validation instrument given to a material expert – the teacher, an expert in instructional media, and three students in middle school. The results of the data were analyzed quantitatively to determine the feasibility of the game to be used. Furthermore, there was a discussion with the experts concerning the results.

The instruments were developed to explore mainly the two aspects – the storytelling and the game in the instructional media. The items in the instruments are the following: 1) the storytelling aspect: a. how is the quality of the story idea? b. how is the performance (visual) of the story animation? c. how is the performance (audio) of the story animation? d. how is the relevancy of the story to the topic? 2) the game aspect: a. how is the quality of the game idea? b. how is the performance (visual) of the game elements? c. how is the performance (audio) of the game elements? d. how is the relevancy of the game to the topic?.

In order to determine the feasibility of the game, the validation instrument is given a Likert scale with the answer choices "1-5" and the calculation is carried out using the following formula: The guideline to determine the feasibility of the media is to interpret the results of the percentage of questionnaire data with criterion sizes. If the total score obtained is 86% - 100%, then it is included in the "Very Eligible" criteria, the total score is 66% - 65% included in the "Eligible" criteria, the total score is 56% - 65%, including the "Less Eligible" criteria and a total score of 0% - 55% is included in the "Not Eligible" criteria [15].

3. RESULT AND DISCUSSION

3.1. The storytelling aspect

There were 4 items asking about the quality and the appropriateness of the storytelling in the instructional media. The results showed that the media is very eligible in the quality of the story idea, the performance (audio)

of the story animation, and the relevancy of the story to the topic. The performance (visual) of the story animation is eligible. In the further discussion, it was the result from the students that stated that the visual performance of the story animation could be improved.

Many experiments have been conducted in recent years in the digital narrative sectors by educators and designers to involve children gradually in the story environment in order to guarantee that the experience is pleasant and pleasurable while keeping educational values [16]. Moreover, the storytelling genre in this media is fantasy. According to Park et al, children immerse themselves in fantasy and imagination, then try to solve the problems in the story [17]. So that the storyline can be the basis for students to solve problems and complete the game.

One key piece of input for improving the Savior the Kingdom Plantae game as an instructional media is the visual performance of the storytelling animation. Given how children use video games on their devices and how advanced video games have become, it is anticipated to receive such feedback, particularly from children. The researchers would need to include the relevant elements depicted in the narrative animation for the next investigation.

3.2. The game aspect

The game was developed using Construct 2 software which is able to create 2D games and also has a multiplatform output so that it can be used on the Android operating system. There were 4 items asking about the quality and the appropriateness of the game elements in the instructional media. The results showed that the media is very eligible in the relevancy of the story to the topic. While for the quality of the game idea, the performance (visual) of the game animation, and the performance (audio) of the story animation are considered eligible. In the further discussion, it was the result from the students that stated that the quality of the game design could benefit from additional challenges.

As previously indicated, in this initial study, we concentrated on using three-game elements: points, levels, and badges, aside from the storytelling aspect. Students get points for completing each obstacle in the game (scores). This score can be considered as a reward for student achievement and ongoing direct feedback [18], [19]. The level is the grade that students must achieve. Each level in the game Savior of Kingdom Plantae has a different difficulty level. It was quite challenging to decide on these levels, knowing that difficulty might prevent the students from going further.

Students are expected to earn badges while playing at various levels. A player's achievements may be tracked by how far they go to a higher level of play [20]. The three-game aspects in this instructional video are designed to encourage students to keep learning and develop their abilities.

4. CONCLUSION

This initial study focuses on the development of instructional media that integrates storytelling and game elements. The results reveal that the design is eligible to be further developed as an instructional media. However, in further development, some aspects of the media need to be improved, such as the visual performance of the storytelling and the challenges of the game.

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Nang Ning Nung Neng Gung's Philosophical Study in the Strains of Javanese Gamelan as a Guide to Urip Bebrayan

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ABSTRACT

This study aims to examine the philosophical meaning of nang ning Nung neng gung in Javanese gamelan strains as a guide for urip bebrayan agung. The concept of expression through gamelan music prioritizes togetherness, tolerance, cooperation, and emotional control. The Javanese way of life expressed in gamelan music is harmony in speech and action so that it does not give rise to explosive expressions and creates tolerance among others. In Javanese society, gamelan has an aesthetic function related to social, moral and spiritual values. This study uses interpretive descriptive methods and literature using the philosophical study of nang ning Nung neng gung in Javanese gamelan strains to guide urip bebrayan. So that the data collection in this study uses observation, interviews, and document analysis, the results of this study can be formulated as an effort to preserve the nation's culture through the strains of Javanese gamelan, which contribute to the development of knowledge, skills, and basic values, which are reflected in the habits of thinking and acting in filling urip bebrayan. The habit of thinking and acting consistently and continuously enables a person to be competent, in the sense of having the knowledge, skills, and basic values to do something and are implied in daily behaviour in living life and life so that it can print a generation of good quality in the nation—Intellectual, personality and useful with a good personality in the future. Based on the problem above, the researcher wants to carry out research activities by combining the study of the philosophical meaning of nang ning Nung neng gung in the strains of Javanese gamelan as a guide for urip bebrayan. The research activity is entitled: the philosophical study of nang ning Nung neng gung in the strains of Javanese gamelan as a guide for urip bebrayan.

Keywords: *Philosophical, Nang Ning Nung Neng Gung in Javanese Gamelan Strains, Urip Bebrayan Agung Guidelines.*

1. INTRODUCTION

The many traditions and cultures that this nation has represented the wealth of this nation. Various traditions that have grown from generation to generation among the tribes are a unique attraction for other nations to the rich traditions and culture of the Indonesian nation. The results of this nation's rich traditions and culture should be preserved and passed on to our children and grandchildren as the nation's successors to become a world heritage that can bring the name of the Indonesian nation in general.

The speciality of Javanese gamelan music is that it tends to sound soft and low as if deliberately presenting an atmosphere of peace of mind and harmony with

Javanese society's life principles in general. Javanese gamelan instruments, in general, cannot be separated from the views of the Javanese people, who tend to maintain harmony in life, both physically and spiritually. This situation makes Javanese people always avoid temperamental expressions and try to create tolerance among others.

The most obvious form of the strains of Javanese gamelan music is the hallmark of the gamelan itself, namely the moderate pulling of the fiddle string, the guide to the balance of the sounds of kenong, saron, drums and xylophone, as well as the sound of a gong at each closing of the gamelan rhythm when played. As for the function of the gamelan ageng or presentation with

the whole gamelan set is generally used to present gending.

Philosophically, Javanese gamelan is an inseparable part of Javanese life because the life philosophy of the Javanese people is related to their cultural arts of Javanese gamelan and the development of their religion. In Javanese society, gamelan has an aesthetic function related to social, moral and spiritual values. Gamelan is a flexible musical instrument because it can also function for education. Gamelan has its majesty; the proof is that the world also recognizes gamelan as a traditional eastern musical instrument that can match the large western musical instruments.

Gamelan philosophy can be explained in many ways. One of them in the human body there is a harmonious rhythm of heartbeat, breath, blood flow that has a regularity that forms music. Just as the universe also has a rhythm. For Javanese people, in particular, the tone that comes from the gamelan is a tone used as a tool for worship and spiritual contemplation. The tones in gamelan music are considered art and are the language of the soul, the spirit of life, the music of the creator, the first language from which life originates. As a universal medium and form of communication, musical notes pass through verbal language, are received by the senses of hearing, and are transmitted to the heart, the centre of taste. Based on the problem above, the researcher wants to carry out research activities by combining the study of the philosophical meaning of nang ning Nung neng gung in the strains of Javanese gamelan as a guide for urip bebrayan. The research activity was entitled: the philosophical study of nang ning Nung neng gung in the strains of Javanese gamelan as a guide for urip bebrayan.

1.1. Formulation of the Problem

Based on the background above, the problems that can be raised are as follows:

1. How is the philosophical study of nang ning Nung neng gung in the strains of Javanese gamelan?
2. How is the philosophical study of Nang Ning Nung Neng Gung Dalam as a guide for Urip Bebrayan Agung?

1.2 Research Purposes

This research has several objectives, namely as follows:

1. Analyzing the philosophical study of nang ning Nung neng gung in the strains of Javanese gamelan.
2. Analyzing nang ning Nung neng gungdalam's philosophical studies as a guide for urip bebrayan agung

1.3 Benefits of research

The benefits of this research are:

1. For the academic community, it is useful in understanding the meaning of the philosophical study of nang ning Nung neng gung in Javanese gamelan strains as a guide for urip bebrayan agung.
2. For readers, this research is useful in understanding the meaning of the philosophical study of nang ning Nung neng gung in Javanese gamelan strains as a guide for urip bebrayan agung and its implementation in real-life realities.
3. For researchers, this research is useful in improving the quality of understanding of the philosophical study of nang ning Nung neng gung in Javanese gamelan strains as a guide for urip bebrayan agung, which is implemented in real life.

2. METHOD

In this study, researchers used qualitative research methods with a descriptive qualitative approach. Qualitative research is research that has the intention to understand what phenomena are experienced by research subjects [9]. Through this qualitative research, descriptive data collected is in words, pictures, and not numbers [11]. In qualitative research, humans play an important role as an instrument. In conducting research, the researcher himself becomes the main data collection tool in the form of observations, interviews, or document reviews.

2.1. Research Data

Data is an attribute attached to a particular object, which functions as information that can be accounted for, and is obtained through a data collection method/instrument [12]. According to another opinion, data is information related to the circumstances, information, and characteristics of a matter on the research subject used as material for analysis [13]. According to [14], data is collected divided into two types, namely primary data and secondary data.

2.2. Data Collection Technique

Data collection is an attempt to collect information in research to get a conclusion [9]. Data collection is divided into two: (1) Interview recorder: The recording device is used to capture the voices that appear when conducting interviews. This is intended to anticipate if the interviewer does not have time to write down important information during the interview. (2) Note-taking on observations: In qualitative research, notes are necessary to serve as material for data analysis. Making notes can be done at the time of conducting interviews or while still conducting interviews and observations [14].

(3) Documentation comes from the word document, which means written goods. Using the documentation method means collecting data by recording existing data. The document is a record of events that have passed [11]. Documents can be in the form of writing, pictures, or the works of someone.

2.3. Validity Techniques Data Checking

Validity of data is an important concept that is updated from the concepts of validity (validity) and reliability (reliability) according to the "positivism" version and adapted to the demands of knowledge, characteristics and paradigms themselves [15]. In a study, the technique of checking the validity of the data is very necessary to determine its validity. To test the validity of the data in this study using extended observations and triangulation to test the validity of the data obtained from the study. In this case, the researcher uses a validity check of the triangulation data to obtain complete data in the show.

2.4. Data Analysis Technique

Analyzing data is the process of selecting and analyzing data, measuring the sequence of data, and organizing it into a pattern, category, and basic description order [15]. In conducting data analysis, of course, you will go through collecting data in the field through field notes, reading or studying data, collecting it, sorting it out, and then thinking by making the data categories.

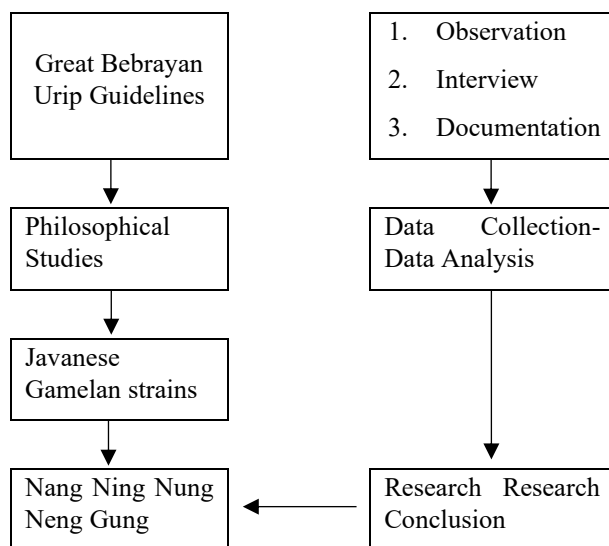
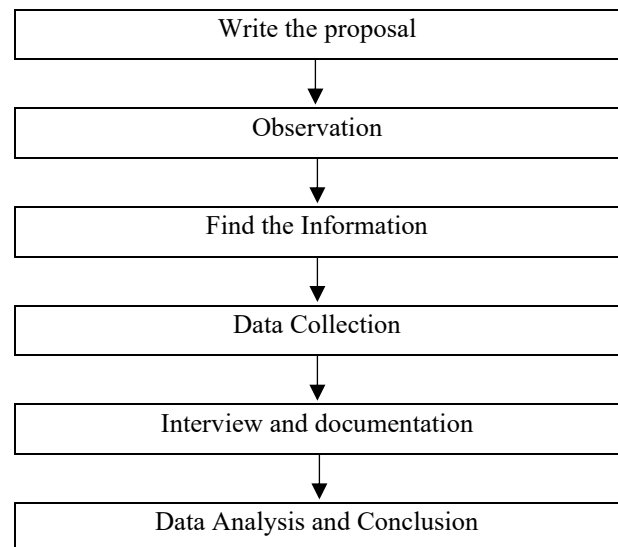


Figure 2. Analyze procedure

This research's flow starts from the preparation and proposal, then observation, looking for the intended subject/informant, data collection, primary data collection, data processing and analysis, interpretation of the results and finally, the preparation of results and discussion. More details can be seen in the flow chart below.



3. RESULT AND DISCUSSION

3.1. Aesthetic Functions of Gamelan

The relationship between language and thinking has been a very long debate, especially among cognitive psychologists. Since Benjamin Whorf and Edward Sapir put forward their hypothesis, the controversy over their relationship has not subsided [1]. However, the argument of [2] confirms this hypothesis.

By the 1970s, many scientists became disenchanted with the Sapir-Whorf hypothesis, and it was all but abandoned as a new set of theories claiming that language and thought are universal muscled onto the scene. But now, decades later, a solid body of empirical evidence showing how languages shape thinking has finally emerged. The evidence overturns the long-standing dogma about universality and yields fascinating insights into the origins of knowledge and the construction of reality. The results have important implications for law, politics and education."

The American Journal of Political Science states that Boroditsky very clearly provides evidence of the influence of language on thinking patterns. The figure stated that language is even involved in many aspects of human life more than experts have suspected. The implications of the role of language in education have been widely discussed among others [1], and in schooling and learning, among others, by presenters in a workshop entitled "Language Diversity, School Learning and Closing Achievement Gaps [3]. The purpose of language learning is, as stated in the introduction, to the standard content of English subjects that use this belief as to the basis for its development [4]. English with this foundation has been taught to assist intellectual, emotional, and social development and assist the mastery of other subjects by the students and develop the ability to communicate in English. With this opinion, then it has

an impact on gamelan. With Gamelan media, it will be easy to connect philosophical meanings using language.

Gamelan is a set of musical instruments or instruments that are often played together. Gamelan music is original music from Indonesia with a non-diatonic tone system in slendro and pelog barrels which also uses a notation system, good colour, rhythm. Gamelan games are usually called karawitan.

"Rhythm generally states the ratio of the successor saron (Peking) strokes to other balungan punches/slashes" [5]. The distinctive rhythm produced is a combination of the sound types of each gamelan equipment unit. Gamelan is a flexible musical instrument because it can also function for education and relaxation.

Just as the universe also has a different rhythm and rhythm. Rhythm is one of the concepts of understanding life through art [6]. On some occasions, the tone from the gamelan is used as a medium for worship and spiritual contemplation. The tones in gamelan music are considered art but are the language of the soul, the spirit of life, the creator's music, the first language from which life originates. As a universal medium and form of communication, musical notes pass through verbal language, are received by the senses of hearing, transmitted to the heart, and processed into the centre of taste.

3.2. Gamelan Philosophy Ontology

In philosophy, the object studied or referred to as the ontology basis here is a gamelan formed from philosophical aspects obtained from the Javanese community itself. The strains of the gamelan sound also contain the meaning of thoughts by the Javanese people's personalities. In general, the tone in the gamelan that is played is Nang Nung Ning Neng Gung. The meaning in the sound of Nang Nung Ning Neng Gung is not just the sound that comes out of a set of musical instruments that are played, but a harmony that arises from the diversity of various kinds of instruments, and if these instruments are played one by one it will not be as beautiful as when played together. That is a set of tools called gamelan. Moreover, if philosophically, the sound of the sound has a deep meaning in life in the brain. From a religious point of view, Christians interpret the sound of gamelan as follows:

- a) Neng: It means meneng (silence) to stop all physical activities in life
- b) Nung: It means contemplating, introspecting oneself towards oneself to improve attitudes.
- c) Ning: It means silence, surrender to God's decrees in living life
- d) Gung: It means to go to the creator's greatness for the blessings that have been felt.

Gamelan, in the meaning of its name, can also be philosophized as G (gusti), A (Allah), M (maringi), E (emut-remember), L (lakonono), A (teaching), N (prophet). In meaning, there is usually a connotative and denotative meaning. So, if a sign is known for its connotative meaning, then that meaning develops into a denotative meaning, then the denotative meaning in this second stage will become a myth [7]. For Barthes, meaning is semiotically shaped like the chart below.

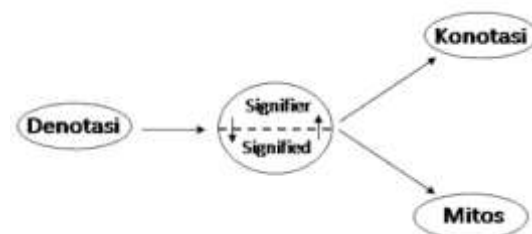


Figure 1. Semiotics, according to Roland Barthes

Barthes studied signs in two stages. In the first stage, examine the sign in language, namely the sign seen from the background on the marker and the signified. This stage gives birth to denotative meaning. The second stage examines signs by involving context. At this stage, the connotative meaning is obtained [8]. However, in Javanese gamelan, the overall meaning is positive in a denotative sense.

3.3. Epistemology Of Gamelan Philosophy

Epistemologically or how knowledge is obtained, in the philosophy of the gamelan, it is taken through its history. Similar to the function of every instrument in the gamelan, the organization can be interpreted like the parts of our body, each of which has its function. So the philosophy in gamelan can be a learning method or basic education in humans. Moreover, become a new science that has a theoretical basis in studying it.

3.4. Axiology Of Gamelan Philosophy

In terms of axiology, there are many benefits and values in gamelan philosophy that can be learned if we use gamelan, including: Playing music, especially in gamelan, can control emotions with harmony; It can stimulate the brain because when playing gamelan, the level of awareness will increase; Learn to work together by not prioritizing one note over another; Foster empathy and tolerance, among others; Cultivate an attitude of self-control and emotions because playing gamelan requires a harmonious process that does not take a moment.

3.5. Bebrayan Urip Guidelines

Humans are required to place them in a balanced way or interpret other prices with the price of hierarchical religious beliefs, which have a higher final value. Differences in perspective in understanding values have implications for the formulation of the definition of value [9]. Values are normative benchmarks that influence

humans to choose among alternative ways of action [10]. Value is the address of a word "yes", or value is something that is indicated by the word yes. Value is a conception of what is desired, which influences the means of intermediate goals and ultimate goals of action [10]. From some of these opinions, it can be concluded that value is a reference and belief in making choices. The values contained in gamelan are closely related to norms and morals in life.

Gamelan can be a therapeutic tool to guide humans back to a harmonious life. Not only seen as a musical instrument, but gamelan also has a philosophy that promotes harmonization and contains human values regarding togetherness, patience, and courtesy. This is expected to be a healing method for humans to learn to live a harmonious life. The spirit of gamelan music can be summed up in one word "unity". This is because gamelan music is produced by many players playing in unison. It takes mutual understanding among the musicians involved to match their efforts to produce music with hypnotic rhythms. Therefore, the type of gamelan music is often associated with a harmonious soul.

Gamelan philosophy is also studied by religions that have a point of view from their respective religions, such as Islam and Christianity, who view gamelan philosophy.

a) Gamelan philosophy in Islamic studies

Gamelan music was created to create harmony in human life. The device is made using a very high philosophy full of meaning and messages for humans always to remember the Creator, Allah SWT. That humans live in this world must always remember the creator in our every thought, movement and step.

b) Gamelan philosophy in Christian studies

The church is essentially like a set of gamelan. If only one or two instruments dominate in one set of gamelan, it will become a beautiful gending (song). So it takes cohesiveness and togetherness in playing the gamelan so that there is a harmony that builds a song (gending). The church can take the gamelan philosophy as the basis for building a community of believers. A sacrament that is the centre of the life of faith has been clearly described in Neng, Nung, ning, gung. Faith does not belong to the priest alone but is a common property that all people must live together.

4. CONCLUSION

In gamelan, music was created indeed to make the harmony of human life. The device is deliberately made using a very high philosophy full of meaning and messages for human life. One of the goals is always to remember the creator, namely Allah SWT. In life, we

must always realize that we live in this world and must always remember the creator in every thought, movement and step we take. The following are some of the philosophical meanings of the gamelan instruments, including developing their potential by expressing themselves through the strains of gamelan music, which is considered for prioritizing togetherness, tolerance, cooperation, and emotional control, which is closely related to the philosophical meaning contained in it. Although Indonesia's achievements are still not reverberated in various fields, at least with the playing of gamelan in various parts of the world, we can sing songs that give philosophical meaning to life and life as an effort to make peace in the world. The researcher assumes that one alternative to improving the characteristics of the younger generation is through gamelan philosophy, which is also studied by religions that have a point of view from their respective religions, for example, from Islam and Christianity who view gamelan philosophy from their point of view in interpreting and filling life and life that is full of life. Often referred to as *urip bebrayan agung* in Javanese.

The study of the philosophy of *nang ning Nung neng gung* in the strains of Javanese gamelan as a guide for *urip bebrayan* contains a deep meaning. Gamelan, formed from philosophical aspects obtained from the Javanese community itself, describes the meaning of living life. In the concoction, the sounds of *neng, Nung, ning, gung* are not just the sounds that come out of a set of musical instruments being beaten, but a harmony that arises from the diversity of various kinds of instruments, and if these instruments are played one by one, it will not be as beautiful as when played together. That is what is called gamelan. Moreover, if in the brain, philosophically, the sound of the sound has a deep meaning. A relaxed situation is important to release the mental tension. A relaxed situation is a calm and pleasant condition, as well as a peaceful atmosphere. Music that is melodious, melodious, melodious, and harmonious can relax the nerves. So that in peaceful conditions it can produce a generation of people who are of good quality in terms of intellectual, personality, social and can live a life that is right and useful in the future.

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The Differences of Self Regulated Learning in Senior High Schools Students in Terms of Gender and Class Specialization

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ABSTRACT

This research aims to examine methodologically and empirically the differences in the level of self-regulated learning of senior high school students in science class and Social class, seen from a gender perspective. The research variable consisted of: (a) the level of self-regulated learning, (b) class specialization, and (c) gender that was measured using modified Likert scale and using self-regulated learning level. This research is quantitative. The population is the second-year students of SMA Negeri 1 Menganti Gresik. The research sample obtained is 80 samples consisting of 40 samples from 20 males and 20 females of Natural science class, and 40 samples from 20 males and 20 females of Social science class. The data analysis used the two-way ANOVA technique. ANOVA test using the help of a computer program (SPSS 19.0 for windows) is used to test two variables or more and determine whether the two variances are the same or not. After conducting the different tests using two-way ANOVA with the help of SPSS 19.0, the research results gained average Natural science class and Social science class of 103.21. The results showed that the Natural science class and Social science class students were seen from the gender.

Keywords: *Self-Regulated Learning, Senior High School, Gender, Class Specialization.*

1. INTRODUCTION

Self-regulated learning in the covid-19 era is a concept that needs to be considered in students: particularly for Senior High Schools students. *Self-regulated learning* contributes to students' learning success since it is an individual's internal capability to learn self-management [1]. Furthermore, it explained that *self-regulated learning* would regulate, analyze, and control students' learning patterns to reach expected outcomes [2].

Self-regulated learning refers to students' expectations of learning outcomes [3]. Self-regulated learning is formed by the influence of self-efficacy, motivation, and goals to be achieved. However, the contemporary point out that self-regulated learning is also affected by Social factors around the individual.

A study showed that each individual commonly has a different level of self-regulated learning which can be categorized into a high and low level of self-regulated learning [4]. The number of students in a class could distinguish the students based on their achievements and activities in school. This study has conducted a preliminary study by observing and interviewing some

students in the Public Senior High School 1, Menganti. The interview also included guidance and counseling teachers in charge of Natural sciences and Social sciences classrooms. According to them, 85 percent of science students are more active than Social students. On average, four out of five students in a Social science class felt less focused on their studies, were late in submitting assignments by the due date, only studied during the exam, and perceived themselves as less disciplined.

Self-regulated learning is an essential part of individual success. Therefore, the school should provide sufficient space to form self-regulated learning. For this reason, it is necessary to learn how to create learning which prompts the development of self-regulated learning so that students can develop self-management in learning to get academic achievements. There is a difference in students' self-management in learning to achieve academic achievement between Natural science and Social science classes. Students of Natural science class will feel proud because they can be accepted in Natural science class. On the other hand, they also get the pressure to maintain their achievements to remain in the top position during the covid-19 pandemic.

Meanwhile, the Social science class students feel insecure received in the Social science class because the prejudice is not good from the teacher and surrounding environment. On the other hand, Social science class students are also required to excel academically. It is why different regulations between students happen in school. Students with high self-regulated learning will tend to have good learning time management, while students with low self-regulated learning will have messy learning time management.

Male and female adolescents have different self-regulated learning; 85% of female students in science class tend to be more disciplined and active in learning, but 75% of male students in science class remain disciplined but less enthusiastic in learning[5]. High self-regulated learning can be interpreted as the ability of an individual to stay persistent, tenacious, and diligent in learning. Low self-regulated learning will make individuals tend to give up easily on complex assignments and make less effort to get a better result. High self-regulated learning in students positively impacts their academic achievements[6]. Self-regulated learning will make them actively participate in online and offline learning at this time. In contrast, low self-regulated will make students less concentrated and be lazy to understand the lessons.

It is interesting to examine the different levels of self-regulated learning seen from the gender perspective as in the phenomenon taken from senior high schools in SMA 1 Menganti Gresik regarding the differences in self-regulated learning level; for instance, there were many female students finished their tasks earlier than the male students during a covid-19 pandemic. The school counselor who handled both classes stated that most of the times during the online learning, it was the female students showed active participation [7]. The class teacher added that female students expressed their opinions more and were actively participating in learning activities.

Based on the background above, it raises the question of whether there is a difference in the level of self-regulated learning in senior high school students regarding gender and class specialization or not.

2. METHOD

A quantitative method was applied in the research design. This research is a two-way ANOVA research analysis, which attempts to determine the various coefficients of two variables comprising of two classes at the same time. Purposive random sampling was used to get the research sample. This study did not include all populations; instead, it employed 80 samples, including 40 from a Natural science class of 20 men and 20 women and another 40 from a Social science class of 20 men and 20 women in senior high schools. The Likert scale is

applied to measure the data collection instrument. This study's instrument employs two forms of validity. It entails obtaining indicators and items stated in the study instrument using content validity and professional judgment. Because the instrument covers issues that have been described as dimensions and elements that explain the notion, this validity is applied. Professional judgment is used to determine if the items in the research instrument are on a good and proper scale based on the objectives and measuring and writing standards. The degree to which measuring instruments can be trusted or consistent is reliability. [8] (2001). Internal consistency reliability approaches are a series of tests administered to individuals just once. Then, the estimated reliability of the test is calculated using the Cronbach Alpha method by SPSS 19.0 (2008) [9].

Data collection of self-regulated learning levels was carried out using a closed questionnaire using a self-regulated learning scale. The closed questionnaire in this form of self-regulated learning level scale consists of 4 multiple choices to which the research subject will respond by choosing one of the four choices directly. Data collection is done online using google form because of pandemic COVID-19. The data analysis of this research employed a statistical analysis technique using two-way ANOVA to test the hypotheses of the difference between two or more samples. Each sample consisted of two or more types simultaneously. Tests were carried out using the help of SPSS for Windows version 19.0. Before doing the calculation using two-way ANOVA, it was necessary to test assumptions as follows: 1) Normality Test, 2) Homogeneity Test, and 3) Two-way ANOVA Analysis Technique.

3. RESULT AND DISCUSSION

3.1 Result

The normality test of the data carried out using the Kolmogorov-Smirnov Test of Normality with the help of SPSS 19.0 for windows was $0.200 > 0.05$, meaning that the data was normally distributed. While calculating the results of the homogeneity of variance is done using Levene. It has been found that the Levene Test (F) is 1.810 with a significance (sig.) or p-value of 0.152. Thus, the research data has a homogeneous variance or data from a population with the same variance. so that the research data is usually distributed and the Analysis Technique of Two-Way ANOVA carries out the homogeneity

The following significant values were found using the Two-Way ANOVA Analysis Technique: 1) The significance value of the between-subject effects on a class is 0.000. In terms of class status, there are multiple self-regulated learning levels. 2) The significance value for the between-subject effects on gender is zero. There are multiple self-regulated learning stages based on

gender, and 3) The significant value of the between-subject effects on class * gender is 0.016. There is a connection between class specialization and gender.

3.1 Discussion

The hypotheses test using the two-way variance data analysis technique (two-way ANOVA) showed a difference in the self-regulated learning level of students between the two classes in terms of gender. Thus, there is a difference in self-regulated learning levels between female and male students. The hypotheses result using a comparative technique by two-way ANOVA, and the between-subject effects test showed a difference in self-regulated learning level between students in Natural science class and Social science class in terms of gender. Therefore, there is a difference between male and female students. It can be seen in the significance level 0,000 on

demonstrated in an experiment conducted on some students in senior high school, in which female students were given a pile of homework and male students[12]. A few days later, female students could finish all the assignments well, while male students could not. Self-regulated learning is based on personal, behavioral, and environmental aspects. According to Bandura, the relationship of these three aspects is the cause and effect of the individual to regulate himself in self-regulated learning[13]. They explained that self-regulated learning is an individual's ability to control his learning activity, motivate, supervise the academic goals by managing the existing resource, and be an executor of decision-making in learning. Therefore, self-regulated learning is an important part of students' learning success[14].

Stated that self-regulated is a combination of

Table 1. Summary of two-way ANOVA

Sources	JK	Db	RK	F	Sig.	Interpretati on
Class Specialization	40725.312	1	40725,312	766.737	.000	Significant
Gender Regulation Learning	58687.133	1	58687,133	110.426	.000	Significant
Class Status and Gender	34.,013	1	342,013	6.200	.00	Significant
Error	4036.570	76	53.155	–	–	–
Total	987747.000	80	–	–	–	–
Class Specialization	40725.312	1	40725,312	766.737	.000	Significant
Gender Regulation Learning	58687.133	1	58687,133	110.426	.000	Significant
Class Status and Gender	34.,013	1	342,013	6.200	.00	Significant

class status, significance level 0,000 on gender, and significance level 0,16 on class specialization and gender.

The statistical analysis result shows a difference in the mean value between science students, 125,78, and Social students, 80,65. It shows that science students have a higher level of self-esteem than Social students. In terms of gender, there is a difference in average scores of male and female students in the class specialization. Female students have an average score of 111,77, while male students have an average score of 94,65. It shows that female students have a higher level of self-regulated learning than male students.

Based on the previous studies on self-regulated learning, each individual has different self-regulated learning levels categorized into high and low levels [10]. The findings showed that the self-regulated learning level of men is lower than women [11]. The research was

individual self-control and academic learning skill to self-regulate in learning and get the learning outcomes as expected. In self-regulated learning, autonomy and self-responsibility are essential in a learning activity; students will build learning purposes by supervising, regulating, and controlling their beliefs, motivations, and behaviors to achieve their goals[15].

As defined, self-regulated learning will regulate, analyze, control students learning patterns to reach optimal learning outcomes[16]. Thus, students' self-regulated learning will be realized by depending on the students' internal ability to do self-management in learning to get optimal academic achievements.

The difference in self-regulated learning level of students occurred due to the interaction effects in society or environment [17]. This kind of interaction mostly occurs during social gathering at school. When people act

and treat someone in social manner and make comments about the person in question, which has a substantial impact on the creation of self-regulated learning. The competitive climate in the classroom is high for students in Natural science classes [18]. Students in Natural science are eager to pay attention in class. However, the majority of them ignore their peers and not easily distracted during classroom session.

The discrepancies are also apparent in the research conducted by observing the Science and Social class. Even though they were learning online, the environment in the class was reasonably tranquil, with most of them tending to work more and speak less. On the other hand, the Social class atmosphere was a bit out of control; when the learning process ran, they were busy with their own business and less focused. Another factor that could differentiate self-regulated learning levels on students was the environments. A comfortable learning environment with supporting facilities was another factor that determined students' self-regulated learning level.

4. CONCLUSION

This study concludes that there are differences in the self-regulated learning process between students in Natural Science and Social Science classes in SMA Negeri 1 Menganti Gresik. Natural Science class students have a higher level of self-regulated learning than Social Science class students. There are also differences in the self-regulated learning process between male and female students in SMA Negeri 1 Menganti Gresik. Female students in both classes have higher levels of self-regulated learning than the male students in both classes. A two-way ANOVA analysis obtained the research findings from a significance level of 0.16 based on gender and class specialization. Based on the findings then we can conclude that there is an relation between class specialization and gender on the level of self-regulated learning in SMA Negeri 1 Menganti Gresik.

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Teaching Factory Management in the Edutel Sector at SMK Negeri 1 Surabaya

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ABSTRACT

The purpose of this study was to determine the teaching factory (TeFa) management in terms of planning, organizing, implementing, and evaluating. The Regional Public Service Agency in structuring the TeFa began to be implemented at SMKN 1 Surabaya in 2018. Since BLUD was implemented at SMKN 1 Surabaya, that school received financial assistance for the development of TeFa, one of the examples is the construction of Edutel in the hospitality department. This study used a survey method with data collection techniques like questionnaires, documentation, and interviews, data analysis using descriptive statistical techniques with 26 respondents, there are teachers, and students. The results showed (a) planning has been done well, such as administering time, tools, and division of tasks; (b) organizing a well-structured teaching factory, start from the head of the expertise competency, school principal, subject teacher, pptk; (c) the implementation has been done well with 83.3% of respondents stated that Edutel has been well socialized in the school and community environment, designed and implemented based on actual work procedures and standards. 84% of respondents stated that the learning process in the field of Edutel is learning by doing, improving students' soft skills, developing and sustainably implementing business-based learning patterns. 77% of respondents stated that the implementation of TeFa in Edutel carries out big data literacy, teaches critical, creative, communicative thinking skills improves skills in market research. 69.5% of respondents stated that Edutel activities are supported by the industrial world. The standard error value less than 0.15, indicates that the total average value of the respondents is close to the true value. It has a standard deviation less than 0.8 which indicates a low standard deviation value, so the data approaches the average value. Has an average sample variant less than 0.6; (d) Evaluation of the Teaching Factory in Surabaya has been carried out by involving all members of Teaching Factory learning, the principal, the head of an expertise competency, teachers, and employees.

Keywords: *Edutel, Evaluation, Planning, Organizing, Implementing, TeFa*

1. INTRODUCTION

The status of BLUD (Regional Business Service Agency) for SMK (Vocational High Schools) with TeFa (Teaching Factory) is considered the most appropriate, compared to PNBP or BUMN status, everything that related to TeFa production such as the use of state facilities, income, and financial expenditure independently can be done. The benefits of implementing BLUD in SMK are Financial Management Flexibility, Improved Human Resources Quality, Improved Quality of Learning, Improved Quality of Facilities and Infrastructure, Character Strengthening Education, Enhanced Collaboration. If SMKN as a UPTD has become a BLUD, the flexibility of PP No.12 of 2019 can be implemented. BLUD has flexibility in Financial Management Patterns, Implementing BLUD in business practices can improve services to the community without

seeking profit for advance public welfare and educate people's lives. Healthy business practices the organizers of organizational functions are based on good management principles for providing quality, sustainable and competitive services. One of a method to be able the flexibility and good organizational functions are SMKN TeFa with BLUD can make collaborate with the Business World and the Industrial World.

The general definition of competence is a skill that is possessed by each individual in carrying out a task or job in a particular field, following the position that has been given. Competence is very important to be developed in every lesson in SMK [1]. High student competence can be used by vocational students to compete in business and industry [2] [3] [4]. Law no. 13 at 2003 related to employees, the definition of work competence is a work skill possessed by everyone which includes elements of knowledge, skills, and work attitudes

that are following standards.

In Indonesia, the application of the TeFa concept was introduced in SMK in 2000 in a very simple form like the development of a production unit form that has been implemented in SMK. And then the concept has improved in 2005 into an industry-based SMK development model. There are three basic forms of industrial-based SMK development categories, 1) Simple industry-based SMK development; 2) developing industrial-based SMKs that are developing, and; 3) Industrial-based vocational development that develops in the form of factories as places of learning. Then in early 2011, the development of SMK has improved with the third model becoming the development of industrial-based SMKs that developed in the form of factories as places of learning and known as the teaching factory. The factory is just a term and does not mean a factory literally, but in the form of learning, the learning is done in the practice place and not the classroom, and the practice is oriented as in real industry. The operation of this model completely combines study and work, no longer separating the place for the delivery of theory and practice [5].

Teaching Factory's teaching is a production / service- based learning concept in SMK which refers to the standards and procedures that apply in the industry and is carried out in an atmosphere like what happens in the real industry. This is following the characteristics of vocational education as mentioned [6]. namely: (1) preparing students to enter the workforce; (2) based on the needs of the world of work "demand-market-driven"; (3) mastery of the competencies needed by the world of work; (4) student success in "hands- on" or world work performance; (5) close relationship with the world of work; (6) responsive and anticipatory to technological advances; (7) learning by doing and hands-on experience; (8) requires greater investment and operational costs than general education. The teaching factory concept is combining learning and a realistic work environment and creates relevant learning experiences. "Teaching factory concept as an approach that combines the learning and working environment from which realistic and relevant learning experiences arise" [7].

Lamancusa revealed that the teaching factory concept was found because to three things [8], there are: (1) ordinary learning is not enough, (2) students gain from direct practical experience, and (3) experience Team-based learning involving students, teaching staff, and industry participation enriches the educational process and provides real benefits for all parties. The Teaching Factory's learning paradigm is based on its goal of effectively integrating educational, research, and innovation activities into a single concept, involving industry and academia. Teaching Factory's learning focuses on industrial and academic integration

through an approach to curriculum, teaching/training. Therefore, it is necessary to develop a Teaching Factory learning model by looking at various learning concepts and theories. The application of Teaching Factory learning in which the atmosphere of the learning process is designed like the real world of work [9]. Based on the introduction as described above, the problems are formulated as follows: 1. How is the planning of TeFa Edutel at SMKN 1?; 2. how to organize TeFa edutel so that it runs well ?; 3. How is the implementation and evaluation of TeFa?

2. LITERATURES

TeFa is a learning concept in a real atmosphere so that it can bridge the competency gap between industrial needs and school knowledge [10]. Innovative learning technology and productive practice are concepts of educational methods oriented towards management. Students in learning to align with the needs of the industrial world. Because most people who succeed in this world have strong motivations that drive their actions. They know well about their motivation and maintain their motivation in every action [11]. In 2020, Euis stated that in TeFa there is an interaction between teachers, industrial technicians, and students who learn using real tools, instruments, procedures, and work methods in the industry in producing goods/services that are suitable for sale with industrial product standards. Supari Mulsim stated the benefits of Teaching Factory in principle is to make students aware that in mastering skills it is not enough to train soft skills in learning, working in teams, and training interpersonal communication skills, but also have to realize direct knowledge and work training to enter the world of work significantly [12].

Lamancusa stated that the Teaching Factory concept was found due to three factors, namely: (1) ordinary learning is not enough; (2) learners gain from direct practical experience; and

(3) experiential, team-based learning involving students, teaching staff, and industry participation enriches the educational process and provides tangible benefits to all parties [8]. Teaching Factory is learning that requires students to produce products following market/consumer demands.

In 2018, Hadlock stated that the Teaching Factory has a goal, namely to realize that teaching students should be more than just what is contained in books [13]. Students not only practice soft skills in learning, learn to work in teams, practice interpersonal communication skills, but also gain direct experience and practice work to enter the world of work later. Furthermore, Moerwismadhi states that in the Teaching Factory, schools carry out production activities or service services which are part of the teaching and learning process [14]. Thus schools are required to have a factory,

workshop, or another business unit for learning activities. Following Prosser's philosophy where vocational schools will be effective if the learning process is carried out in an environment that is an imitation or replica of the actual work environment [15]. So the teaching factory program aims to bring the business / industrial environment into the school environment. Students directly carry out the same production activities as what is done in the business / industrial world. Thus students follow the same learning process as what will be experienced in the real world of work. One of the goals to be achieved from the teaching factory program is the growth of ability as an entrepreneur in the school environment. Entrepreneurs are self-employed workers with uncertain incomes [16]. This definition is an understanding of entrepreneurs in the past. At present, an entrepreneur is not only someone who opens a business, but an entrepreneur is someone who tries with courage and persistence so that his business grows [17]. Growth or change becomes a keyword for someone who can be called an entrepreneur. According to the Directorate of Technical and Vocational Education, the advantages of the teaching factory are 1. As a means of production-based training and direct practice for students, which are market-oriented; 2. Assisting in funding the costs of maintenance, facilities, and operations for education and improving welfare; 3. Develop an entrepreneurial spirit for teachers and students; 4. Developing the independent attitude and self-confidence of students through the production process program; 5. Establish better relationships with the business world and industry as well as other communities [18]. TeFa application must be done professionally. Support of HR (Human Resources), facilities and infrastructure is a part that must be continuously improved so that it can become a source of learning to improve competence or expertise for students [19]. In its management, it can apply SBM (School- Based Management) with the principles; (1) independence, (2) accountability, (3) transparency, (4) partnership, (5) participation, (6) effective, and (7) efficient [20]. The formation of TeFa management is a must so that its implementation can achieve its goals. TeFa management that is meant is the management of the teaching factory. Ricky W. Griffin, and Darmawan define management as a process of planning, organizing, and coordinating, as well as monitoring resources to achieve goals effectively and efficiently [21].

Effective means that goals can be achieved according to planning, while efficiency means that existing tasks are carried out correctly, organized, and according to schedule. The appropriate evaluation model for processing programs is the goal-oriented evaluation model, the goal-free evaluation model, the formative-summative evaluation model, the consideration description, the CSE-UCLA evaluation model, the CIPP evaluation model, the gap evaluation model [22].

From the various evaluation models mentioned above, in TeFa Edutel management, the authors use a formative- summative evaluation model. By Michael Scriven, formative evaluation is carried out during the program, while summative evaluation is carried out after the program ends or at the end of the program [22]. The reasons for choosing this type of evaluation were based on the following objectives: 1) knowing how the Teaching Factory planning process at SMKN 1 Surabaya; 2) knowing the organizational structure of the Teaching Factory at SMKN 1 Surabaya; 3) knowing how to implement the TeFa Edutel.

3. RESEARCH METHOD

This type of research used in this research is phenomenological research with a quantitative approach. The design of this research is quantitative research. According to Mukhadis, a quantitative research design is an explicit and systematic description of research plans and stages that can be replicated by both researchers themselves and other researchers [23]. Research is a representation of problem- solving that has been determined as an object of study using a scientific mindset. This research was conducted at SMKN 1 Surabaya for two months, from March to April 2021. The sources of this research included the principal, the vice-principal in the curriculum field, teachers, and students of Teaching Factory's subject in Edutels. Collecting data in this study are using interviews, observation, and documentation of 26 respondents through 37 questions with an answer range of 1 (Yes), 2 (No), 3 (Doubt). The results of the research were then processed through descriptive statistics to find out the answers from the respondents.

4. RESULTS AND ANALYSIS

The research was conducted at SMKN 1 Surabaya, carried out by the management of the Edutel Teaching Factory in the hospitality department, to develop the quality of learning at SMKN 1 Surabaya. From the results of interviews, observation, and documentation, the following results were obtained. Darmawan defines management as a process of planning, organizing, and coordinating, as well as monitoring resources to achieve goals effectively and efficiently [24].

4.1. Planning in The Teaching Factory at SMKN 1 Surabaya

In general, planning is the process of determining organizational or company goals and then clearly presenting the strategies, tactics like program implementation procedures, and operations in actions

needed to achieve overall company goals [25]. Therefore, planning in the Teaching Factory at SMKN 1 Surabaya begins with planning a work program that is adjusted to the vision and mission of the school. This work program planning is a follow-up after determining the school's vision. This planning is very important so that the school's vision can be achieved in a planned and systematic manner. This planning process is carried out by analyzing the results of the implementation and evaluation using the condition and potential analysis at SMKN 1 Surabaya. The potential analysis at this school is:

Facilities and infrastructure for the Edutel Teaching Factory in the hospitality department are closely related to the facilities and infrastructure that support the optimization of the achievement of these learning objectives. The facilities and infrastructure needed in learning are the availability of facilities that can help the smooth running of service activities, including the lodging room itself, and along with the available facilities, suitable materials to support service activities such as café units, laundry units. From the research results, the Edutel Teaching Factory has 1 lodging building called SMESA, which has 6 bedrooms consisting of 3 single bedrooms, 2 Double bedrooms, and 1 triple bedroom, comfortable front office. The state of the facilities and infrastructure in this workshop is complete according to its function.

The need for machine tools and materials has been met. This can be seen from the results of the documentation conducted by researchers. Besides that, it is also supported by documents obtained from the school, the inventory at this SMESA has been recorded properly. Talking with existing machines, of course, various obstacles make the learning process disrupted, one of which is the existence of a pretty good laundry machine grant by the local government through BLUD but its utilization is not optimal because there is no training on the operation of the tool for students.

Fund for workshop Teaching Factory. In managing this Teaching Factory, it requires funds to support practical needs. In this funding at SMESA, the government uses grants to propose tools and materials to support the practice through the BLUD budget, which has been budgeted from 2018 to the present. Meanwhile, the addition of large machines is carried out based on the need only, looking at the work program that is arranged, if you want additional machines or technological updates, then for funding, you submit a proposal to the directorate. The submission plan is written in detail, such as the name of the tool, its specifications, then the material needs to be needed which will be compiled in the RAKS (Rencana Anggaran Kegiatan Sekolah). This proves that the funding for the Edutel Teaching Factory workshop at SMKN 1 Surabaya is very much paid attention to so that the learning process runs smoothly.

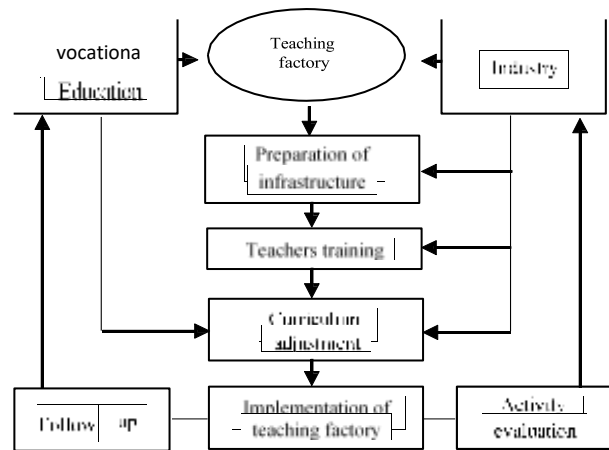


Fig 1. BLUD organizational structure at SMKN 1 Surabaya

4.2. Organizing Teaching Factory Outlet at SMKN 1 Surabaya

Planning a good work program grouping will certainly be maximized with the presence of an organizational arrangement. The results of research on organizing the Teaching Factory program at the Edutel workshop illustrate that organizing the work program for the Teaching Factory workshop at SMKN 1 Surabaya has been arranged systematically in coordination and cooperation between the head of expertise competency/head of the department who coordinates the implementation of learning, of course with the Head of the Hospitality Study Program, teachers, vocational which is then reported to the school. The head of an expertise competency coordinates members and is responsible for the implementation of practical learning in the workshop.

The duties and responsibilities are also supported by a description of the duties and responsibilities of each member. The results showed that the organization of the Edutel Teaching Factory workshop was going well. The administration system is already running well, the hotel coordinator already has a report book on the inventory of tools and reporting carried out by the coordinator in writing which can be seen in Figure 1. SMKN 1 Surabaya since 2018 has officially received BLUD. By holding a BLUD, TeFa activities at SMKN 1 Surabaya get financial assistance from the government, such as in 2018 getting approximately 800 million funds to increase surprise, 2019 increased to 900 million until now. With government assistance, TeFa activities will be more optimal. Through Figure 1, it can be seen that through vocational education and the industrial world, a Teaching Factory was created to introduce students to the industrial world. Funds from the BLUD were used to prepare infrastructure such as building construction and purchasing equipment to support TeFa activities especially edutel. The existence of training for teachers

from industrial partitions is very helpful in making school curricula to suit the industrial world. Then the results are applied in the implementation of Teaching Factory such as edutel. To maintain the quality of education, an evaluation of the PPTK is needed, the results of which will be conveyed to the principal and as material for evaluating their readiness.. At SMKN 1 Surabaya TeFa Edutel, students will carry out an internship for 6 months and study front office, housekeeping, and FNB materials. The front office covers how to welcome guests, appearance, administration. Housekeeping includes room makeup, laundry, and ironing. FNB (food and beverage) includes bartenders, baristas, waitresses, which can be seen in Figure 2. The following is the BLUD organizational structure at SMKN 1 Surabaya.

4.3. Implementation of Teaching Factory at SMKN 1 Surabaya

Implementation is one of the most important management functions because without the implementation of what has been planned and organized will never become a reality. Implementation of Teaching Factory Edutel at SMKN 1 Surabaya was carried out by grouping students based on their competencies and levels. This is in line with Hadlock, who explained that the purpose of Teaching Factory is to realize that teaching students should be more than just what is contained in books. Students not only practice soft skills in learning, learn to be able to work in teams, train interpersonal communication skills, but gain hands-on experience and practice work to enter the world of work later.

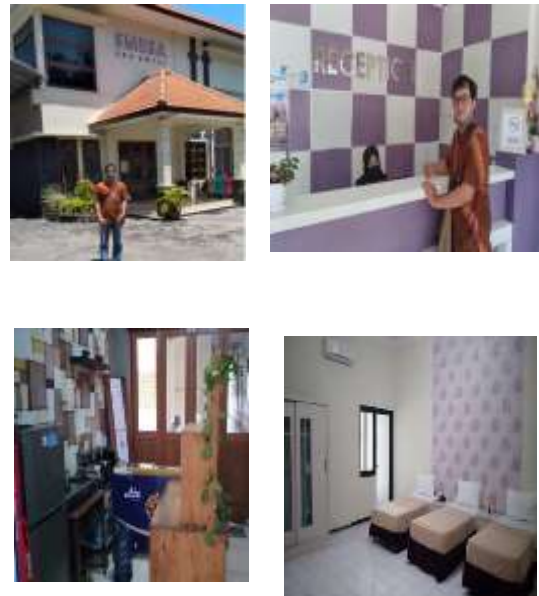


Fig 2. EDUTEL Display

In the implementation of the Edutel Teaching Factory at SMKN 1 Surabaya, several aspects underlie its implementation like aspects of HR, aspects of the partnership, aspects of facilities and infrastructure, and aspects of products. To find out about the implementation of Edutel at SMKN 1 Surabaya, interviews were conducted and questionnaires were distributed. 26 teachers and students as respondents who have answered questions via a google form, the results are Figure 1. It can be seen that the total male respondents were 12 respondents or 46.2% and female respondents were 14 respondents or as much as 53.8%.

Table I. Descriptive statistics results

Questions	Descriptive Statistics										
	Mean	Standard Error	Median	Mode	Standard Deviation	Sample Varianc	Kurtosis	Skewness	Minimum	Max	Count
P1	1.19	0.11	1	1	0.57	0.32	7.34	2.89	1	3	26
P2	1.19	0.11	1	1	0.57	0.32	7.34	2.89	1	3	26
P3	1.12	0.08	1	1	0.43	0.19	16.03	3.97	1	3	26
.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.
P36	1.58	0.16	1	1	0.81	0.65	-0.73	0.96	1	3	26
P37	1.58	0.16	1	1	0.81	0.65	-0.73	0.96	1	3	26

4.4. Evaluation of the Teaching Factory Workshop at SMKN 1 Surabaya

Evaluation is the whole effort of observing and implementing operational activities to ensure that these activities are following the established plans. The evaluation at SMKN 1 Surabaya was carried out by

analyzing the potential and conditions. From this evaluation, it can be used for future program planning. Various evaluation models can be used, there are goal-oriented evaluation model, goal-free evaluation model, formative-summative evaluation model, consideration description, CSE-UCLA evaluation model, CIPP evaluation model, gap evaluation model [2]. From the results of research and field studies, it can be concluded

that the evaluation of the Edutel Teaching Factory program involves all managers, including principals, teachers, and employees. Evaluation is used to make further planning. There is an evaluation which is a continuation of the planning and implementation cycle, so in the coming year planning will be better, as well as its implementation. Supporting and Inhibiting Factors for Teaching Factory at SMKN 1 Surabaya are as follows:

- a. Understanding the Teaching Factory from all parties the activity will run smoothly if all elements understand the program to be implemented. As in SMKN 1 Surabaya, all school elements were involved in the socialization of the Teaching Factory program.
- b. The curriculum that is in line with DUDI / Industry Teaching Factory is an adoption of the existing curriculum in the industry, which is to bring an industrial atmosphere into the school. SMKN 1 Surabaya is a school that prepares prospective workers who are ready to be deployed to Industry.
- c. Having qualified human resources. Teaching Factory will run well if the human resources that are owned have good professionalism and good competence.
- d. Have good practice facilities and infrastructure. Has a large hall that can synergize with the use of SMESA hotels such as for weddings that can be connected to lodging.
- e. There has been cooperation with the government through BLUD
- f. The students' enthusiasm in the Teaching Factory workshop. Students of SMKN 1 Surabaya are very enthusiastic in terms of practice, they think practice is one of developing their talents and skills.

The inhibiting factor in the Teaching Factory Edutel workshop in the hospitality department is that SMESA Hotel does not have a lot of accommodation space for the learning process, only 6 rooms, so that Tefa FNB learning cannot be maximized because FNB learning in hospitality is at least 9 rooms. To get around this, a mini cafe was created for Tefa learning. Although only 6 rooms. Room conditions in Edutel are almost close to class 3 hotels. Even the triple room is equipped with a bath so that it looks luxurious. Management of Edutel Teaching Factory, majoring in hospitality to develop the quality of learning at SMKN 1 Surabaya:

Planning in the Edutel Teaching Factory work program has been going well, such as administration is designed from the start, planning time and schedules are following the block system which is circumvented by the distribution of students. With good planning, practical activities are earnest and enthusiastic because the equipment is following industry standards whose use has been provided such as laundry machines, tables, and front office furniture, etc.

Organizing the Teaching Factory work program at SMKN 1 Surabaya has been well structured, starting from the chairman of the hospitality expertise competency, the head of the workshop, the skills competency teacher. This organizational structure involves all members of the workshop. With the division of student tasks in preparing, storing, and performing services, students feel helped and the learning process is more effective. Good organization, it can help in developing the quality of learning at SMKN 1 Surabaya.

The actuating of Teaching Factory Edutel at SMKN 1 Surabaya has been running very well, it can be seen that the process of meeting needs, tools, and materials is carried out by the head of the department and then submitted to the school principal. In the maintenance and maintenance of machines, tools and materials have been running well. Practical activities use a schedule made using a block system where learning can be carried out from beginning to end. Time-division rotation in Teaching Factory learning is also good, considering the number of students. In practical activities, the students were very enthusiastic. With good implementation, students can carry out learning activities comfortably and enthusiastically.

5. CONCLUSION

From the results of interviews with 26 respondents, it was found that 83.3% of respondents agreed that TeFa in the Edutel field had been well socialized in the school and community environment, was designed and implemented based on actual work procedures and standards. 84% of respondents answered agree that the TeFa learning process in the field of Edutel is learning by doing, improving students' soft skills, developing and sustainably implementing business-based learning patterns. 77% of respondents agree that the implementation of TeFa in the field of Edutel implements big data literacy, teaches critical, creative, communicative thinking skills, improves skills in market research. 69.5% of respondents answered that they agreed that TeFa activities in the Edutel sector were supported by the industrial world. The value of standard error or standard error of 37 questions to 26 respondents has a value of less than 0.15, this shows that the total average value of respondents is close to the true value. It has a standard deviation which is the difference between the sample value and the average, less than 0.8 which indicates a low standard deviation value, so that the data is close to the average value. Has an average sample variant of less than 0.6. the number of respondents is 26. And the majority of respondents answered 1 which means agree, but for question 34. Respondents answered yes by 46% and 46% of doubt with the question whether there are TeFa alumni in the field of Edutel who are entrepreneurs. Therefore, further research may be needed regarding tracer studies of

hospitality accommodation graduates. Supervision in the management of Teaching Factory Edutel at SMKN 1 Surabaya is carried out by an education unit that monitors the implementation of management, namely PPTK which will later be reported to KPA, namely. head. The evaluation is carried out to review the work program that has been carried out on the Teaching Factory edutel at SMKN 1 Surabaya by the school management at the end of the year. With the supervision carried out, it can develop quality in Surabaya.

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An Influence of Problem-Based Learning Models Assisted by Media Trainer Programmable Logic Control and Achievement Motivation on Skills Competence

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ABSTRACT

This study aims to obtain information: (1) differences in the competence of students who are taught using a problem-based learning model assisted by PLC trainer media and assisted by conventional media; (2) differences in the competence of students with high achievement motivation, compared to students with low achievement motivation. The research design is quasi-experimental: the non-equivalent control group design. In this design, the experimental group and the control group were not chosen randomly. As a measuring tool for competency achievement in this study, learning outcomes tools and instruments were made, which functioned as instruments to assess the competence of students during the learning process. The experimental treatment used a problem-based learning model assisted by the Programmable Logic Control media trainer and for the control class assisted by conventional media. The study found: (1) the competence skills for students who were taught using a problem-based learning model assisted by the Programmable Logic Control trainer learning media, were significantly higher than those assisted by conventional media; and (2) skill competence for students with high achievement motivation is significantly higher than those with low achievement motivation.

Keywords: *Problem-based learning model, Achievement Motivation, Skill competence*

1. INTRODUCTION

The definition of the National Education System for Vocational High Schools is education that prepares students ready to work in certain fields." To achieve expertise competence, several things are taken into consideration including technological developments, the job market, population growth, changes in work patterns, the concept of local excellence, infrastructure, number, and quality of teachers [1].

SMK Negeri 2 Probolinggo is one of the Vocational High Schools that have experience in education in the electrical power installation engineering expertise package. Based on an initial survey of other teachers and the curriculum section, It is found several problems that the students who study in the electrical power installation engineering expertise package lack of understanding of learning control systems. They lack understanding about Programmable Logic Control (PLC) subjects, lack understanding of sensor functions in real or near-real conditions. The student learning activities in PLC subjects

less evenly (only a few students active), and less attractive learning media, especially Programmable Logic Control media.

The learning model according to [2][3] is one of the training approaches wont to stimulate students' higher-order thinking in problem-oriented things, together with learning the way to learn. The characteristics of problem-based learning are authentic problems, involving many subjects, scientific investigations, producing real work, developing thinking skills, and social skills in dealing with complex problems.

The ultimate goal of learning is to produce students who have attitudes, knowledge, and skills in solving problems faced in their lives. For this reason, teachers must have appropriate learning strategies. So it is necessary to plan a lesson that can be applied in PBM. To achieve optimal learning outcomes, it is necessary to design a problem-based learning model planning properly. Starting from preparing problems following the curriculum that will be developed in the classroom, raising

problems from students, equipment, and assessments used. The planning made is a means of smoothing the phases of problem-based learning and achieving the desired learning objectives.

In addition to the use of appropriate learning models, motivational factors also affect the competence of students. [4], "Motivation is an impulse contained people who always want to try to make behavioral changes to be better [9] argues that learning is very necessary for motivation. The higher motivation is given, the more attainment for the lesson[5]. The function of motivation can be as a driving force for humans to act, namely determining what actions must be done to achieve goals by setting aside actions that are not useful for these goals. Meanwhile, research in[4] argues that there are three motivational principles, namely to make something do something, to keep doing something, and to determine which direction to do something.

The motivation is an urge to go to certain conditions that have not previously had the urge to do something, with that urge someone will keep doing something, and determine which way to do something to meet his needs towards a better direction.

To improve the quality of learning outcomes, there is some method by applying the learning strategy or learning media. Problem-based learning is one of the strategies to improve the learning outcome of the student. Research that discusses problem-based learning to lead the pedagogical process has been explored in [6], improving transversal cognitive in [7]. develop computer-based learning in [8], constructive approach in [9], dynamic electricity course in [10], and cooperative PBL in [11]. There is some problem- based learning method to improve the student learning outcome.

Based on the background in the introduction, the aims of this study are. 1) Obtaining information on differences in competency skills of students who are taught using a problem-based learning model assisted by Programmable Logic Control learning media, compared to those assisted by conventional media in learning to describe the design and apply a series of Programmable Logic Control. 2) Obtaining information on the difference in competency skills of students with high achievement motivation compared to those with low achievement motivation in learning to describe the design and implementation of PLC circuits.

2. RESEARCH METHODS

This study uses the type of experimental research. The purpose of this experimental research is to: test the hypothesis proposed in the study, predict events or events in the experimental setting, and draw generalizations of the relationships between variables. The design used in this study is a Quasi-Experimental design: the non-equivalent control group design. In this design, the

experimental group and the control group were not chosen randomly. In this design, both the experimental group and the control group are compared, the groups are selected and placed without going through random. The two existing groups were given a pre-test, then given treatment, and finally given a post-test. The design of this study involved an independent variable, and one dependent variable, with the complication that additional independent variables (moderator variables) were included in addition to the control variables.

Experimental treatment uses a learning model based on problems assisted by Programmable Logic Control media and in the control class using conventional media.

Illustration of the modification of the pre-test-post-test design of the control group with one variable into a factorial design with one treatment variable and one moderator variable (the moderator variable is indicated by the letter Y with two levels, Y1 and Y2), The research design is as shown in Figure 1

C _E	O ₁ O ₃	X ₁	Y ₁ O ₂ Y ₂ O ₄

C _c	O ₅	X ₂	Y ₁ O ₆

Fig 1. Quasi-Experimental design: the non-equivalent control group design [11].

C_E : Experiment class

C_c : Control class

X₁ : Treatment / experimental class treatment

X₂ : Treatment/control class treatment

O_{1,3,5,7} : Pre-Test

O_{2,4,6,8} : Post-Test

Y₁ : High achievement motivation

Y₂ : Low achievement motivation

In this study, the subjects were divided into two classes, namely: (1) CE class, which is a class that is taught using a problem-based learning model assisted by PLC media, and (2) CC class, which is a class that is taught using problem- assisted learning by conventional media.

Determination of the high and low attainment of motivation in the class group by finding the middle score, namely the lowest score is added up with the highest score divided by two. The high achievement motivation group has a score greater than or equal to the middle score, while the low achievement motivation group has a score less than the middle score.

Data analysis techniques used in this study include:

1.1. Analysis Prerequisite Test

1.1.1. Normality test

A normality test is used to test whether the learning outcomes obtained are normally distributed or not. The learning outcomes tested include: knowledge, attitudes, and skills learning outcomes. For learning outcomes, the knowledge tested includes a pre-test and post-test scores. The adopted test, in this case, is the Kolmogorov-Smirnov. It uses the SPSS program. If a significance level of 0.05 is obtained, the data is normally distributed, and if 0.05 then the data is not normally distributed.

1.1.2. Homogeneity Test

The experimental and control group are examined with the homogeneity test to get the knowledge performance of the student learning outcomes.

Table 1. Descriptive Statistical Data On Learning Outcomes In The Skills Area

Mean	80,77	79,64
Std. Deviation	2,335	2,205
Variance	5,450	4,860
Skewness	0,155	0,260
<u>Kurtosis</u>	<u>-0,646</u>	<u>0,522</u>

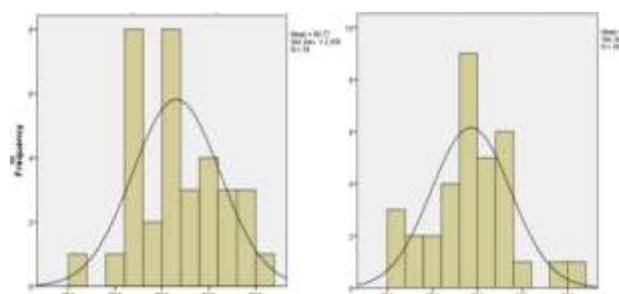


Fig 2. Histogram and normal curve the expense of learning results in the skill field (a) in the control class, and (b) in the experimental class.

The two groups were the same or not. The learning outcomes tested include learning outcomes of knowledge, attitudes, and skills. For learning outcomes, the knowledge tested includes a test before and after treatment. In this study, Levene's was used to get the variance value.

Table 2. Testing The Statistical Hypothesis Of Learning Outcomes In The Domain Of Skills

Tests of Between-Subjects Effects
Dependent Variable: Learning Outcome Scores in the
Experimental Class and Control Class Source

Source	Of Squares	df	Mean Square	F	Sig
Corrected	152,859a	3	50,953	15,603	0,000
Intercept	437431,654	1	437431,654	133948,	0,000
Model_PBM	21,606	1	21,606	6,616	0,012
Motivasi_Berpre		1	103,592	31,721	0,000
Model_PBM *	27,661	1	27,661	8,470	0,005
Motivasi_Berstasi	209,003	64	3,266		
Error		68			
Total		68			
Corrected Total		67			

a. R Squared = ,433 (Adjusted Squared = ,406)

Statistical hypothesis: $H_0 : \mu_1 = \mu_2$
 $H_1 : \mu_1 \neq \mu_2$

To evaluate the homogeneity, the application of SPSS software has been purposed. obtained a significance level of 0.05 then the data is taken from a homogeneous sample and if 0.05 then the data is taken from a sample that is not homogeneous.

1.2. Hypothesis Evaluation

Testing the value of the hypothesis is the last way to determine what is the alternative answer to the problem formulation. It was noticed by considering the truth assumption in this research. Otherwise, statistical hypothesis evaluation is also meaningful if the null hypothesis is obtained or declined. The denominator hypothesis test usage is a two-way ANOVA. In this study, the separation of statistical hypothesis evaluation was carried out between knowledge learning outcomes, attitude learning outcomes, and skills learning outcomes on student achievement motivation. The research hypothesis above will be accepted if the significance value obtained from the calculation of the F value using SPSS is less than 0.05 and which effect is better by looking at the difference in the mean between groups.

3. RESULTS AND DISCUSSION

The results of statistical data processing scores of learning outcomes in the realm of skills are given in Table 1. Meanwhile, the normal curve for learning outcomes in the skill domains is shown in Figure 2. The measure of concentration and learning outcomes in the skill domain of the experimental class and the control class is in the form of a different average score, for the experimental class it is 80.77 and for the control class, it is 79.64. The size of the data distribution is indicated by the value of standard deviation, variance, skewness (slope), and kurtosis (slenderness). The value of standard deviation, variance, skewness (slope), and kurtosis (slope) of experimental class data are 2.335, 5.450, 0.155, and -0.646.

While for the control class are 2.205, 4,860, 0.260, and 0.522, respectively. In the experimental class the tendency of the data towards a low value because the value of positive skewness is 0.155 and the control class has a tendency of data towards a low value because the value of positive skewness is 0.260. The experimental and control classes have a kurtosis value below 0.263, so it can be consummate that the learning result score in the skill domain has a high distribution. Based on the histogram in Figure 2, it appears that both graphs have normally distributed.

Analysis Prerequisite Test

3.1. Normality test

The results of the normality test are adopted to examine whether the distribution of the scores is normal or not. It used is the Kolmogorov-Smirnov method. Then to answer the research hypothesis, hypothesis testing is carried out as follows.

3.1.1. First Hypothesis Testing:

H1: Skills learning outcomes for students who are taught using a problem-based learning model assisted by Programmable Logic Control media are powerfully assisted the student understanding than uses the conventional media in learning to describe the design and implement a series of Programmable Logic Control at SMK Negeri 2 Probolinggo.

H0: Skills learning outcomes for students who are learning using a problem-based learning model assisted by Programmable Logic Control media are the same as those assisted by conventional media in describing the design and implementation of a series of Programmable Logic Control at SMK Negeri 2 Probolinggo.

3.1.1.1. Skills Area Learning Outcomes

Table 2 exposes the hypothesis results obtained from the test. It got a Fcount of 6.616 with an important value of 0.012. If the the result achieved at = 5%, $df_1 = (3-1) = 2$, $df_2 = (68-3) = 65$, so the rate of Ftable is 3.99. Due to the $F_{count} = 6.616 > F_{table} = 3.99$, then H0 is rejected and H1 is accepted, meaning that the learning outcomes for students of the skills domain who use problem-based learning models assisted by Programmable Logic Control media are higher than the skills learning outcomes who use the learning model. problem-based conventional media assisted in learning to describe the design and implement a series of Programmable Logic Control at SMK Negeri 2 Probolinggo. Furthermore, to reinforce the research hypothesis, further testing of the mean is practiced, as presented in Table 3.

Table 3 shows the value result of student skills for experimental and control classes that consist of data

distribution. The experimental class was assisted by Programmable Logic Control media of 80.769. It is greater than the skills learning outcomes using problem-based learning models assisted by conventional media of 79.641. With $F_{count} = 6.616$ and a significance of $0.012 < 0.05$, then H0 is rejected and H1 is accepted. Thus, it can be concluded that the learning outcomes for the student with high motivation resulted in a higher score than the low motivation. From hypothesis testing, it can be concluded that the competence of students who use problem-based learning models assisted by Programmable Logic management media is beyond the competencies of scholars who use problem-based learning models assisted by standard media in describing the look and implementation of PLC circuits at SMK Negeri 2 Probolinggo.

3.1.2. Second Hypothesis Testing:

H1: Skills learning outcomes for students with high achievement motivation were significantly higher than those with low achievement motivation in learning to describe the design and implement a series of Programmable Logic Control at SMK Negeri 2 Probolinggo.

H0: Skills learning outcomes for students with high achievement motivation are the same as those with low achievement motivation in learning to describe the design and implement a series of Programmable Logic Control at SMK Negeri 2 Probolinggo.

3.1.2.1. Research Hypothesis Testing:

Skills Area Learning Outcomes on the Effect of Achievement Motivation

Table 3. The Mean Learning Outcomes Test Results In The Skills Area On The Effect Of Learning Models
Dependent Variable: KE KK K

Class	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Experiment class	80,769	0,310	80,149	81,388
Control Class	79,641	0,310	79,022	80,260

In Table 3 it seems that the results of hypothesis testing obtained Fcount of 31.721 with a significant price of zero.000. If the check is allotted at = 5%, $df_1 = (3-1) = 2$, $df_2 = (68-3) = 65$, therefore the price of Ftable is 3.99. Because $F_{count} = 31.721 > F_{table} = 3.99$, then H0 is rejected and H1 is accepted, meaning that the learning outcomes of the skill domain describe the design and apply a series of Programmable Logic Control on students who have high achievement motivation will be higher than students with low achievement motivation. Furthermore, to answer the research hypothesis, it used the mean result, as explored in Table 4.

Table 4. Results Of Testing Mean Prices Of Learning

Outcomes In The Skills Area On The Effect Of Achievement Motivation

	KE KK K			
	Achievement motivation	Mean	Std. Error	95% Confidence Interval Lower Bound Upper Bound
Low Achievement motivation		78,971	,310	78,351 79,590
High Achievement motivation		81,439	,310	80,820 82,058

Table 4 exposes the learning outcomes resulting in the skill domains based on the accomplishment of the students. It results in the high motivation got the value of 81,439, while low motivation got a result of 78,971. With $F_{count} = 31.721$ and a significance of $0.000 < 0.05$, then H_0 is rejected and H_1 is accepted. So, by considering the results of the mean test and two-way ANOVA test, it can be achieved that the learning outcomes of the skill domain of describing the design and implementing a series of Programmable Logic Control on students who have high achievement motivation will be higher than students who have low achievement motivation.

From hypothesis testing, it could be drawn that student with high achievement motivation has higher competence than low ones.

4. CONCLUSION AND SUGGESTION

The competence of students in the realm of skills taught using a problem-based learning model assisted by Programmable Logic Control learning media is significantly higher than those assisted by conventional media in describing the design and implementation of electro- pneumatic control circuits at SMK Negeri 2 Probolinggo. The competence of students in the skill domain with high achievement motivation is significantly higher than those with low achievement motivation in learning to describe the design and implement a series of Programmable Logic Control at SMK Negeri 2 Probolinggo.

Problem-based learning model assisted by Programmable Logic Control learning media is very well used in learning to describe the design and implement a series of Programmable Logic Control. To apply a problem-based learning model assisted by Programmable Logic Control media, students need to be given more adequate preparation, especially in terms of mastery in learning to describe designs and apply PLC circuits related to DUDI. With sufficient preparation, it is hoped that during the implementation of the lesson there will not be many obstacles in planning and operation.

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Development Of Employability Of Fresh Graduate Alumni Through Tracer Study By Evaluating The Likert Scale Method

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ABSTRACT

The number of electrical engineering graduates produced every year. The suitability of the required competencies with those of alumni is essential. In this research, a tracer study of electrical engineering graduates was conducted. Tracer study research is significant to find out the competency profile of graduates and alumni's workability about user needs. The target of tracer study is graduates of new graduates in 2019 and 2020. Research is significant to assess and improve the relationship between alumni characteristics and the field of work of graduates of study programs. The research used a descriptive approach design. The population is UNESA Electrical Engineering undergraduate graduates in 2019 and 2020 who have successfully filled out the online tracer study form. The number of samples as many as 139 respondents. The survey media uses university website links and google platform surveys distributed to each alumnus within six months. Data analysis used the descriptive analysis method Likert scale. Before the questionnaire was distributed to respondents, the validity of the questionnaire will be tested with Pearson correlation. The tracer study results in a Likert scale of 5 instrument questions by paying attention to the most significant percentage. The results of the tracer study instrument for knowledge obtained by alumni from lectures have a substantial contribution to the job market with a rate of 73%. Internships have a significant role in increasing world knowledge with a percentage of 63%, Practicum contributes a lot to the ability to work with a rate of 67%, English has a share of 41% of language skills obtained during college, and communication skills obtained from lectures with a percentage of 70% which received during studies, as well as the ability of alumni to solve problems in the job market which is the most significant percentage of 69%

Keywords: *Tracer Study, Likert Scale, Employability*

1. INTRODUCTION

The world of education, including undergraduate education in electrical engineering, is always dynamic. Moreover, the changing times and the era of globalization require a university to produce graduates with competencies that meet their needs [1]. Therefore, consistent and continuous improvement in the quality of education to make qualified electrical engineering engineers by the educational competency standards of Indonesian electrical engineering graduates and able to compete globally is part of the vision and mission of the Faculty of Engineering and electrical engineering undergraduates UNESA / study programs listed in the Strategic Plan UNESA (Renstra UNESA) 2020-2024 [2].

One of the efforts to improve the quality of education is that educational institutions, in this case, the Faculty of Engineering, especially the electrical engineering undergraduate study program, are required to continue

to improve the curriculum and learning process. In addition, it is also supported by improving the quality and quantity of academic staff and supporting facilities.

Tracer Study is one of the research activities that collect information about the distribution of alumni and various inputs that can help develop the curriculum itself [1]. For engineering, undergraduate institutions, especially electrical engineering, alumni can provide information about the suitability of the competencies obtained during education with those needed at work. This information can be used as the basis for educational institutions in curriculum development and learning processes. UNESA's bachelor of electrical engineering was established in 2012, categorized as a new study program at UNESA.

This UNESA electrical engineering graduate alumnus is spread across various parts of Indonesia, from big cities to remote rural areas. These UNESA electrical

engineering graduates work in multiple types of employment, both directly related to the electrical engineering field and outside the electrical engineering field. In addition, Tracer Study activities can liaise between institutions and alumni regarding future graduate orientation. In the implementation of the Tracer Study at the UNESA electrical engineering graduate, this activity has been carried out before at the time of planning the performance of the Competency-Based Curriculum (KBK) and OBE (Outcome Based Education), which was just applied to the UNESA Electrical Engineering study program with the Problem Based Learning method. (PBL). To continue, in 2021, the Tracer Study will be carried out with the scope of graduates from the UNESA Electrical Engineering Bachelor [2].

1.1. LITERATURE

1.1.1. *Employability Skills*

In the job market, the term employability skill can be considered a personal characteristic related to working and interest in remaining active in the labor market. Employability skills [3] can be categorized into (1) fundamental skills needed to work for better ability development. These basic skills consist of communication skills, the ability to manage information, and operating numbers. (2) Personal management skills, namely personal skills, attitudes, and behaviors, spur a person's growth potential [4]. Personal management skills consist of showing positive attitudes and behavior, having a sense of responsibility, adapting, striving to learn continuously, working carefully, thinking, and solving problems. (3) Teamwork skills, namely skills and attributes needed to increase productivity. This skill consists of the ability to cooperate and be able to participate in tasks.

UNESA electrical engineering graduates are expected to work as technicians or entrepreneurship in technology and industry. This implies that graduates of the UNESA electrical engineering degree are expected to have the ability to operate technological tools according to their area of expertise. Thus, for UNESA electrical engineering graduates to remain attractive in the labor market, in addition to having fundamental skills, personal management skills, and teamwork skills, UNESA electrical engineering graduates must also have technological skills.

Competencies can be divided into three main groups— first, competencies obtained in schools can be directly used in the business industry after graduating. Second, competencies are acquired in schools that facilitate the acquisition of new competencies. Third, the competencies obtained in the context of their work.

Thus, the longer the working period and the length of training that a person has attended, the more frequent the learning process will be repeated. In this learning process,

there will be a connection between the employability skills of the (old) facilitator and the new employability skills, or repetition of the use of employability skills, so that it will increase the mastery of one's employability skills, which in turn will make a person more trusted to do work with a more complex level.

According to human capital theory [5], differences in human capital inherent in a person will result in variations in income. According to this approach, a person's productive abilities can be increased through self-investment. They can do this through education or training because education or training provides knowledge and skills that can be useful for their work and can be used productively in the labor market. If someone has increased or increased productivity by doing education or training and then working, then he will receive a bigger salary

Employability skills competence is expected to influence income (from the perspective of the labor market). According to human capital theory, competence is one indicator of productivity reflected in the amount of income. An increase in productivity means he does something faster, which means more mastering skills [6]. Because productivity affects salary, the skills mastered affect salary too

When someone is already working in the industry, learning activities occur while they are working or when they are attending training. Thus, the longer the working period, the more frequent and repeated learning activities will occur. In this learning activity, there is a connection between the facilitator's employability skills component (old employability skills), which includes technical skills, fundamental skills, personal management skills, and teamwork skills with the new employability skills component. or there will be a repetition of the use of employability skills components

Training also includes learning activities that are more planned than learning that occurs while working. During the training implementation, there was also a connection between the facilitator's employability skills (old employability skills) which included technical skills, fundamental skills, and personal management skills. And teamwork skills with new employability skills components, or there will be repeated use of employability skills components.

In addition, while working or participating in training, a person will acquire new employability skills unrelated to previous employability skills (while in education at the UNESA electrical engineering undergraduate study program). Thus, for someone who has a more extended working period, there will be a process of increasing mastery of the employability skills component (technological skills, fundamental skills, personal management skills, and teamwork skills). Likewise, with the length of training, the more often a person receives training, the more employability skills will be obtained,

including technical skills, fundamental skills, personal management skills, and teamwork skills.

The description above shows that during work or training, there will be a change in the level of mastery of employability skills, both technical skills (technological skills), the ability to use numbers and communication skills (fundamental skills), the ability to self-regulate in dealing with work (personal management skills). As well as the ability to work together (teamwork skills). Thus, it can be concluded that the longer the working period and the length of training a person will be, the shorter the mastery of technological shifts, fundamental skills, personal management skills, teamwork skills will be.

The payment system for workers' wages in Indonesia is primarily determined by years of service. This can be seen from the pattern of severance pay which is solely determined by years of service. Thus, someone who works long hours will get a higher wage/salary payment. In addition, a person who has worked in the company for a long time means that the person is trusted to do the work they are mastered. Therefore, one form of company trust in someone provides more income than people who have worked fewer hours with the same job.

Productivity is one measure of the success of an individual or company. People who have high employability skills will work faster and more effectively than other people. The person means having higher productivity the better. Because the productivity is taller, the person will get better rewards. The expected form of appreciation for the work is giving a higher salary than people who master and use employability skills under them.

In addition, people who have higher employability skills will be faster in doing a job and get better results than those who have employability skills below them. Because the results of his work are more and better (more productive), then the person will get a better reward (income).

The explanation above shows that the longer a person's working period, the higher the level of mastery of employability skills, the higher the level of employability skills used, and the more often employability skills are used, the higher the income received by a person.

1.1.2. Tracer Study

Tracer Study or alumni survey at several universities in Europe and North America developed since the late 1970s. However, in Indonesia, Tracer Study only started around the early 2000s. It implemented national accreditation requirements for study programs by the National Accreditation Board for Higher Education (BAN-PT) formed by the Directorate General of Higher Education, Ministry of Education and Culture. The critical focus of this Tracer Study is to measure the quality of

learning outcomes (learning outcomes) or graduate competencies by recording job satisfaction and the relationship between the fields of knowledge studied and the type of work obtained or occupied. In addition, in some areas of the world, the Tracer Study is also intended to measure alumni competencies related to critical thinking skills, problem-solving skills related to their knowledge, communication skills, both oral and written, leadership skills, social sensitivity, etc.

The Tracer Study is based on the idea that the quality of educational institutions and the effectiveness of learning can be seen from the achievements of alumni several years after they leave college [7]. In addition, satisfaction with work, income, job or career achievements, concern for social problems, political problems, and the ability to accept others can be added. Thus, there are three fundamental questions related to the measurement of alumni competence.

1. How satisfied are the alumni with the education they received from their home university?

2. How satisfied are the alumni with their work?

3. How far is the contribution of alumni to the progress of the alma mater, society, and country?

The primary purpose of holding a Tracer Study is to collect information from alumni about the strengths and weaknesses of the study program related to learning objectives to prepare alumni for professional careers or further studies. In addition, another goal is to get input from alumni about things that need to be developed in learning to improve the teaching process in the future. This can be done by carefully observing the professional status of alumni. In addition, Tracer Study is also needed to (a) get feedback from alumni and graduate users regarding the learning process; (b) measure the satisfaction of alumni and graduate users about an educational program (study program). Finally, the congruence between the curriculum and the labor market demands will be seen in the alumni activities in work [8].

The objectives of carrying out the Tracer Study [5], among others, are as follows.

1. Identify graduate competencies (covering knowledge, skills, and attitudes).
2. It knows the relevance of the curriculum of the study program to the demands of the job market.
3. It knows the suitability between the competence of graduates and the type of work (profession) alumni.
4. They know the desires of the job market (job market signals) and their relevance to the competencies designed by the study program.

5. Meet accreditation or certification requirements (for example, BAN-PT, IABEE, ASIIN, and international accreditation) [9]
6. Fulfilling the requirements for a grant based on a study program or institution

1.1.1.1. Likert Scale [10]

The scoring for the survey data that has been collected is processed using the Likert scale method, which is a scale that contains several levels of answer choices regarding the respondent's opinion on a statement put forward. Changes in the Likert scale are used by eliminating some shortcomings of the multilevel Likert scale, such as the 5-level Likert scale, changing the Likert scale by eliminating the middle answer category, which aims to: (1) provide a neutral statement. (2) the middle answer gives the respondent's choice if the positive and negative choices are considered less appropriate. (3) the objectives of the very many (VM), many (M), few (F), and very few (VF) categories give respondents a choice in a positive or negative direction.

This study uses five alternative options to adjust the tracer study instrument with five criteria: very much, a lot, enough, a little, and very little. The Likert scale used a person's perception in an online survey. Respondents expressed opinions by choosing one of the alternative answers provided on the survey instrument based on the respondent's level of expression at the five levels of answer choices given. [11].

Survey data collection is used to obtain opinion data from respondents. According to the specified instrument, the survey questionnaire selects the type of optional questionnaire that asks respondents to choose an answer. A score is given for the alternative solutions in this questionnaire for each choice using a Likert scale. Thus, in this study, respondents answered questions in only five categories, including very many (VM), many (M), enough (E), few (F), very few (VF). The answers above have a weighted score. with details in table II [10]

Table 1. Score Categories

Answers	Score
Very Much	5
Much	4
Enough	3
Few	2
Very Few	1

1.1.1.2. Correlation Pearson [12]

Before the instrument survey is distributed, it is necessary to carry out a validity test that aims to clarify the meaning contained in the instrument survey. The survey is done in such a way that respondents have no

difficulty in answering the instrument survey. The survey instrument was distributed through online media to alumni.

The reliability data obtained from the instrument survey shows the consistency of the data measurement if it is used to measure the phenomenon of answering the same instrument survey at different times. The questionnaire instrument was tested using a Likert scale (1 to 5). The validity of the Likert scale method questionnaire using the Pearson correlation test described in equation 1 [12]

$$r_{XY} = \frac{n\sum XY - \sum X \sum Y}{\sqrt{n\sum X^2 - (\sum X)^2} \sqrt{n\sum Y^2 - (\sum Y)^2}} \quad (1)$$

Description:

r_{XY} : correlation coefficient validity

n: number of respondents

X: comparison value

Y: the value of the instrument whose validity is sought

2. METHOD

Tracer Study is an evaluative study using descriptive and qualitative quantitative approaches. The 2021 Tracer Study will be carried out throughout March – September 2021. The research population in 2021 is all alumni of UNESA electrical engineering graduates who graduated in 2019 and 2020, while the sample was taken using a purposive random sampling method. The Tracer Study 2021 team collects data from alumni of the UNESA electrical engineering undergraduate. Several data collection activities have been planned, such as going directly to the field in various areas and using a correspondence system. However, going directly to the field and the correspondence system cannot be implemented due to time, cost, and human resources constraints. According to technological advances, other ways to utilize the internet [13][14], namely through the distribution of social media, which people are increasingly using in communicating and using email, an electronic mail currently widely used by people. The distribution carried out in the tracer study uses a broadcast system through WhatsApp groups and email broadcasts. The results obtained from the distribution through social media and email are very satisfying because many alumni fill out the tracer study website [15].

The difficulty experienced by the Tracer Study team in 2021 was that of the 139 respondents who were targeted to fill out the questionnaire through the website tracer study.unesa.ac.id, only 130 were successful. In addition, some have not filled in because the alumni contact cannot be contacted via email or mobile phones and alumni WhatsApp accounts. Therefore, this Tracer Study research is in the form of an evaluative study using a

structured questionnaire as a research instrument and added with open-ended questions to obtain as much information as possible.

In this study, steps were taken to obtain the survey results needed for tracer study analysis. Our action research is described in Figure 1. Some of the research steps depicted in Figure 1 are making tracer study instruments. Before making the tracer study instrument, we analyzed alumni's situation and problems in the job market. This initial analysis was obtained from various information from alumni through alumni meeting communication in the online meeting application. This alumni meeting is regularly held at least once a year by inviting alumni from UNESA. From several analyses and problems obtained, we focus on six main issues: the relationship of knowledge acquired on campus with the world of work, internship programs, practicum, English, problem-solving skills, and communication skills in the world of work. After we determine the problems faced by alumni, we use several supporting references so that the study instruments that are made are better.

Regarding the establishment of the tracer study instrument and the conduct of the tracer study, we designed some basic questions used as research data. These questions are instrumented into the research grid used in the survey. The questions we use are analogous to the descriptions of several tools that have been described in the study and can provide an overview of the state of the survey factors. The statement item is positive support. This positive supporting statement is used to motivate respondents to fill out the survey/questionnaire that has been distributed. We made the study instrument using the Likert scale method. The questionnaire that we made used online questionnaire media. The questionnaire was filled in by spreading the tracer study website to registered alumni. Then the alumni fill in the tracer study to completion with instruments that can support alumni in their work.

The next stage is to test the validation of the questionnaire data that alumni have filled out by using Pearson correlation so that the instruments distributed meet the survey rules. After making the tracer study instrument, we determined alumni as the target for the spread of the tracer study. The alumni target is new graduates in 2019 and 2020. The tracer study instrument created in the web-based online questionnaire is distributed through social media and online chat applications. It is hoped that the distribution of the tracer study alumni will fill in with the complete tracer study instruments provided. The data obtained from the online media will be collected using a data processing application. After the tracer study data is collected, the data processing and analysis stage will be carried out.

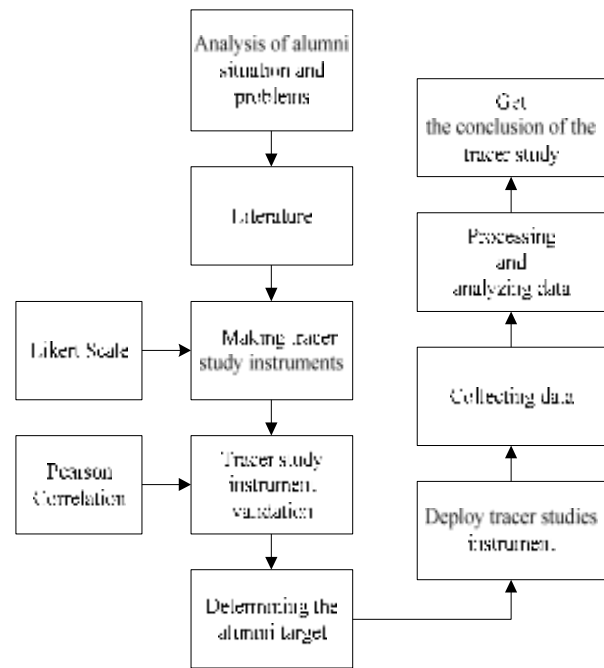


Figure 1. Research Method

The percentage obtained for each positive supporting question given from the alumni is recorded. From the data analysis, we can review the distribution of the number of positive support points related to the supportability possessed by alumni in the job market from the criteria we determined for this tracer study. From the results of the analysis we carried out, conclusions and recommendations can be drawn for universities and students who are currently undergoing education constantly to improve their resources, and universities can use analysis of tracer study data as a reference for evaluating the implementation of teaching in higher education, primarily undergraduate study programs. UNESA.

Electrical Engineering and improving the performance of tracking studies next year and supporting the accreditation of study programs.

For the last stage, we distribute what has been analyzed previously so that it can be used as a reference for evaluating the implementation of education in universities, especially the UNESA Electrical Engineering undergraduate study program, as well as improving the performance of tracking studies next year and as a support for study program accreditation.

In the questionnaire used for data collection, we used six questions containing the alumni's ability to job market

Q-1. Knowledge gained during lectures with work relationships

Q-2. The contribution of the internship program to work experience

Q-3. The contribution of the practicum of the lecture period to the work

Q-4. Ability in English to the world of international work
Q-5. Ability to solve problems in the job market

Q-6. Ability to communicate in conveying ideas, reports, networking, and negotiating job market

In questions 1 (Q-1) to question 6 (Q-6), we want to know the distribution of alumni abilities in the job market through the Likert scale method with a question instrument that has been validated using Person correlation with a specified significance level (α) of 0.05 and the number of respondents as many as 139 alumni.

3. RESULT AND DISCUSSION

In analyzing the data to collect questionnaire data about the ability of alumni, especially fresh graduates in the job market, in this study, we obtained data in tabular form with descriptions.

Table 2. Question Questionnaire Q1

Criteria	Percentage
Very Much	40%
Much	33%
Enough	10%
Few	13%
Very Few	4%

In table 2, the Q-1 questionnaire with the highest percentage value of “much” total with a percentage of 73% states that science in lectures has a considerable contribution to the world of alumni work. Researchers need to propose to education providers to improve education delivery even better.

Table 3. Question Questionnaire Q-2

Criteria	Percentage
Very Much	31%
Much	32%
Enough	17%
Few	15%
Very Few	5%

In table 3, the question questionnaire Q-2 has the highest percentage value of “much” total with a percentage of 63% stating that the internship program held by the study program has a lot of contribution to the work experience of alumni.

Table 4. Question Questionnaire Q-3

Criteria	Percentage
Very Much	36%
Much	31%
Enough	18%
Few	10%
Very Few	5%

In table 4, the Q-3 questionnaire with the highest percentage value with a percentage of 67% states that practicum has a significant role in increasing the part of practicum in expanding the ability of alumni to face the job market.

Table 5. Question Questionnaire Q-4

Criteria	Percentage
Very Much	20%
Much	21%
Enough	30%
Few	20%
Very Few	9%

In table 5, the Q-4 questionnaire has the highest percentage value of “much” total with a percentage of 41% stating the English language skills possessed by alumni in facing the global market, which requires alumni to communicate using an international language (English).

Table 6. Question Questionnaire Q-5

Criteria	Percentage
Very Much	30%
Much	39%
Enough	15%
Few	10%
Very Few	6%

In table 6, the questionnaire questions Q-5 with the highest percentage value of “much” total with a percentage of 69% stating the ability to solve existing problems related to the job market and some issues that affect the quality of work of alumni.

Table 7. Question Questionnaire Q-6

Criteria	Percentage
Very Much	45%
Much	25%
Enough	15%
Few	10%
Very Few	5%

In table 7, the Q-6 questionnaire with the highest percentage value of “much” total with 70% states that communication skills are very influential in the job market because communication skills can expand work networks, negotiate the job market, and others.

Table 8. Validity Test Questionnaire

Question	r-Count	r-Table	Decision
Q-1	0.614916	0.195	Valid
Q-2	0.616862	0.195	Valid
Q-3	0.616764	0.195	Valid
Q-4	0.624593	0.195	Valid
Q-5	0.62694	0.195	Valid
Q-6	0.627607	0.195	Valid

In table VIII, we analyze the questionnaires that have been carried out/distributed to validate the questions used by the questionnaire and are used to avoid statements that are not clear in meaning, eliminate words that are difficult to answer, and consider adding subtracting items. Testing of the instrument was carried out on alumni outside of the recorded data.

4. CONCLUSION AND SUGGESTION

From the analysis and discussion that has been carried out previously, we can conclude that in general terms on the questionnaire data that we have conducted, most of the alumni have considerable abilities in facing the challenges of the job market with the provision of knowledge during lectures, work experience gained from the internship program, work skills obtained from practicum from classes, English language skills in dealing with global markets, ability to solve work-related problems, and communication skills to expand network and work of quality. Therefore, with this tracer study, universities can use it to improve educational services, both formal and non-formal, mainly covering knowledge related to the world of work, internship programs, practicum, English language skills, ability to solve problems in the world of work, and communication skills in conveying information, an idea, report, network, and negotiation. On the other hand, tracer studies can be used by students who are currently studying at the university to maximize their learning experience, skills, and work both on and off-campus to become powerful human beings facing the world of work.

Future research is expected to use other instruments besides the instruments in this study, which are more weighty through online tracer studies.

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Development of Research and Community Service Roadmap of UNESA

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ABSTRACT

The Surabaya State University (UNESA) is required to be able to independently manage institutions and be ready to innovate and collaborate with other institutions. The institutional and academic orientation has also experienced a paradigm shift from a teaching-based university to an entrepreneurial-based university. In the process towards independence, UNESA has prepared itself by compiling various documents required to become a State University with a Legal Entity (PTNBH). Research and community service activities are carried out in order to seek and find the truth through scientific methods in the fields of science, technology, or art for the advancement of science, technology, or art itself and the welfare of society. This study aims to produce the development of a road map document for research and community service (PKM) UNESA PTNBH. The main methods used to achieve this goal are reviewing documents related to research and community service, focus group discussions and workshops, and finalizing them. The resulting research outputs are UNESA PTNBH research and PKM roadmap documents and articles. The Technology Readiness Level (TKT) to be achieved at the end of this study is 3. The roadmap describes research and PKM plans from 2022-2045. There are 5 periods of time where the achievements are described in stages. Research is entirely based on innovation and commercialization (mass commercialization of innovative products) and also supports smart industry research and joint research with the world's multi campuses. Whereas PKM in 2045 is described as achieving independence and partnerships that empower 3 UNESA flagships (Disabilities, Sports, Arts, and Culture).

Keywords: *Roadmap, Research, Community Service, Academic, University*

1. INTRODUCTION

Higher education research policy aims to improve the quality of research governance and efforts to increase institutional competitiveness in supporting programs in tertiary institutions[1]. Institutional studies are urgently needed to integrate existing human resource strengths in each unit, strengthen institutions, achieve academic quality standards, and internationalize institutions[2]. In the era of industrial revolution 4.0 and society 5.0 as it is today, Surabaya State University (UNESA) is required to be able to innovate and collaborate and be independent in managing itself[3][4][5]. UNESA must have insight into the future, by changing the mindset and governance system from depending on government budgets and routines, to entrepreneurial universities[6] and running a good governance system. Therefore, UNESA's institutional and academic orientation in the future must also change from a teaching-based university[7][8] to an entrepreneurial-based university, which can play a role both at the national and international levels. To prepare

UNESA going forward toward the vision and mission, it is necessary to produce academic papers which provide an explanation of concepts, paradigms, policy directions, strategic goals, and milestones for each Strategic Plan (Renstra) in stages, continuously and holistically in the form of a Long Term Development Plan (RPJP) UNESA 2022-2045. This important document is intended as a reference for mapping the direction and basis for UNESA's future development strategy. UNESA as an academic industry[9] must immediately change the institutional orientation from a teaching-based university and a research-innovative-based university to an entrepreneurial-based university. This effort is used to change the academic process which has been consumptive to be productive[10][11].

This research aims to develop a research and community service roadmap at UNESA to improve the quality of governance and efforts to increase institutional competitiveness in supporting programs at UNESA. Institutional studies are urgently needed to integrate the

existing human resource strengths in each unit, strengthen institutions, achieve academic quality standards, and internationalize institutions.

2. LITERATURE STUDY

UNESA's research and community service roadmap does not stop at achievements, patents, intellectual property rights, and/or publications. Research and community service that moves from fundamental to development are directed downstream and commercialized to support UNESA academic activities based on entrepreneurship[12][13][8]. Even so, this still has to guarantee scientific autonomy in the implementation and development of the field of research and community service within UNESA. UNESA development stages can be seen in Figure 1.

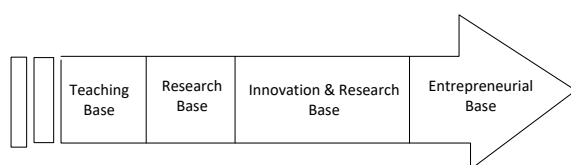


Figure 1. Surabaya State University Development Base

In addition, the development of harmonious and synergistic research collaborations between UNESA researchers both with the industrial world (DUDI)/relevant agencies in the country as well as research collaborations with foreign countries through collaborative research which will result in joint publications between UNESA researchers and foreign researchers.[14][15].

The stages of achieving the five-year UNESA Vision-Mission target for 2022-2045 can be seen in Figure 2

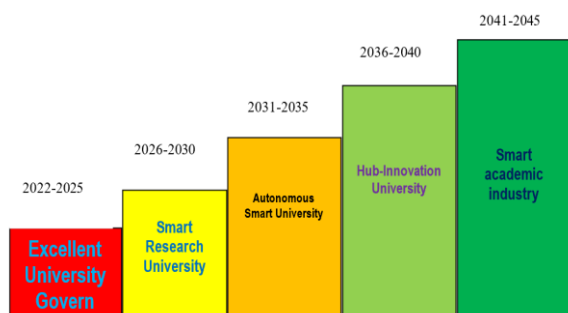


Figure 2. Stages of Achievement Target Vision - Mission UNESA five years 2022-2045

Engaging research to improve the quality of innovation from an entrepreneurial standpoint may be accomplished in a variety of ways. [7]:

a. Increasing the quality and quantity of research to produce and improve the quality of innovation in educational and non-educational fields with entrepreneurial orientation.

b. Improving the quality and quantity of publications, as well as innovating entrepreneurial-oriented educational and non-educational works in reputable media and increasing the number of copyrights (PATEN/HAKI)

c. Strengthening downstream innovative products as an academic-based industrial development effort.

d. Increasing collaborative research (joint research and innovation), consortium research both domestically and abroad with joint production outputs of PATEN/HKI, and joint publications both at conferences and publications in international journals

e. Design and implement a comprehensive and integrated repository system to support research activities and support the achievement of UNESA internationalization

f. Institutional strengthening and management of the Center for Science and Technology Excellence (PUI) and Science Techno Park (STP) as media for transforming research results into innovative entrepreneurial-oriented products

g. Strengthening the management of business incubators and start-ups as a place to prepare young entrepreneurs for students.

Doing community service to disseminate innovations with an entrepreneurial perspective for the welfare of society

a. Strengthening the quality and quantity of community service that is oriented towards producing innovation in the educational and non-educational fields with an entrepreneurial perspective.

b. Increasing the quality and quantity of coaching in the context of developing innovation in educational and non-educational areas with entrepreneurial orientation.

c. Increasing the quality and quantity of productive collaboration with educational and non-educational stakeholders and entrepreneurship.

The current global trend is innovation as a driving force for the progress of the nation in the 4.0 era. Changes in the knowledge production process: namely creativity, collaboration, and co-creation. The complexity of the problem can encourage a multidisciplinary approach. UNESA was appointed by the ministry as an independent group of higher education institutions in research management. So UNESA should have a research policy direction. The research roadmap includes research activities that have been carried out by the proposer

several years earlier on this topic, research planned in this proposal, as well as research direction plans after the proposed activities are completed [8]

3. METHODOLOGY

This research is from a micro perspective using the 4D development research model. 4-D development model by Thiagarajan. The 4D development model consists of 4 main stages, namely: Define, Design, Develop and Disseminate as shown in Figure 3.



Figure 3. Four steps of the research stage

There are 4 steps to be applied in this research. The research started from the definition stage by compiling the instruments needed in the research, namely instruments to capture aspirations regarding UNESA's research direction to the Dean and Director of UNESA's environment. In the design phase, an analysis was made of the views of the deans and directors. The third stage is product development, namely developing a research roadmap and PKM. The next roadmap was tested early by 2 experts. Input from experts is used as input in making revisions. The final stage of dissemination is by holding a research results seminar.

The output of this research is in the form of a research roadmap blueprint and PKM UNESA. The product has been tested by experts and given seminars in the current year and is ready to be used as a guide for research and PKM at UNESA. Additional outputs are in the form of academic research papers and PKM which are recorded.

4. RESULT AND DISCUSSION

This research begins with the define stage, by conducting a needs analysis by looking at the roadmap or research strategic plan and PKM in the faculty. The search results for the roadmap or strategic plan for each faculty are as follows. Researchers also examined research roadmaps from other universities, in addition to faculty research roadmaps. Research in the last 5 years has experienced very significant developments. Many lecturers and students compete in carrying out research and community service, and there are even research results that have received appreciation from the Ministry of Research, Technology, and Higher Education. Based on the results of the 2016-2018 higher education research performance assessment as outlined in the Decree of the Inspector General for Strengthening Research and Development Number B/5678/EI.2/H.M.00.03/2019 dated 13 November 2019 concerning Clusters or groupings of research-based Higher Education Institutions for 2016-2020, UNESA rose to become an

"independent" cluster which was previously a "main" cluster. This achievement will continue to be improved by increasing the quantity and quality of research, research funding, and research outcomes.

LPPM UNESA has formulated UNESA's leading research fields to accommodate research by lecturers, students, and education staff. There are 6 fields, namely Sports and Health Sciences; disability; Art and culture; science and Technology (Saintec); social humanities, and Education. This flagship research will be able to accommodate all the competencies and research roadmaps of the UNESA academic community so that each academic community can develop its expertise and competence in the research field. In addition, UNESA has also established a science and technology center of excellence (PUI) which will become UNESA's trademark and trademark namely sports science; Arts, and Disabilities.

The research strategy in terms of quantity for basic research is to decline because this research is expected to rise to applied research, applied research to development research, and so on, while applied research, development research, and commercialization increase significantly. The movement of applied research to research development or commercialization cannot be as fast and as large as basic research because it is constrained by the obligation to have distribution permits and partners. In this case, the UNESA Business Incubator Center (PIBT) must take on the role of increasing cooperation between Researchers and DUDI (Business World and Industry), including MSMEs. With these efforts, it is hoped that in the future the acquisition of development research will continue to increase. Apart from collaborating with DUDI, cooperation is also carried out with various stakeholders nationally and internationally. Joint research with foreign countries also needs to be improved, especially to initiate the acceleration of UNESA to become a world-class university.

The implementation of the Tridharma of Higher Education at UNESA by the academic community which includes lecturers and students must adhere to the basic principles of scientific truth. These basic principles must also be put forward in conducting research activities to achieve high quality. In carrying out research activities, every academic community must pay attention to academic ethics and including bioethics, especially in carrying out research activities related to human, animal, plant, microorganism, and environmental health. In addition to the basic principles mentioned above, UNESA research activities must comply with operational principles in the field and can be immediately adopted by the community. Research activities are carried out, among others, to produce scientific publications, innovations, technology packages, systems, models, and

Intellectual Property Rights (IPR). The results of the research must be immediately disseminated to the public, both nationally and internationally. The results of research that are applicable and field-oriented must be immediately conveyed to the interests of the community which includes universities, government agencies, and partners from DUDI circles. The process of disseminating research results as community service activities can be carried out in various collaboration models with related partners. Collaborative models with related partners can provide positive feedback on improving research and education implementation processes. The operational principle of implementing UNESA research in the community is carried out in various forms of action activities. The collaboration model referred to can be in the form of professional cooperation or business partnerships that are mutually respectful and mutually beneficial for UNESA and UNESA partners

The second stage is to develop or develop a research roadmap and PKM. The roadmap was developed after examining roadmaps and research strategic plans and PKM faculties, as well as roadmaps for other universities, such as ITB and UGM. The roadmap is prepared over 25 years. It is hoped that this time will be able to provide adequate results. In 2021-2025 it is expected that UNESA's PUI along with 3 other UNESA leading research fields, namely science, technology, social humanities, and education, will conduct research that leads to development research, namely conducting research product legality so that it can be commercialized and can serve as a pilot for building a Science Techno Park (STP) or Science and Technology Park. STP is an integrated area that combines the world of industry, higher education, research and training centers, entrepreneurship, and central and local government, in one location that enables the flow of information and technology to be more effective and efficient. In STP, the research carried out will be developed and grown in the form of a technology-based start-up company (spin-off). Thus, an innovation ecosystem is formed consisting of academics, business people, government, and society.

In developing innovation, UNESA collaborates with various parties by providing real benefits to society both nationally and internationally. In the field of collaboration, UNESA opens wide the doors of strategic cooperation with the industrial world, both domestically and abroad, including also conducting joint multi-campus research within ASEAN. To realize this, it is targeted 80 lecturers will become research leaders who can produce patent articles and can implement their research results towards commercialization.

In 2026-2030 it is hoped that UNESA will become a reference for applied research and PUI development as well as 3 other leading research fields where UNESA's research leads to smart research (based on Artificial Intelligence) and develops teaching factors at UNESA so that it is hoped that the process of commercializing innovative products will continue to develop and collaborate on research with multiple campuses throughout Asia

In 2031-2035 UNESA has become a reference for applied research and development of PUI as well as 3 other leading research fields where UNESA's research leads to smart research (based on Artificial Intelligence) and develops the teaching industry at UNESA so that it is hoped that the process of commercializing innovative products will continue to develop and collaborate research with multi-campus in continental Europe. The teaching industry is an institutionalized research, development, and innovation activity with a collaborative business model between universities and the industry. The goal is to enhance learning and research. With this teaching industry, it is hoped that it can increase the capacity and capability of higher education institutions to be able to produce R&D products and innovations for the real business world industry. In addition, it is also expected to be able to increase the level of industry performance through the effective use of research expertise from academic resources.

In the context of UNESA's development as a PTNBH in 2036-2040, UNESA also conducts comparative study activities for entrepreneurship management and business incubation which were developed as a step towards establishing and developing a holding company that will later manage UNESA's assets. The initial steps taken for the development of business units were initiated from existing assets in tertiary faculties. With the pilot development of corporate and multi-holding companies, business activities, business incubation, and entrepreneurship in Higher Education can develop so that they can become business models and best practices so that they can become references, especially in the field of PUI and 6 leading fields of UNESA research. To develop this, it is hoped that UNESA will collaborate with various

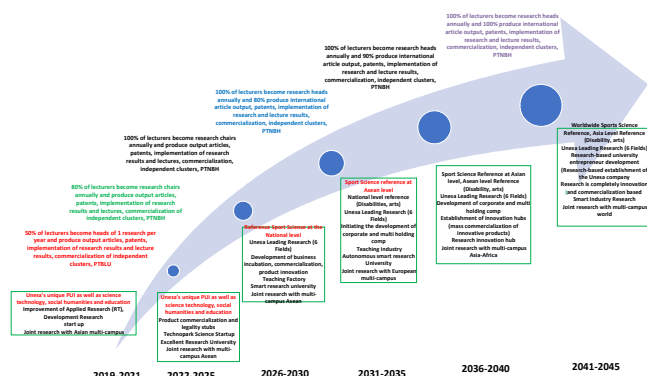


Figure 4 UNESA Research Roadmap Draft

parties from within and outside the country to cover the Asian region.

In 2041-2045 sports science is a world-class reference. Meanwhile, the leading research on disability and art is a reference for the Asian level. Supported by 6 national research excellence. To become a productive country, we must be able and independent in terms of mastering science and technology. This is where the role of research is needed and for this, our country must increase the quantity and quality of its research. Entrepreneurship is a mindset that uses creativity and innovation to boost the economic value of a product or the results of research or invention.

It is this research-based entrepreneurship that can change Indonesia from a consumer country with minimal added value to a productive country with high added value and ultimately have an impact on increasing people's welfare. Universities must change their vision and mission from just learning universities or research universities to becoming entrepreneurial universities, namely universities that apply the results of their research for the benefit of the business world or the wider community.

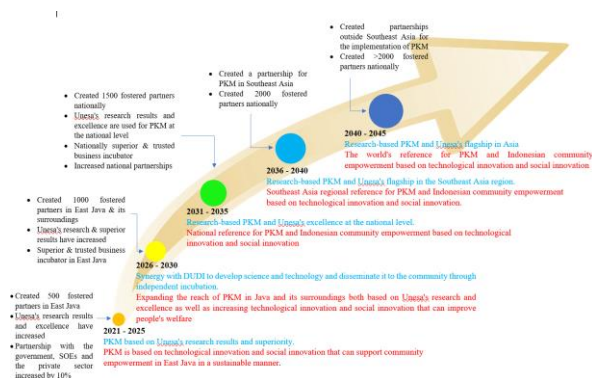


Figure 1 UNESA Community Service Roadmap Draft

Community Service Activities at UNESA in 2021-2025, are downstream activities of research results and superior research carried out by UNESA lecturers. Downstream in the form of community service will further strengthen UNESA in the eyes of the community as a university that cares about and supports government development programs in community empowerment.

Community Service activities at UNESA do not only focus on research results but community service activities are also based on problems faced by society socially, economically, and culturally. Therefore, technological and social innovations are increasingly being enhanced to address existing problems in society.

Through Community Service activities based on excellent research and research as well as innovation in the technological and social fields, it is hoped that 500 fostered partners will be created such as villages,

communities, and UMKM / IKM who continuously collaborate with UNESA. In addition to these partners, it is hoped that there will be an increase in cooperation with BUMN and the private sector both in the implementation of community service and the use of UNESA research and innovation days.

In the 2026-2030 period, UNESA as a PTN BH will enter 5 years. It is hoped that this year's Community Service activities at UNESA will involve a lot of DUDI. DUDI wants to work with UNESA to develop science and technology and disseminate it to the community through UNESA's independent incubation. Optimizing this business incubation can develop well if it is supported by stakeholders such as DUDI. The more DUDI collaborates with UNESA incubators, the more superior and reliable UNESA incubators are.

It was also during this time that UNESA's community service activities expanded their reach. Community service activities are not only carried out in East Java but also reach out to partners around East Java. This activity remains based on UNESA's research and superiority as well as increasing technological innovation and social innovation that can improve people's welfare. It is hoped that community service activities in 2026-2030 will create 1000 fostered partners in East Java and its surroundings.

Community Service Activities in 2031-2035 based on UNESA research and excellence should also be carried out at the national level. If in 2026-2030 it is still in East Java and its surroundings, then in 2031-2035 Community Service activities will be carried out in areas in Indonesia.

The increasing number of UNESA Community Service activities carried out at the national level will make UNESA a national reference for PKM and Indonesian community empowerment based on research, excellence, technological innovation, and social innovation. The scope of this national Community Service activity will further emphasize UNESA's research results and excellence at the national level and receive national recognition, that UNESA is capable of being a solution to the problems faced by the people of Indonesia.

It is hoped that in the 2031-2035 period, 1,500 fostered partners will be created nationally. Along with community service activities nationally, it is hoped that business incubators will also receive national recognition. In addition, UNESA's cooperation with national institutions has increased sharply. superior & trusted nationally

In 2036-2040 UNESA began to think about its work in Southeast Asia in utilizing UNESA's research and excellence for community service activities in Southeast

Asia. If this activity is carried out more and more, it will have an impact on UNESA's name in the eyes of the people of Southeast Asia. Community service activities carried out by UNESA both at the local and national levels are expected to be a reference for universities or other institutions in Southeast Asia in community service.

In 2036-2040 it is hoped that 2,000 nationally fostered partners will be created who can become examples for the people of Southeast Asia. In addition, to support community service activities in Southeast Asia, a partner is needed who can help carry out these activities.

In 2040-2045 UNESA community service activities are not only carried out in Indonesia and Southeast Asia but have reached areas outside Southeast Asia. Of course, this activity would not have been realized if it had not collaborated with world institutions or multinational companies. Therefore, increased cooperation with related parties must be increased.

In 2040-2045 it is expected that there will be an increase in the number of fostered partners from 2000 partners to 2000 fostered partners. These fostered partners are expected to be examples of UNESA's success in managing community service activities in Indonesia. So that UNESA can be a reference in managing community service.

4. CONCLUSIONS

Priorities, themes, and research focus at UNESA cannot be separated from the 2017-2045 National Research Master Plan (RIRN) following Presidential Regulation of the Republic of Indonesia Number 38 of 2018, that there are 10 priority research areas, namely food, energy, health, transportation, product engineering, defense and security, maritime affairs, social humanities, advanced materials, and other research fields. Of the 10 focuses, UNESA determined 6 national leading research namely leading research in the fields of sports and health, arts and culture, disability; science and technology; social humanities, and education. Three of the six areas of focus, namely sports science, arts, and disability, are UNESA's mainstays.

In accordance with RIRN, UNESA's research and community service roadmap was also prepared from 2020-2045. At the end of the research roadmap, in 2041-2045 sports science will become a world-class reference. Meanwhile, the leading research on disability and art is a reference for the Asian level. Supported by 6 national research excellence. To become a productive country, we must be able and independent in terms of mastering science and technology. This is where the role of research is needed and for this, our country must increase the quantity and quality of its research. Entrepreneurship is a

mindset that uses creativity and innovation to boost the economic value of a product or the results of research or invention. It is this research-based entrepreneurship that can change Indonesia from a consumer country with minimal added value to a productive country with high added value and ultimately have an impact on increasing people's welfare. Universities must change their vision and mission from just learning universities or research universities to becoming entrepreneurial universities, namely universities that apply the results of their research for the benefit of the business world or the wider community. PKM in the 2040-2045 period is expected to increase the number of fostered partners, from 2000 partners to 2000 fostered partners. These fostered partners are expected to be examples of UNESA's success in managing community service activities in Indonesia. So that UNESA can be a reference in managing community service

AUTHORS' CONTRIBUTIONS

In this article, Darni contributes to writing, SEC as editor, LS and NN contributes to analyzing the data.

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EFFECT OF HOLES IN THE FEMORAL STEM MADE OF Ti6Al4V ON THE STRENGTH OF THE MATERIAL

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Abstract

The hip joint or hip joint is a very important joint in the human skeletal system because it is the connection between the legs and the body. Stage joints often experience damage caused by many factors. Damage to the hip joint usually causes the patient to have to use an artificial hip joint or what is usually called an artificial hip joint. Hip Prosthesis takes into account the anatomical shape in terms of patient size. The focus of this research is modeling the femoral stem using Ti6Al4V titanium material through simulation software. Analysis of variables in the form of offset length, stem length, hole and magnitude of force on the implant. The results of the stress analysis simulation can be concluded that the femoral stem design in terms of the largest Von Mises stress distribution is size 7 at 448.4 Mpa. The greatest strain in femoral stem size 3 is $1.672 \cdot 10^{-3}$. The largest total deformation in femoral stem size 7 was 1.768 mm.

Keywords: *Hip joint, hip prosthesis, femoral stem, Von Mises stress*

Introduction

Osteoarthritis (OA) is chronic inflammation of the joints caused by damage to cartilage which causes the joints to feel painful, stiff and swollen. This disease can attack all joints, but most often occurs in the joints of the fingers, knees, hips and spine. Hip osteoarthritis is a type of inflammation of the hip joint (ball-and-socket joint) with the femoral head. One way to treat hip osteoarthritis is by replacing the implant material in the hip joint by an orthopedic doctor, which is called a hip prosthesis.

The artificial hip bone consists of an acetabular and femoral system. The acetabular system consists of the acetabular shell and acetabular liner, while the femoral system consists of the femoral head and femoral stem. Various combinations of materials, such as metal, ceramic, and polymer are the materials used to manufacture hip implants. Biomaterials are materials that have direct contact with biological systems in living creatures. These materials must have characteristics, including not having a negative impact on the body, having good corrosion resistance, and having good strength, especially physical strength and toughness [1].

The materials that are widely used for these components are mostly acetabular liners using UHMWPE, while the acetabular shell, femoral head and femoral stem use Ti6Al4V, CoCrMo or 316L stainless steel alloys. Permanent damage to the hip joint due to calcification, aging or accidents requires artificial hip joint replacement or what is usually called artificial hip joint replacement [5]. In developed countries, the number of

patients using artificial hip joints is very large. On the European continent there were 600,000 cases of artificial hip joint replacement in 2005, then there were also 230,000 cases found in America in 2004 and at least 150,000 cases were found in Japan over the last few years. Therefore, this research is needed to model a femoral stem that is suitable and tough for patients. To obtain a femoral stem that has low metal stiffness and does not have much effect on the maximum stress, a hollow femoral stem is designed. Porous metals have lower stiffness than solid implants [2].

Simulation is needed to analyze the performance of the model that has been created. One technique that is often used for simulation is using the finite element method (FEM). Analysis using FEM is very useful to determine the effect of changes in parameters such as load, speed, geometry, material properties and others. FEM analysis was carried out because the femoral stem model was quite complex so it would be very difficult to calculate manually. By carrying out FEM simulations, it can be seen whether the femoral stem is safe to use under loading conditions.

Table 1. Types of Materials and Their Applications [3]

Material	Superiority	Weakness	application
Metal: stainless steel, titanium alloy, cobalt-chrome	Strong, tough, tenacious	Non bioactive	Orthopedic implants, dental implants, artificial

alloy, etc			joints, heart rings (stents), etc
Ceramics: zirconia, alumina, bioglass, Hydroxyapatite	Bioactive, inert	Brittle	Orthopedic implants, dental implants
Polymers: nylon, polyactide, polyethylene, polyester, etc	Bioactive, elastic	Not strong enough	Blood vessel grafts, suture threads, sockets, artificial joints, etc
Composite: amalgam, fiber reinforced bone cement, etc.	Custom made.	Relatively difficult to make.	Bone cement, dental resin, etc

Method

This research focuses on the design of a hollow femoral stem that suits the patient's anatomy. The femoral stem geometry is in accordance with Indonesian anatomy with 3 main parameters, namely CCD angle (centrum-collum-diaphysis angles), stem length, and offset.

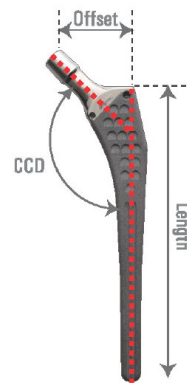


Figure 1. Femoral Stem [7]

Femoral Stem Modeling

The results of modeling for various femoral stem sizes can be seen in the image below.



Gambar 2. Femoral stem

Material Selection

This research uses titanium material Ti-6Al-4V. The composition of titanium Ti-6Al-4V is 90% titanium atoms, 6% aluminum atoms, and 4%

vanadium atoms and is included in the classification of titanium alloys which have an alpha-beta phase. Providing holes in the femoral stem design aims to reduce the material used and reduce the stiffness of the metal. The results of the femoral stem modeling can be seen in Figure 2. Using 3 femoral stem sizes, namely size 3, 5 and 7 [6], the load simulation was then analyzed. By using a load variation of 700 N, the femoral stem stress distribution,

Discussion

Modeling and simulation of femoral stem using Ti6A14V material with static loading. The simulation is carried out statically. The load used for patients weighing 700 N. The output results from the overall simulation are von Mises stress,

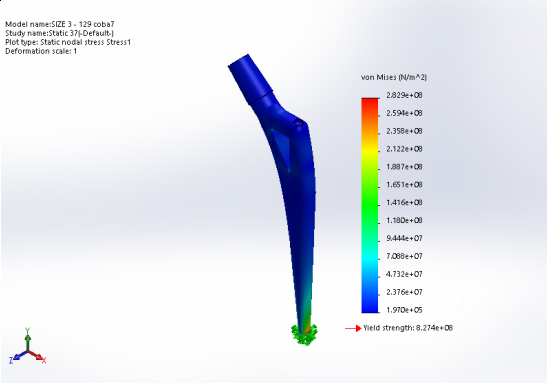
strain and total deformation will be known and analyzed.

Tabel 2. Mechanical Properties Material

Titanium Ti6A14V			
Properties		Unit	Titanium Ti6A14V
Yield strength		MPa	1100
Ultimate	tensile	MPa	1170
strength			
Modulus of elasticity		GPa	114
Poisson ratio		-	0,33

strain and displacement values in the form of images. Based on the results of the hip prosthesis simulation, maximum von Mises stress and strain data were obtained with the steam body concentration area at the bottom as can be seen in the table below.

Table 3. Results of analysis of Maximum Von Mises Stem Stress with a load of 700 N

Size Femoral Stem	Von Mises (Mpa)	Stress Distribution
3	282,9	 Model name: DE 3 - 128 cobas7 Study name: Static 371 (Default) Plot type: Static modal stress (Stress1) Deformation scale: 1 von Mises (N/m²) 2.829e+08 2.594e+08 2.358e+08 2.122e+08 1.887e+08 1.651e+08 1.416e+08 1.180e+08 9.444e+07 7.088e+07 4.732e+07 2.376e+07 1.970e+05 → Yield strength: 8.274e+08

5	161,9	Model name: SIZE 5 - 137 cobra 5 Study name: Static 3 5-137(Default) Plot type: Static nodal stress (Stress1) Deformation scale: 1
7	448,4	Model name: SIZE 7 - 145 cobra 5 Study name: Static 1-145(Default) Plot type: Static nodal stress (Stress1) Deformation scale: 1

Table 4. Stem strain analysis results with a load of 700 N

Size Femoral Stem	Strain	Strain Distribution
3	$1,672 \cdot 10^{-3}$	Model name: SIZE 3 - 129 cobra 5 Study name: Static 37(Default) Plot type: Static strain (Strain1) Deformation scale: 1
5	$1,060 \cdot 10^{-3}$	Model name: SIZE 5 - 137 cobra 5 Study name: Static 3 5-137(Default) Plot type: Static strain (Strain1) Deformation scale: 1

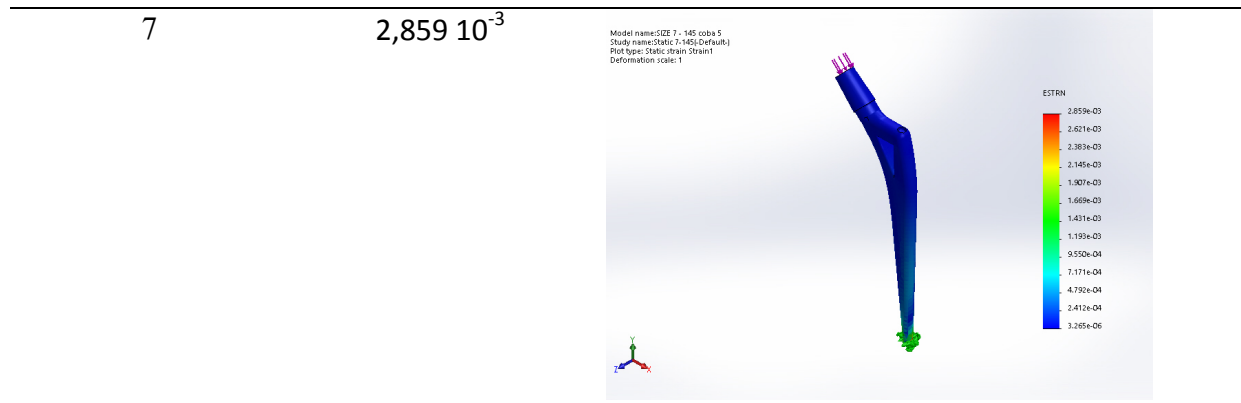
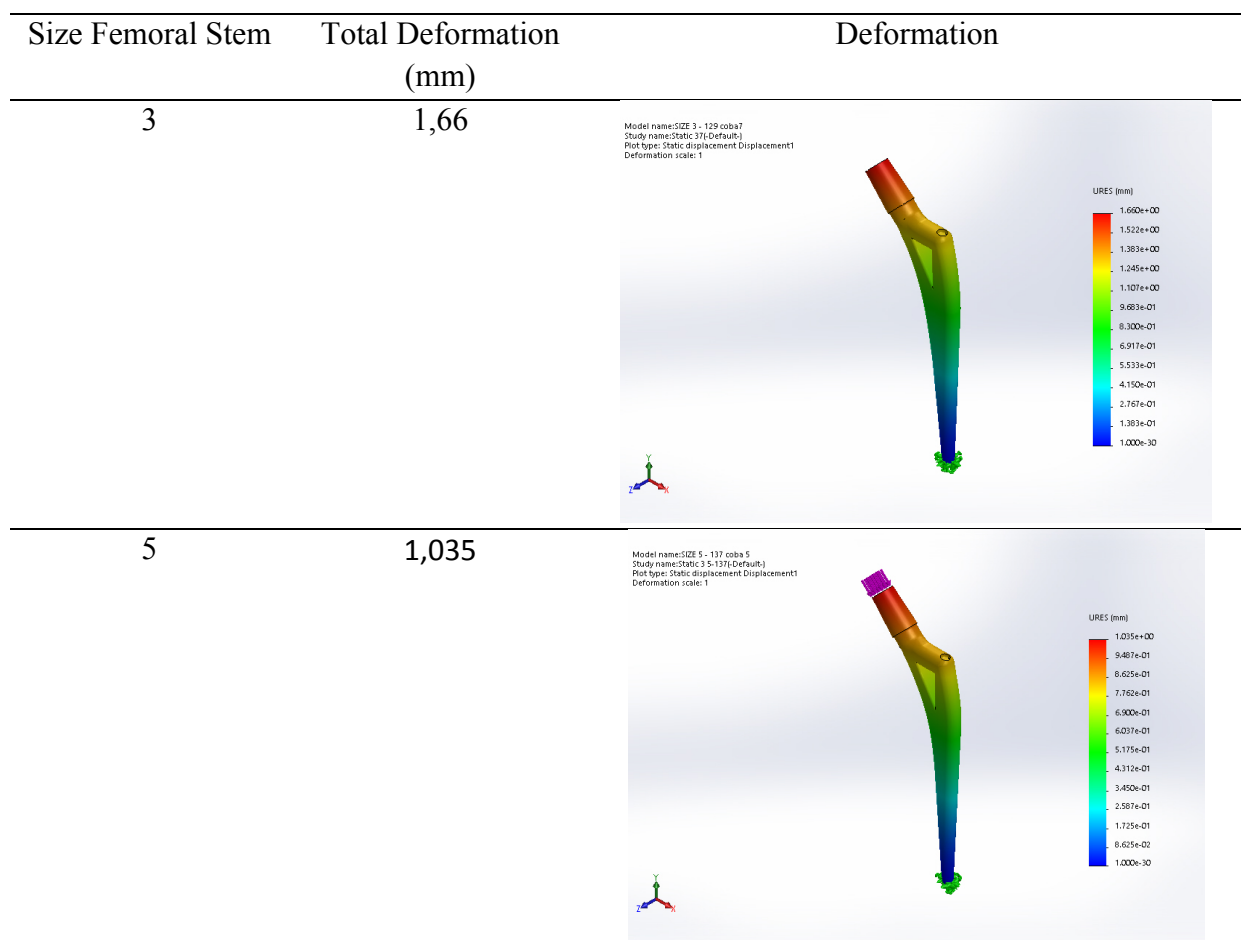
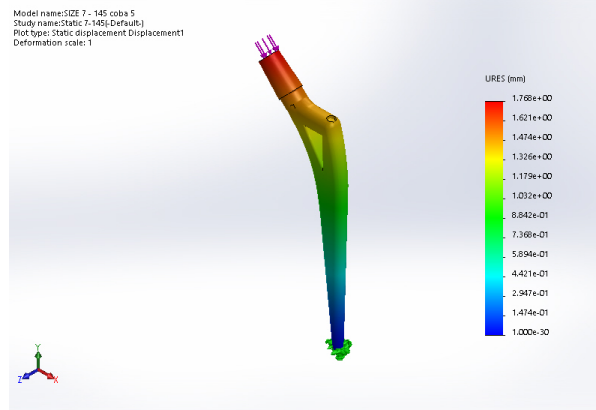


Table 5. Results of Total Deformation analysis with a load of 700 N





The figure above shows that the maximum von Mises stress on the femoral stem tends to be stable and does not change much for various sizes. Among these sizes, the largest von Mises stress occurs in size 7 at 448.4 MPa. Providing a hole in the femoral stem causes the larger the size, the greater the von Mises stress and total deformation. . If viewed based on the area that experiences deformation under all loads, it shows that the neck area of the femoral stem experiences maximum deformation.

Conclusion

1. The results of the stress analysis simulation can be concluded that the femoral stem design in terms of Von Mises stress distribution is the largest in size 7 at 448.4 Mpa.
2. The largest strain in femoral stem size 3 is $1.672 \cdot 10^{-3}$.
3. The largest total deformation in femoral stem size 7 was 1.768 mm.

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Development of PLC Festo Module to Support Mechatronics Course in Department of Mechanical Engineering Unesa

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ABSTRACT

Equipment assistance in the form of a Festo PLC trainer obtained from Islamic Development Bank (IsDB) has not been optimized to support Mechatronics lectures because there is no module in the operation of the trainer. To answer these problems, the specific purpose of this research is to develop the Festo PLC module to support Mechatronics lectures at the Department of Mechanical Engineering, Faculty of Engineering, Universitas Negeri Surabaya (Unesa). The long-term goal to be achieved in this research is the realization of learning tools that can bridge the competencies possessed by students with the demands of the rapidly growing needs of the industrial world as an optimal debriefing effort for students who will later work as professionals in industry world. To achieve the above objectives, this research method uses the ADDIE model development (analysis, design, development, implementation, evaluation). The expected result of this research is that the Festo PLC module is declared suitable for use in mechatronics courses and gets a positive response from students so that it can improve their learning outcomes.

Keywords: *Module, Learning, Mechatronics, PLC Festo*

1. INTRODUCTION

The technological development of various production processes in the industrial world is progressing rapidly, of course this will have a consequence, that the workforce operating plants in the industry must meet adequate qualifications so that production runs optimally. This will be a challenge for institutions or educational/training institutions to continuously develop their learning patterns so that their students can be accepted according to the qualifications of the industrial world. Many advanced companies have implemented automatic control systems to support their production processes. Because this system has many advantages, namely the way it works is simple, easy to operate, easy to maintain, and efficient in supporting the production process.

Referring to the development of process technology in the industrial world, the Department of Mechanical Engineering at Unesa, especially in the Mechatronics course, the subject of PLC requires learning facilities and infrastructure in order to meet the demands of the industrial world. The form of effort that has been carried out by Unesa is cooperation with IsDB (Islamic Development Bank) which is a multilateral financial institution founded in 1975 by the Islamic conference

organization. One of the learning support equipment received was in the form of various Programmable Logic Controller (PLC) trainers from PT. Festo.

The main problem is that the Festo PLC trainer has not been used optimally in supporting learning. This is because there is no learning device in the form of a module as a guide for lecturers and students in operating the Festo PLC trainer. To answer these problems, in this study, a learning device in the form of a Festo PLC module will be developed to support Mechatronics lectures at the Department of Mechanical Engineering, FT Unesa. It is hoped that the results of this research will be able to bridge the competence of PLC control materials owned by students with the demands of the rapidly growing needs of the industrial world, especially from graduates of the Unesa Mechanical Engineering department who will later work as professionals in the industry.

Based on a research with the title "Development of a learning module based on festo fluidsims v4.2 as a teaching material for electropneumatic control systems" as a learning material for class XI students of Industrial Automation Engineering at SMKN 2 Depok. The results of the assessment of the feasibility level of the learning module include aspects of material, media and student

assessment as users. The results of the evaluation of the material expert component get a "very feasible" category with an average score of 3.23 from a maximum score of 4, then the average total score of the evaluation results of media experts is 3.12 from a maximum score of 4 so that it is included in the category "very feasible", the total score from the results of the initial field trial was 3.39 from a maximum score of 4 so it was included in the "very feasible" category, then the total score from the results of the operational field trial was 3.29 from a maximum score of 4 so that it included in the "very decent" category. [3]

According to research entitled "Development of the Omron CPIE PLC Practicum Module to Support Instrumentation and Control Courses in the Department of Mechanical Engineering Unesa". an average of 3.48 is included in the very feasible category from the aspect of material, design, and language. Then the results of the average student response get a value of 3.72 and the lecturer's response to the practicum module gets a value of 3.36 which is included in the very good category so that the module can be used as teaching materials to support instrumentation and control courses. [10]

According to research entitled "Development of the festo fluidsime software-assisted practicum module in the subject of electric motor installation at SMK Negeri 3 Jombang" shows that the results of his research for aspects of the validity of the Festo Fluidsim software-assisted practicum module are stated to be very good. valid with a rating of 91.01%. Then for the results of the research from the practical aspect of the practicum module, namely: (1) the teacher's response got a very good response with a rating of 97.20%, (2) the student's response got a very good response with a rating of 95.40%. The results of the study for the aspect of the effectiveness of the practicum module, namely the learning outcomes of the affective domain of students, were obtained from the average experimental class 87.10 and the control class 84.84, it can be concluded that the practicum module developed is feasible to use in terms of 3 aspects, namely aspects of validity, aspects of practicality, and aspects of effectiveness.[4]. According to the results of research the physical chemistry practicum guide developed is in the good category (3.2). The existence of the practicum guide can make it easier for students to achieve learning goals because learning becomes more well structured [7]. Referring to some of the results of the research above, the author will conduct research on the development of the Festo PLC module to support the Mechatronics lectures on the subject of PLC in the Mechanical Engineering department, Faculty of Engineering, Unesa.

2. METHOD

The development of learning tools in this study uses the ADDIE model. The ADDIE Model Learning Design is one of the interactive learning processes with the basic stages of effective, dynamic and efficient learning. The ADDIE (Analysis Design Development Implementation Evaluations) model originated from the concept of the Instructional Design Model and Theory for the US Army in 1950. Then in 1975 it was developed again by Florida State University for use in all US Armed Forces. Educational practitioners made several revisions and in the mid-1980s a more interactive and dynamic model emerged than the original. This model can then be used for various forms of product development such as learning strategies and methods, media and teaching materials. The ADDIE model can be used as a guide in building tools and infrastructure for training or learning programs that are effective, dynamic and support the performance of the training itself in several stages.

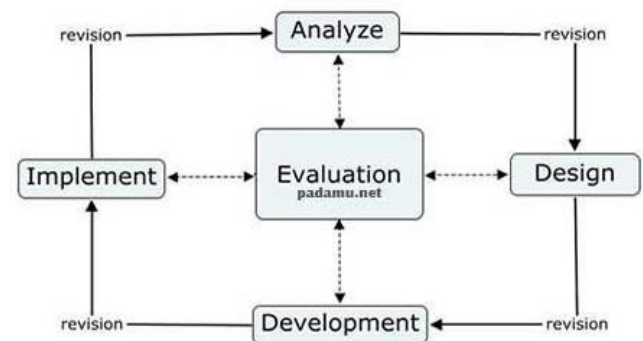


Figure 1 Schematic of ADDIE Model.

The ADDIE model of learning design scheme forms a cycle consisting of 5 stages consisting of: analysis, design, development, implementation and evaluation [8]

1. Analysis The design of the analysis phase focuses on the target audience. At the analysis stage, the definition of instructional problems, instructional objectives, learning objectives is carried out and identification of the learning environment and knowledge possessed by students is carried out.
2. Design The design phase is related to targeting, assessment instruments, exercises, content, and analysis related to learning materials, lesson plans and media selection. The design phase is carried out systematically and specifically.
3. Development During development, the creation and incorporation of content that has been designed at the design stage is carried out. In this phase, storyboards, content writing and graphic design are needed.
4. Implementation In this phase, procedures for training are developed for trainees and their instructors/facilitators. The training for facilitators includes curriculum materials, expected learning

outcomes, delivery methods and testing procedures. Other activities to be carried out in this phase include copying and distributing materials and other supporting materials, as well as preparing in case of technical problems and discussing alternative plans with students.

5. Evaluation Each stage of the ADDIE process involves formative evaluation. It is multidimensional and an important component of the ADDIE process. It assumes a form of formative evaluation in the development stage. Evaluation is carried out during the implementation phase with the help of instructors and students. After the implementation of learning is complete, a summative evaluation is carried out to improve learning. The designer of the entire evaluation stage must ascertain whether the problems relevant to the training program are resolved and whether the desired objectives are met.

3. RESULT AND DISCUSSION

3.1. Analysis

The analysis phase focuses on students. The analysis phase is the first phase that must be done. In this phase, the main concern for the designer is the target learner. There are three segments that must be analyzed, namely learners, learning, and learning media to deliver teaching materials. Student analysis is used to assess the level of cognitive, psychomotor and affective development of students who will use the developed practicum guide. The subjects of this study were undergraduate students of Mechanical Engineering, Department of Mechanical Engineering, FT UNESA class of 2020 who were 20 years old on average. The developmental stage of students is included in the formal operational stage (12 years to adulthood). At this stage, students have the characteristics of being able to think abstractly and purely, able to form concepts that are not dependent on physical reality and can solve problems through the use of systematic experimentation by applying the knowledge learned in everyday life. In studying the Mechatronics subject of PLC, students want an increase in cognitive, affective and psychomotor abilities that can be packaged in the form of practical activities on PLC applications. Therefore, a learning device is needed in the form of a PLC Festo practicum module to support PLC application practicum activities. [9]

3.2. Design

At this design stage, several things were carried out, namely: preparation of tests, selection of media, selection of formats, and initial design of the module.

1. Test Compilation, Learning outcomes tests are arranged based on indicators and learning objectives that are used to measure student success in teaching and learning using a direct learning model combined

with a problem-based learning model. Measurement of learning outcomes here is more emphasized on student self-assessment, an assessment that compares student competency achievements with previous ones, as recommended [11].

2. Media Selection, this activity was conducted to determine the appropriate computer-assisted media and trainer kits for conveying sensor material. The media used are as follows: a) Computer learning based The computer media used is a minimal set of computers/laptops/notebooks with a Corei3 processor with the Cx.Programmer application installed. b) Assisted learning based The learning aid used is an PLC trainer.
3. Preliminary Design of the module,
4. Format Selection: 1) The paper size used in compiling the module is A4 vertically. 2) Column (single or multi) proportional. The use of single or multi columns is adjusted to the shape and size of the paper used. 3) The sign or symbol used is easy to catch which aims to emphasize things that are considered important or special. The signs or symbols are pictures, tables, bold print, italics, etc.
5. Module Draft, The initial design activity of the module resulted in a draft of a practicum guide covering several aspects as follows. 1) The title of the module that describes the material to be included in the module; 2) Learning outcomes that will be achieved after completing studying the module; 3) The final ability that will be achieved after students study the module; 4) Learning indicators that will be achieved after students study the module; 5) Learning objectives to be achieved after students study the module; 6) Module material that contains knowledge, skills, and attitudes that must be learned and mastered by students; 7) Procedures or activities that must be followed by students to study the module; 8) Contextual-based tasks.

3.3. Development

At this stage of development, validation of the feasibility of the Festo PLC module is carried out. Based on the validation results, it shows that the average score of the 3 validators (technical, learning, and Indonesian language experts) is 3.65 which is included in the good category. Overall, it can be concluded that the sensor practicum guide developed is feasible to use.

3.4. Implementation

Trial implementation of the Festo PLC module in mechatronics lectures held in the odd semester 2022/2023 at the Department of Mechanical Engineering, State University of Surabaya. There were

10 students who were the subjects of the limited trial who programmed the mechatronics course in the study program bachelor of mechanical engineering education.

3.5. Evaluation

Student learning outcomes in the limited trial were measured using a performance appraisal sheet. Mastery of student learning is based on the minimum standard of completeness set by the Department of Mechanical Engineering, FT Unesa. The criteria for mastery learning individually is if it reaches a mastery value of at least 70 or 70%. Meanwhile, to determine student learning completeness classically, it is said to be complete if the percentage of students who get a minimum score of 70 is 85%. [12]

A test is conducted to determine the extent to which students can achieve the learning objectives. In this assessment, two tests were conducted, namely pretest (initial test) and post-test (final test) at each meeting. From the results of the initial and final tests, it can be seen that student learning outcomes have increased. In addition, the average test results from learning activities 1 to learning activities 3 showed that all students did not complete the pretest while at the posttest all students completed. For classical completeness in the pretest learning activities 1 to learning activities 3 is 0% while in the posttest it is 100%. Learning devices that are arranged in the form of modules are one of the factors that determine whether or not the learning objectives are achieved. Good learning tools will determine the quality of learning. The development of learning tools carried out by researchers is in accordance with social learning theory and Vygotsky's constructivism learning theory. Social learning theory suggests that most humans learn through observing and remembering the behavior of others. Meanwhile, Vygotsky stated that learning occurs through social interaction, through the help of teachers or peers who are more capable, specifically providing direction or scaffolding, namely providing support for learning and problem solving. This support can be in the form of instructions, warnings, encouragement, detailing the problem into steps, giving examples, or other actions that allow students to grow independently as learners.[1]

Data collection on the results of student responses to the use of the module is carried out after implementation of the developed module. Based on the results of student responses obtained through student response questionnaires. In the questionnaire, there are several questions based on the assessment of the response to the use of the module which consists of 3 aspects, namely, the display aspect, the material presentation aspect and the benefits. Based on the table above, it is known that the students gave a very good response. This can be seen from the average response value in each aspect. In the

aspect of appearance obtained an average of 3.65; the aspect of material presentation is 3.62 and the aspect of benefit is 3.62. If the results of the three aspects are averaged, it will get a value of 3.63 which is included in the very good category. It can be concluded that the developed module received a positive response from students.[2]

4. CONCLUSION

Based on the research that has been done, it can be concluded that: (1) based on the validation results from 3 validators, it shows that the average validation score is in the good category (3.65). It can be said that the developed module is feasible to be used to support mechatronics learning, (2) based on the test results, it can be said that learning is more effective with indicators that the positive response from students is enthusiastic in participating in learning, and (3) student learning outcomes have reached individual and classical completeness.

ACKNOWLEDGEMENTS

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Utilizing Recycled Evaporated Organic Solvent Waste for Green Chemistry in Chemical Laboratories to Reduce Liquid Waste

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ABSTRACT

The use of solvents, especially organic solvents in chemical laboratories, particularly in extraction processes, cannot be separated from laboratory activities. Since extracted organic solvents are not seen as having desirable qualities, they are not recycled and end up as liquid waste. The evaporation method was used to handle organic solvent waste from evaporation, and the evaporator exhibited the same physical and chemical characteristics as technical solvents. This study aimed to determine whether organic solvent waste from the evaporation process could be recycled and reused following the concept of green chemistry in laboratory waste treatment. The research method used in processing the recycled organic solvent waste (ethanol & methanol) from the evaporation was the experimental method through the evaporation process by evaporation and characterized based on the FT-IR and GC-MS test parameters on organic solvents pro-analysis and technical. Based on the results, the correlation coefficient analysis for testing the second recycled methanol- pro-analysis methanol, the second recycled methanol - technical methanol, and the second recycled ethanol- pro-analysis ethanol was quite strong, according to the results of the solvent characterization test of methanol and ethanol from the second recycling solvents by evaporation through the FT-IR test. Technical correlation values of 0.9982, 0.9983 and 0.9902. Meanwhile, the second recycled ethanol- pro-analysis ethanol had correlation coefficient value, 0.0079, was quite low. However, the second recycled solvent did not significantly differ from the technical solvent in the GC-MS test ($p > 0.05$).

Keywords: *Evaporation, laboratory, Liquid waste, Organic solvent*

1. INTRODUCTION

The Chemistry Laboratory is located in buildings C5 and C6, Faculty of Mathematics and Natural Sciences at Unesa, which serves instructors and research students. The amount of laboratory waste containing harmful and hazardous pollutants may rise as a result of lab activity. The majority of the waste produced is liquid waste from the remaining sample, practicum, or research reagents [1].

One of the sources of liquid waste from organic solvents created by the research and development process based on natural materials comes from the organic chemistry lab [2]. Secondary metabolites were frequently extracted from plants using organic solvents. Depending on the type of polarity group, organic solvents could be either polar or non-polar. Alcohol, ether, ester, ketone, and other substances consist of organic solvents [3].

The filtrate of the extraction was evaporated with an evaporator to obtained a thick extract. This process produced organic solvents left over from evaporation

that were not utilized and could eventually turn into liquid waste that could damage living things and affect the environment [2]. This was a big problem in the laboratory because waste treatment was expensive. Efforts to handle organic solvent waste were oriented towards the concept and approach of *green chemistry*.

A concept knew as "green chemistry" sought to solved environmental issues by using chemicals generated, procedures, or reaction steps. This concept was connected to a technique that minimized the usage and production of poisonous chemicals through both process and design considerations [4]. According to research conducted in 2021 [5], the results of recycling organic solvent waste through evaporation exhibited the same properties as technical solvents when measured using the parameters of FT-IR, and HPLC testing. This result indicated that organic solvents from recycled waste solvents from evaporation could be reused, particularly in the maceration process of natural materials.

Based on this background, the authors were interested in continuing to studied the recycling method

by evaporation and examined the stability of the quality of organic solvents from the second recycled waste solvent based on characterization by FTIR and GC-MS tests. The recycling of the evaporated solvent waste could be carried out continuously and following the orientation of *green chemistry* to reduce liquid waste in chemical laboratories.

2. METHOD

2.1. Tools and Materials

This research used the following tools: beaker, measuring cup, dropper, glass funnel, glass bottle, thermometer, Buchner funnel, vacuum pump (Comecta), analytical balance (Adventure), vacuum rotatory (Buchi R-300), FT-IR Spectrophotometer (Perkin Elmer), GC-MS (Perkin Elmer).

This research used the following materials: temulawak, recycled organic solvent waste from the first evaporation (methanol and ethanol), methanol pa, technical methanol, ethanol pa, technical ethanol, and aquades

2.2. Procedure of Research

This research was carried out for the processing of waste from the second evaporation of research students using methanol and ethanol organic solvents, obtained from the recycling of the waste from the first evaporation that was recycled and used for the maceration process [5]. The polar solvents methanol and ethanol used for maceration due to their great capacity to attract secondary metabolites in the sample and their affordable and economical were chosen.

The sample taken was the second evaporation waste which was previously carried out by the maceration process with the recycled solvent from the first evaporation waste. The resulting filtrate from the maceration process was added to a rotary evaporator. A thick extract, as well as the solvent from the rotary evaporator, would be created. We'll utilize this solvent as a sample. These samples will also be evaluated using FT-IR and GC-MS tests to compare the qualities of the second evaporation solvent waste recycling to pure solvents (pro analysis) and technical solvents.

1.3. Data Analysis

The recycling of the second evaporated solvent waste that had been processed by the evaporation method was compared with technical and pro-analysis (pa) solvents to determine the characterization of waste treatment results. Analysis was carried out using a comparative descriptive method for results of the FT-IR test and the t-test for the result of GS-MS test.

3. RESULT AND DISCUSSION

Organic solvents were chemicals often used in organic chemistry laboratories to extract natural materials. Vacuum rotary evaporator was used to separate the acquired extract from the solvent. According to research [5], processing organic solvent waste from evaporation was done using an evaporator that had similar physical and chemical properties to technical solvents.

The purpose of this study was to determine whether the results of recycling organic solvent waste from the second evaporation process could be reused so that it was following the concept of green chemistry in laboratory waste treatment. The solvent waste tested in this study was methanol and ethanol. So that organic solvent waste from the second evaporation process was recycled, the solvent waste was re-evaporated with an evaporator. The second recycled organic solvent was compared with pro-analysis and technical solvents through characterization with FT-IR and GC-MS tests.

3.1. FT-IR Testing

FT-IR (Fourier Transform Infrared) was a technique used to identify functional groups in materials (gas, liquid, and solid) using infrared radiation beams. IR spectroscopy applied to a wide variety of materials and conditions and could be utilized for qualitative and quantitative analyses. Infrared spectroscopy measures the absorption of IR radiation created by each bond in a molecule and as a result, reached a spectrum generally expressed as % transmittance versus wavenumber (cm^{-1}). Spectrum analysis was effective for identifying organic compounds, because of it was highly functional spectrum that absorbs infrared light at a unique frequency [6-7].

IR spectral data were collected from observations in the intact absorption region ($4000\text{-}550\text{ cm}^{-1}$). Figure 1-2 presented the infrared spectral pattern as a result of comparing the second recycled methanol solvent with pro-analyst and technical methanol gave almost the same absorption pattern. The quantitative magnitude of absorption in each wavelength was just marginally different. The spectral data in Figure 4 also presented the infrared spectrum pattern as a result of comparing the second ethanol solvent with technical ethanol. These spectral patterns gave rise to similar absorption patterns, with the only difference being the quantitative value of the absorbance of each spectrum. Meanwhile, Figure 3 showed the infrared spectrum pattern as a result of comparing the second recycled ethanol solvent with ethanol p.a, additional peaks indicated that the tested solvent contained contaminants.

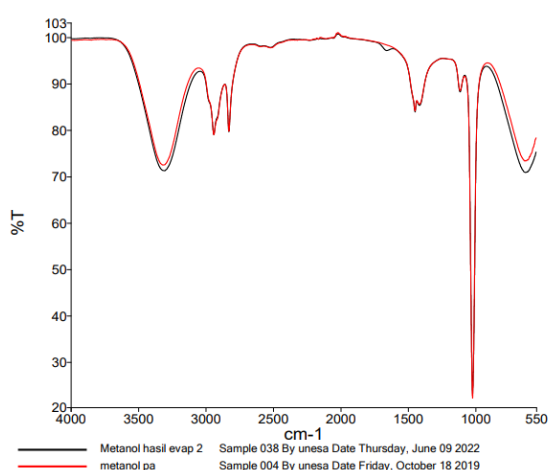


Figure 1 Spectrum IR of compering the second recycled methanol solvents with methanol p.a

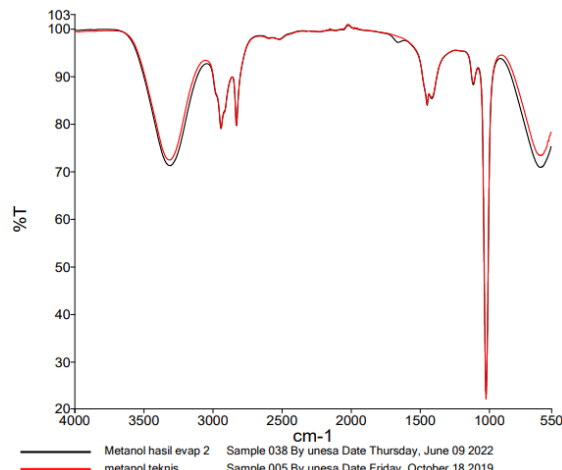


Figure 2 Spectrum IR of compering the second recycled methanol solvents with technical methanol

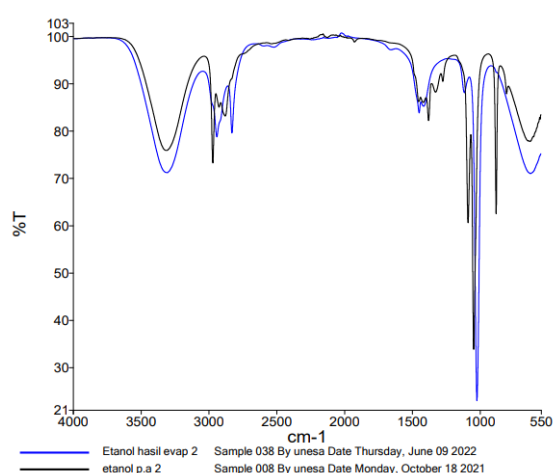


Figure 3 Spectrum IR of compering the second recycled ethanol solvents with ethanol p.a

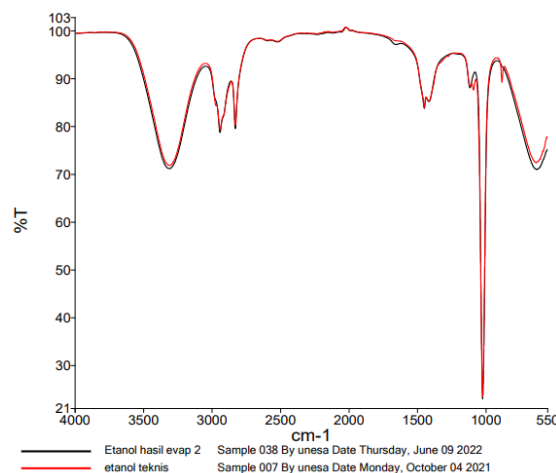


Figure 4 Spectrum IR of compering the second recycled ethanol solvents with technical ethanol.

The second recycled solvents from evaporation wastes were analyzed by FT-IR to saw the correlation coefficient of the functional groups based on the intensity of infrared light absorbed compared to the FT-IR spectrum of pro analyses and technical solvents. Correlation analysis was carried out to studied the closeness or strength of the relationship between the second recycled solvent, pro-analysis, and technical

solvents expressed by the correlation coefficient based on the IR spectrum. The correlation coefficient (r) was a value that indicated whether or not there was a strong linear relationship between two variables with values in the range -1 to 1. Correlation coefficient (r): strong $r = \pm 0.7$ to ± 1 , moderate $r = \pm 0.3$ to ± 0.699 , weak $r = 0$ to ± 0.299 [8]. The following correlation figures are presented in table 1.

Table 1. The results of the correlation coefficient analysis of the FT-IR test.

Type of Solvent	Sample	Correlation
Methanol	The second recycled methanol-methanol p.a	0,9982
	The second recycled methanol- technical methanol	0,9983
Ethanol	The second recycled ethanol-ethanol p.a	0,0079
	The second recycled ethanol- technical ethanol	0,9902

Whether it was a correlation to pro-analysis or technical methanol, it could be showed from table 1 that

the second recycled methanol solvent had a strong correlation coefficient value closed to number one. These findings suggested that the qualities and purity of

the second recycled methanol were essentially identical with pro-analysis and technical methanol. Similarly, the correlation coefficient between the second recycled ethanol and technical ethanol had a substantial value closed to number 1. These findings suggested that the second recycled ethanol qualities and purity were essentially identical with technical ethanol.

Meanwhile, the correlation coefficient value of the second recycled ethanol with pro-analysis ethanol was categorized as weak, because correlation coefficient value closed to number 0, different findings were displayed. These findings suggested that the second recycled ethanol qualities and purity were substandard or different from pro-analysis ethanol.

3.2. GC-MS Testing

Chromatography was a term used to describe a separation technique in which a mobile phase carrying a mixture was caused to move in contact with a selectively absorbing stationary phase. The principle of gas chromatography was adsorption and partition. Gas chromatography was used in the separation and analysis of multi-component mixtures such as essential oils, hydrocarbons, and solvents. GC-MS had become a highly recommended tool for monitoring and tracking organic solvents in samples [9]. The following was the percentage of solvent content in the second recycled solvent by GC-MS testing.

Table 2. Percentage of methanol content

Sample	% Methanol content $\pm$ SD
The second recycled methanol solvents	99,56 $\pm$ 0,35
The technical methanol	99,47 $\pm$ 0.55
$p = 0,450$	

Table 3. Percentage of ethanol content

Sample	% Ethanol content $\pm$ SD
The second recycled ethanol solvents	0.52 $\pm$ 0,01
The technical ethanol	0,66 $\pm$ 0,01
$p = 1,000$	

Based on table 2, there was no significant difference in the percentage of methanol content between the second recycled methanol and technical methanol using the independent sample t-test ($p > 0.05$). It could be argued that the second recycled methanol had a methanol content that was not significantly different from pro-analysis and technical methanol due to the high percentage of methanol content in each sample, which was close to 100%.

Based on table 3, there was no significant difference in the percentage of ethanol content between second recycled ethanol and technical ethanol using the t-test sample independent ($p > 0.05$). It could be argued that the second recycled ethanol had an ethanol content that was not significantly different from technical ethanol. The percentage of ethanol content in each sample was very low, below 1%. However, a low proportion of ethanol content revealed that both had low ethanol purity.

The low correlation coefficient value of the FT-IR test findings between the second recycled ethanol and pro-analysis ethanol of 0.00786803, which was near 0, supported the low ethanol content in both the second recycled ethanol and technical ethanol. This suggests that mixtures or impurities in the technical solvent employed in the first extraction procedure impaired the technical purity of ethanol. The ethanol concentration was impacted by contaminants like water that were present in ethanol. The fraud committed by ethanol

sellers was selling 96% technical ethanol added with water so that the concentration of technical ethanol traded to consumers decreases. This fraud was supported by the difficulty of distinguishing between technical ethanol with high or low concentrations because the density of ethanol (0.8 gr/cm³) [10] was close to water (1 g/cm³) [11], so it was impossible to distinguish only by eye observation.

The processing of liquid waste from used solvent evaporation was one of the efforts to approach the concept of green chemistry to realized safe and environmentally friendly laboratory activities by reducing the use and production of hazardous substances, preventing the formation of waste, and using renewable raw materials [12-13].

4. CONCLUSION

Based on the results of the solvent characterization test of methanol and ethanol from the second recycling by evaporation through the FT-IR test, it showed that the correlation coefficient analysis was quite strong for testing the second recycled methanol- pro-analysis methanol, the second recycled methanol-technical methanol and the second recycled ethanol-technical ethanol with a correlation value close to 1, namely 0.9982, 0.9983 and 0.9902. While the correlation coefficient value of the second recycled ethanol- pro-

analysis ethanol was relatively weak, namely 0.0079. Meanwhile, the GC-MS test did not showed a significant difference ($p>0.05$) between the second recycled solvent by evaporation compared to the technical solvent. The GC-MS test did not showed a significant difference ($p>0.05$) between the second recycled solvent by evaporation compared to the technical solvent. The purity of the second recycled ethanol solvent and technical ethanol was very low based on the percent ethanol content. The second recycled solvent using the evaporation method could be reused because it had the same characteristics as the technical solvent and was expected to reduced liquid waste from chemistry laboratories.

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SINBIONESA: Synbiotic Powder Made of Indigenous Microorganisms from Goat Digestive Tract with Rice Bran and Corn Flour Fillers

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ABSTRACT

This study aims to evaluate the quality of SINBIONESA produced to meet the probiotic quality of the SNI benchmark. Identifying potential probiotic bacteria isolated from a goat's digestive tract by using molecular analysis of the 16S rRNA gene was conducted. Selected isolates were observed and tested to identify potential bacteria as probiotics, including cell shape, gram methods, positive character test, negative character test, cellulolytic activity test, optimal pH, optimum temperature, acid resistance, and resistance to bile salts. The selected bacteria were formulated with a filler of 75% rice bran and 25% corn starch, then dried by freeze-drying. SINBIONESA quality was evaluated on the moisture content (by drying technique), the total number of probiotics (by total plate count), and the expiration period (linear regression formula). The results show that SINBIONESA has three potential probiotic bacteria: *Bacillus pumilus*, *Bacillus brevis*, and *Pseudomonas diminuta*. It has a water content of 2.89% with an expiration period at room temperature storage and cold temperatures of 1 year, four months, and two years five months, respectively. Based on these results, it is stated that SINBIONESA has met the SNI quality of probiotics in Indonesia.

Keywords: Prebiotics, probiotics, Symbiotic, Indigenous microorganism.

1. INTRODUCTION

Efforts to improve the efficiency of the livestock business continue to be carried out. In previous years, research has been carried out on the production of fermented feed made from raw hyacinth with a high nutritional content called fermege. This feed has been tested in goats with convincing results such as [1]. It has been shown to increase goat weight, improve carcass quality, increases the number of female goat cubs, and enhance the quality of male goat sperm [2-5]. Using fermented feed also decreases the manure odor intensity, which can help farmers save costs and effort for maintenance. The advantage of fermented feed must be caused by microorganisms in feed raw materials and work during fermentation. These microorganisms degrade the complex compounds contained in the feed into simple compounds that are more easily absorbed by the goat's digestive system. This combination will function as probiotics that positively impact their health.

The benefits of probiotics for humans, mainly the Lactic Acid Bacteria (BAL) group, have been proven to improve the health of the digestive system [6]. This benefit can also be applied to livestock, especially those classified as mammals, including ruminants. Empirical facts and theoretical studies become a solid background for conducting

research on the development of prebiotics, probiotics, and symbiotic for livestock based on indigenous microorganisms isolated from the manure of goats fed with fermented feed. In this study, a special symbiotic was developed for ruminants called SINBIONESA.

In the production of symbiotic, fillers are commonly used to fulfil the nutrients of the symbiotic bacteria. The filler used is generally an organic substance that meets several requirements, such as being resistant to the acidity of the gastrointestinal tract, can be fermented by the microflora of the gastrointestinal tract, and supporting the growth of these microflorae [7].

This study aims to evaluate the quality of SINBIONESA, which has been developed from several aspects following the SNI (Indonesian National Standard) for applicable probiotics. In addition, microorganisms must meet several requirements to function as probiotics. It includes being resistant to acidic and alkaline atmospheres in the digestive tract, can be attached to the mucosa or epithelial layer of the food digestive tract, having activity against pathogenic microorganisms in the digestive tract, and hydrolysis activity on bile salts [8]. Clinical trials are conducted to ensure the safety of probiotics, and the probiotic bacteria remain alive within the product's shelf life [9].

2. MATERIALS AND METHODS

This research is an exploratory study (to find potential bacteria as probiotics from the goat's digestive tract/feces) followed by experimental research (to determine the best filler composition). Bacteria from the digestive tract of the testing goat were isolated by the method of spread plate, then incubation and purification of isolates were carried out. Pure isolates were identified based on molecular analysis of the 16S rRNA gene to determine their species. Furthermore, observations were conducted each isolate to determine its potential as a probiotic. Isolates were observed and tested in several aspects, including their form (microscopic observations), bacterial gram identification, positive/negative character test, cellulolytic activity test (clear zone observation on CMC media coloured with Congo Red), optimal pH (measurement with pH meter), optimum

temperature (duplation with thermometer), acid resistance (in acidic media conditions) and bile salts resistance (on bile-stained media). The three selected isolates are then propagated to 1012 cells/mL and mixed with various filler formulas (three formulas), a combination of rice bran and commel. SINBIONESA powder is produced by the method of freeze-drying. The product is then evaluated in the aspects of water content, total probiotic bacteria content, and product expiration period at room temperature storage and cold temperature (ice cupboard), whose determination is carried out by the TPC (total plate count) method followed by a linear regression formula.

3. RESULTS AND DISCUSSION

The results of observations and tests of selected bacteria that have the potential to be probiotics are presented in **Table 1**.

Table 1. Diversity of goat digestibility indigenous bacteria that have the potential to be probiotics

Species	Form	Gram Identification	Positive Character Test	Negative Character Test	Cellulolytic Activity Test	Optimum pH	Optimum Temp.	Acid Resistance	Bile Salts Resistance
<i>Bacillus pumilus</i> (B1)	Rod-shape	Positive	Oxidase Motility Nitrate CMC Catalase ONPG Inositol Sorbitol	Amylum Lysine Ornithine H ₂ S Glucose Mannitol Xylose Indole Urease VP CitrateTDA Gelatine Malonate Rhamnose Sucrose Lactose Arabinose Adonitol Raffinose Salicin Arginine	Clear zone in CMC media 11,5 mm	6	38	Withstand pH of 5 to 6 hours with a decrease in the number of isolates of not more than 3 log units /mL	0.3% Bile salt resistance (w/v) with a decrease in the number of isolates not more than 3 log/mL units after 4-hour incubation

Species	Form	Gram Identification	Positive Character Test	Negative Character Test	Cellulolytic Activity Test	Optimum pH	Optimum Temp.	Acid Resistance	Bile Salts Resistance
<i>Bacillus brevis</i> (B4)	Rod-shape	Positive	Oxidase ONPG VP	Motility Nitrate CMC Catalase Inositol Sorbitol Amylum Lysine Ornithine H ₂ S Glucose Mannitol Xylose Indole Urease Citrate TDA Gelatine Malonate	Clear zone in CMC media 10,67 mm	6	40	Withstand pH of 5 to 8 hours with a decrease in the number of isolates of not more than 3 log units /mL	0.3% Bile salt resistance decrease in (w/v) with a decrease in the number of isolates not more than 3 log/mL units after 6-hour incubation
<i>Pseudomonas diminuta</i> (B5)	Rod-shape	Positive	Oxidase Motility Nitrate CMC VP	Catalase Inositol Sorbitol Amylum Lysine Ornithine H ₂ S Glucose Mannitol Xylose Indole Urease Citrate TDA Gelatine Malonate Rhamnose Sucrose Lactose Arabinose Adonitol Raffinose Salicin Arginine	Clear zone in CMC media 10,08 mm	5,8	39	Withstand pH of 5 to 7 hours with a decrease in the number of isolates of not more than 3 log units /mL	0.3% Bile salt resistance decrease in (w/v) with a decrease in the number of isolates not more than 3 log/mL units after 5-hour incubation

Three bacterial isolates, namely *Bacillus pumilus*, *Bacillus brevis* and *Pseudomonas diminuta*, were then formulated with three filler compositions and evaluated based on three SNI-based symbiotic parameters, water content, total

number of probiotic bacteria and expiration period.

The results are displayed in the **Table 2**.

Table 2 Water content of probiotic powder at various filler concentrations

Replicates	Formula		
	I (75% rice bran, 25% corn starch)	II (50% rice bran, 50% corn starch)	III (25% rice bran, 75% corn starch)
1	2.05	4.01	4.92
2	3.76	4.23	3.98
3	2.46	3.76	4.92
4	2.68	3.27	4.79
5	3.13	4.03	3.99
6	2.97	4.10	4.76
7	3.01	3.68	4.18
8	2.95	4.03	4.26
9	3.00	3.99	4.91
Average	2.89	3.90	4.52
Error standard	0.16	0.10	0.12
Standard deviation	0.47	0.29	0.41

It can be stated that formula I which contains 75% rice bran and 25% corn starch is the best formula because it has the smallest moisture content, thus making probiotic powders last longer.

From these results, formula I is become the basis of SINBIONESA that will be produced and evaluated for quality such as total number of probiotic bacteria and expiration period (**Table 3**).

Table 3 Total Place Count (TPC) SINBIONESA for determination of expiry date

Days	Number of colony CFU unit ($\times 10^{12}$)/gr			Average
	1 st round	2 nd round	3 rd round	
1	158	149	143	150
2	148	155	143	148.67
5	157	158	138	151
12	143	162	159	154.67
19	160	142	168	156.67
29	160	140	145	148.33
39	152	135	140	142.33
51	148	130	146	141.33
65	145	122	130	132.33
130	85	113	109	102.33
195	85	108	99	97.33
260	74	99	94	89

325	44	65	62	57
390	14	33	31	26

After 390 days (about 13 months), TPC was conducted and SINBIONESA still meets the requirements as an active probiotic (with SNI not less than 10^8 CFU/gr). It is shown that SINBIONESA, which was stored for 13 months at room temperature and cold temperatures, experienced a decrease in the total number of probiotics by 54.71% and 14.61%, respectively (Table 4). Storage at cold temperatures can extend the shelf life of SINBIONESA. Furthermore,

SINBIONESA was observed to expire after a storage period of 500.5062 days (about 16.68 months or 1 year 4 months) at room temperature and expire after a storage period of 910.3466 days (approximately (about 30.35 months or 2 years 5 months) at cold temperatures (ice cupboard temperature) (Table 5). Based on these data, SINBIONESA produced has met the SNI standard (minimum storage period of 3 months) from the aspect of the expiry period.

Table 4 Percentage decrease in the number of probiotics in SINBIONESA stored at room temperature and cold temperatures based on the linear regression formula.

Days	Room temperature storage		Low temperature storage	
	Total amount of probiotics	Decreasing amount of probiotics (%)	Total amount of probiotics	Decreasing amount of probiotics (%)
1	152.8	23.60	185.3	7.40
2	151.5	0.85	187.5	-1.19
5	149.8	1.96	184	0.70
12	152.3	0.33	184.3	0.54
19	151.3	0.98	184.5	0.43
29	149.3	2.29	181.8	1.89
39	144.3	5.56	180.3	2.70
51	139.8	8.51	175.8	5.13
65	133.8	12.43	168.8	8.90
130	101.5	33.57	159	14.19
195	96.5	36.85	148.3	19.97
260	88.5	42.08	135	27.15
325	56.3	36.38	121.8	9.78
390	25,5	54.71	104	14.61

Bacillus pumilus has been shown to be effective as a probiotic in poultry which shown to significantly increase the performance of vegetative growth in poultry [10]. Moreover, research related to the use of *Bacillus brevis* as a probiotic has also been widely carried out. It has been shown to be able to fight a number of pathogenic *Vibriobacteria* in fish, this bacterium can also synthesize proteins that are epidermal tissue growth factors [11-12]. The use of *Pseudomonas diminuta* as a probiotic has been carried out by Farizki et al (2020) mainly to degrade total organic matter, ammonia and total vibrio bacteria content often found in pond shrimp [13].

In SINBIONESA, rice bran or fine bran was chosen as a filler because it has high content of Non-Nitrogen Extract Materials (BETN) which crucial as an energy source. Furthermore, bran contains starch granules that can absorb up to 30% of water which will be tightly arranged and slightly permeable to water after drying. Based on this, it is hoped that the addition of fine bran fillers can reduce the hygroscopic properties of SINBIONESA. Moreover, it has been proven that snail flour filled with bran has produced flour of good quality [14]. And as a filler, bran is sufficient ingredient because it can fill the cavities of powder, as well as an additional nutrient.

Table 5 SINBIONESA expiration period at room temperature and cold temperature storage based on the linear regression formula.

Product	Room temperature storage (days)	Low temperature storage (days)
SINBIONESA	500.5062	910.3466

In addition to bran, another filler that has been chosen is corn starch. It was chosen because of its nutritional content that can meet the needs of microorganisms contained in SINBIONESA. The best fish meal has been produced using cornmeal

fillers [15]. Cornmeal is commonly used as a protector and filler in the pharmaceutical industry for tablets such as aspirin and other drugs. In SINBIONESA, cornmeal can also be a protector during the drying process. The selection of bran and corn flour fillers because it is affordable and easy to obtain which make SINBIONESA powder can be produced easily and adopted/adapted by the farming community.

After mixing microorganisms and fillers to form SINBIONESA powder, the mixture is then dried by freeze-drying. This method was chosen because it can maintain the number of viable microorganisms contained in the material being dried. This process is based on the sublimation process, the evaporation of water directly from its solid form carried out at low temperatures. Thus, the viability of microorganisms in the material is well maintained. SINBIONESA powder has several advantages compared to liquid SINBIONESA. It is more durable, easy handling and the risk of contamination when storage is low, unlike liquid SINBIONESA which need to be subcultures frequently. Liquid SINBIONESA is also easily contaminated which will affect its quality [15]. The quality of SINBIONESA powder is based on three most important parameters: water content, the total number of probiotics in the product and the length of shelf life or expiration. According to Rukmi, et al., (2005) the viability of microorganisms in SINBIONESA during storage is the most important aspect [16]. In this study SINBIONESA with the smallest water content, the total number of probiotics meeting SNI and its shelf life was the longest is the best. The shelf life of SINBIONESA determines the total number of microorganisms contained in it.

The results were obtained that the product with the smallest moisture content was SINBIONESA with the most amount of bran filler, namely formula I which contains 75% bran and 25% corn flour by 2.89%. SINBIONESA powder with the filling agent also has the best shelf life, namely during the storage period, it can still maintain a high number of microorganisms. Bran is a nutrient-

rich material such as protein, cellulose, lipids that are beneficial as suppliers of energy, carbon and cell-building compounds. Therefore, its presence in SINBIONESA powder in large quantities is very beneficial to the population of microorganisms contained in it. Bran also contains antioxidant compounds such as beta carotene and lycopene that protect cells from adverse oxidation reactions [17]. The addition of rice husks and bran to the manufacture of probiotic powder for food additives in livestock gives good results and can maintain the number of bacteria for a longer time [18].

Cornmeal is an endosperm or food reserve for prospective embryos inside the seeds that will grow into corn individuals. Yellow corn starch contains energy of 355 Kcal, protein 9.2 g, carbohydrates 73.7 g, fat 3.9 g, calcium 10 mg, phosphorus 256 mg, and iron 2 mg. In addition, yellow corn flour also contains vitamin A as much as 510 IU, vitamin B1 0.38 mg and vitamin C 0 mg [19]. These compounds support the life of microorganisms contained in the SINBIONESA powder. Water absorption capacity is 40.53% – 65.33% in fermented corn flour, amylose content is 33.10%, and has a water absorption capacity of 117.80% [20]. Based on the properties of cornmeal, to get SINBIONESA powder with ideal water content by using corn flour as a filler, it requires calculating the right level.

The shelf life of SINBIONESA powder is based on the total number of microorganisms contained in it which are known to perform TPC (Total Plate Count) in a certain storage period at two types of temperatures, namely room temperature and cold temperature/ice cupboard in cold temperature storage the total probiotic amount in SINBIONESA is higher when compared to the total number of probiotics in SINBIONESA stored at room temperature. This is due to the fact that at lower temperatures the metabolic speed of the organism also decreases. This means that there is a decrease or saving in the use of nutrients contained in SINBIONESA media, thus SINBIONESA media can support the life of microorganisms contained in it longer.

The quality of SINBIONESA powder, especially maintaining its expiration period can be done in various ways which include providing fillers that can maintain the life of microorganisms in basal metabolism, storing SINBIONESA at cold temperatures so that the metabolic process of microorganisms in it is slow, keeping SINBIONESA dry, or low water content, handling

SINBIONESA well when used so that it is not contaminated with other microorganisms or other materials which can disrupt its stability [21]. SINBIONESA powder produced in this study, if it has gone through an expiration period, can actually still be utilized with a larger dose of administration to the fodder and beverages. SINBIONESA that has passed the expiry period can also be used to speed up the fermentation process of feed ingredients. The fermentation process will take place at a slower speed if SINBIONESA powder is used which has passed its expiration period, but the process is still faster when compared to the speed of the fermentation process without the addition of SINBIONESA.

4. CONCLUSION

SINBIONESA product contains three types of probiotic bacteria, *Bacillus pumilus*, *Bacillus brevis* and *Pseudomonas diminuta* in the oil palm with filler of 75% rice bran and 25% corn flour. The quality of SINBIONESA produced has met SNI standards in terms of water content of 2.89% (SNI < 14%), the total number of probiotics 10^{12} cell/g (SNI > 10^7 cfu/g) and expiration periods at room temperature storage and cold temperatures, 1 year 4 months and 2 years 5 months (SNI > 3 months), respectively.

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Analysis of Patentability on Research Results of Lecturers at Universitas Negeri Surabaya and Implementation of Patent Drafting: A Case Study

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ABSTRACT

The main purpose of this research is to find out the patentability of the research results of Unesa lecturers through PNPB funding for the fiscal year of 2022 and to find out the number of patents after the patent drafting activity. The research methods and stages included documentation analysis, implementation of patent drafting activities, and questionnaire analysis for before and after patent drafting activities. The results of the documentation analysis showed that there were 63 out of 806 lecturers' research titles with potential patents (7.8%). Then, the patent drafting activity was carried out well by inviting 5 highly competent persons in the fields of IT, mechanics and machinery, electrical engineering, science, and arts and humanities. The results of the questionnaire analysis before the activity stated that from 46 respondents: 1) 87% of respondents stated that the output of their researches was believed to be patentable and the rest are not, 2) 67.4% of respondents had produced patents for their researches and the rest were not patents, and 3) 63% respondents have never compiled a patent and the rest have. Although, all of respondents (100%) knew that the patent is very useful. After the activity, there were 29 respondents who filled out the questionnaire. They stated that all presenters were declared good and very good in terms of all aspects of the assessment. Furthermore, all respondents gave an assessment between good and very good (> 90%) for the activities covering all aspects. This means that the activity was declared successful. Also, it is certain that the number of patents that have been successfully assisted have been registered with the DJKI system, although not all of them. The end of the drafting activity has resulted in 13 patents, of which 8 patents have been registered with the DJKI system.

Keywords: Drafting Patent, Research Results, Patentability, Potential

1. INTRODUCTION

Unesa lecturers and students, especially those with social and natural sciences backgrounds (chemistry, biology, and physics) belonging to be vocational engineering (mechanics, electrics, informatics, and others) produce probably a applicable research [1], namely in the form of certain ways of working either products or processes. Therefore, the results of their research have a high chance of producing new things, which have never existed yet or improvements of existing technologies. The activity of producing something new is certainly not an easy. It takes a strong and good scientific background and hard work to produce new technology.

For this reason, it is appropriate for researchers to be given awards or legal protection. Moreover, if the technology is a new thing and has a high economic value. It was reported that there was a total of 806 research titles for Unesa lecturers funded through Unesa PNPB (non-tax revenue) funding for Fiscal Year (FY) of 2022. Those titles came from 476 research titles from various schemes of the faculty policy and 300 research titles from various research schemes outside the faculty policy, such as Unesa strategic policy, basic research scheme for domestic and foreign studies, collaborative competitive research scheme, and so on. From the 806 titles above, further documentation analysis is carried out on the titles that have potentially patents.

The basis for determining the titles with potential patents are: a) in the form of exact research, can be useful, and have an element of novelty [2][3], b) research products should be applicable [4], and c) contain inventive steps [5]. The problems are: 1) how many research results from Unesa lecturers with PNBP funding for FY of 2022 have the potential to be patented? 2) what are the obstacles for researchers in obtaining patent from research outputs conducted by Unesa lecturers? and 3) How are the results of the patent drafting activity able to increase the acquisition of patents from the research results of Unesa lecturers?

The aims of this research are: 1) to know the patentability of the research results of Unesa lecturers who receive PNBP funding for FY of 2022 and 2) to find out the increase in patent acquisition from the research results of Unesa lecturers after the patent drafting activity. This activity has been carried out by several universities in Indonesia [6][7][8] in order to train them to prepare good and correct patent drafts.

3. METHODOLOGY

The research was conducted at LPPM Unesa Surabaya within a period of six (6) months effective starting from June to December 2022.

Types of research

The type of research carried out is descriptive qualitative in the form of mapping data from research titles conducted Unesa lecturers with PNBP funding for FY of 2022 that has the potential to be patented. After that, a patent drafting workshop was performed to obtain patents that are ready to be submitted for registration through DJKI system in 2022. Analysis of data related to patent acquisition using the basis for determining titles with potential patents that has also been prepared will also be carried out in a qualitative descriptive manner.

Procedures

- a. Documentation Analysis: Mapping Potential Patent of Research Results of Unesa Lecturers through PNBP Fund for FY of 2022.
 - 1) Obtain data for research titles from Unesa PNBP fund lecturers who passed the selection and were funded in FY of 2022

from Center for the Research and Strengthening Innovation (RPI) of LPPM Unesa.

- 2) Mapping research titles from Unesa lecturers funded in FA of 2022 that have the potential to be patented on the basis of the above determination and followed by the distribution of questionnaires before the patent drafting workshop.
- b. Preparation and Implementation of Patent Drafting Workshop
 - 1) Coordinate with the Chair/Secretary of LPPM related to the patent drafting workshop plan,
 - 2) Prepare and send a letter of request for resource persons for assistance in drafting patents to the Association of Indonesian Intellectual Property Centers (ASKII),
 - 3) Prepare materials, invitation concept, schedule, and place in order to facilitate the implementation of patent drafting and coordinate with ASKII and/or with the Chair/Secretary of LPPM,
 - 4) Do checking and perfecting the materials and concepts of the invitation letter for the implementation of the patent drafting workshop to the participants,
 - 5) Organize patent drafting activities at LPPM with the IPR adhoc team,
 - 6) Check patent drafting results and perfect patent drafting results
 - 7) Complete the results of patent drafting and submit (reports) to the Chairman/Secretary of LPPM,
 - 8) Compile a report on the results of the patent drafting and submit it to the Chairman/Secretary of LPPM through the Center of IPR LPPM,
 - 9) Prepare all patent drafting documents and their files for further application for patent registration to the DJKI [9] system to obtain an application number of patent registration, and
 - 10) Deliver application number of the patent registration to inventors.

The data collection instruments used in this study include: 1) a check list for determining the research titles of Unesa lecturers in FY of 2022 that have potential patents, 2) a questionnaire using the google form platform to collect all information related to the research profiles of Unesa lecturers in FY of 2022 and readiness for workshops of patent

drafting, and 3) a questionnaire using the google form platform to evaluate the implementation of the workshop adopted and adapted from the Ministry of Education, Culture, Research and Technology [10].

4. RESULT AND DISCUSSION

A. Documentation Analysis: Mapping of Potential Patent Research Results from Unesa PNB Fund for FY of 2022

1. Find out data for research titles from Unesa lecturers who passed the selection and were funded in FY of 2022 from the Center for Research and Innovation Strengthening (RPI) of LPPM Unesa.
Sources of information related to research titles for Unesa lecturers funded for FY of 2022 were obtained from <https://lppm.unesa.ac.id/penelitian-pnbp-2022/> and can be downloaded with the permission of the Head of LPPM through the Head of RPI Center. There are two files that can be downloaded through the website which are in accordance with their respective aims and objectives, namely: 1) Notification Letter for Research and Community Service Proposals funded from Faculty PNB funds for FY of 2022 and 2) Notification Letters for Research Proposals and Community Service Proposals funded from LPPM PNB funds for FY of 2022. From these 2 files, it can be disclosed about the type of research, namely research on faculty policies and various names of research schemes and the number of research titles. In the first Letter, it was reported that there was a total of 476 research titles from various faculty policies with details as shown in Table 1.

Table 1. Number of Research Titles for Various Faculty Policy by PNB Funded for FY 2022

No	Faculty	The Number of Research Titles
1.	Faculty of Education Science (FIP)	75

2.	Faculty of Language and Art (FBS)	62
3.	Faculty of Mathematics and Natural Sciences (FMIPA)	39
4.	Faculty of Social Sciences and Law (FISH)	67
5.	Faculty of Engineering (FT)	59
6.	Faculty of Economics and Business (FEB)	46
7.	Faculty of Sport Sciences (FIO)	38
8.	Post Graduate (PASCASARJANA)	53
9.	Program of Vocation (VOKASI)	30
10.	Learning and Professional Development Institutions (LP3)	7
Total		476

Meanwhile, in the second Letter regarding the research schemes, there are a total of 330 research titles with details as shown in Table 2 below.

Table 2. Various Research Schemes of Unesa PNB Funds for FY of 2022

No	Research Scheme	The Number of Research Titles
1.	Research of Unesa Strategy Policy	16
2.	Basic Research LPPM	102

No	Research Scheme	The Number of Research Titles
3.	Basic Research for Domestic Study LPPM	126
4.	Basic Research for Abroad Study LPPM	10
5.	Basic Research for Professor Acceleration LPPM	23
6.	Collaborative Competitive Research	10
7.	Competitive Research for Innovation Product Development	5
8.	Competitive Research for Center of Excellence in Science and Technology	3
9.	Competitive Research for Educational Personnel	32
10.	Self-funded Research	3
Total		330

Thus, the total number of research titles for Unesa PNBPF funds for FY of 2022 is 806 titles from 476 and 330 titles.

- Mapping research titles for Unesa PNBPF funds for FY of 2022 that have the potential to be patented on the basis of the above determination and followed by the distribution of questionnaires prior to the patent drafting workshop.

From the 806 titles above, further mapping is carried out on research titles that have the potential to be patented. Based on the existing determination, finally out of the 806 research titles it was found and it was decided that there were 63 titles with potential patents and were included in the workshop.

In order to obtain certainty related to research titles for Unesa PNBPF funds for FY of 2022 that are ready to be included in the workshop, a questionnaire is needed to capture the readiness of participants by preparing a googleform platform with the title "WORKSHOP DRAFTING PATEN 2022" (<https://bit.ly/AngketPotensiPaten.>). The point is to find out the readiness of the researchers (participants) regarding the workshop as well as the suitability of the research topic and the patent field. This is done for the smooth implementation of the patent drafting later, so that it is effective and on target.

Questionnaires are given or distributed to several participants through WhatsApp groups at least 1 week before the workshop is held. The result is 46 respondents who have filled out the questionnaire on the link with the deadline for filling out 1 day before the workshop. The results of the analysis of the contents of the questionnaire can be reported as follows.

- The following are research areas for lecturers and/or students with potential patents. The majority of respondents' research fields with potential patents are 45.7% in science (Chemistry, Biology and Physics) and 37.0% in social humanities, as shown in Figure 1.

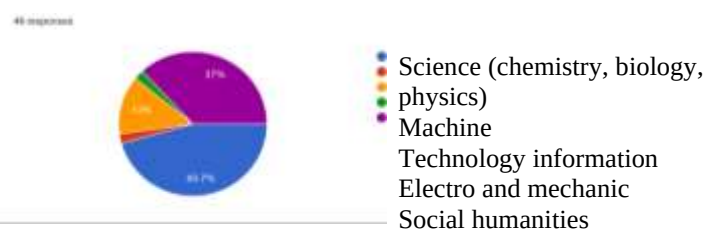


Figure 1. Research areas of lecturers and/or students with potential patents

- b. Output of research results from lecturers and/or students have the potential to be patented. It is known that 87.0% of respondents believe that their research results have the potential to be patented and the rest are not sure, as shown in Figure 2.

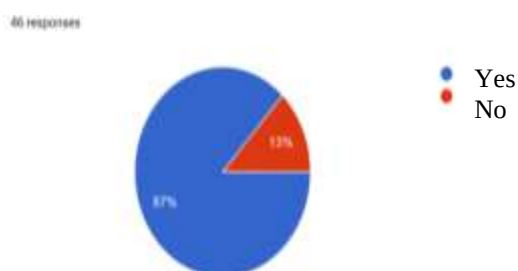


Figure 2. Outputs of research results from lecturers and/or students with potential patents

- c. The research output of lecturers and/or students has been in the form of a patent. A total of 32.6% of respondents answered that their research output was in the form of a patent and the rest (67.4%) had never produced a patent, as shown in Figure 3.

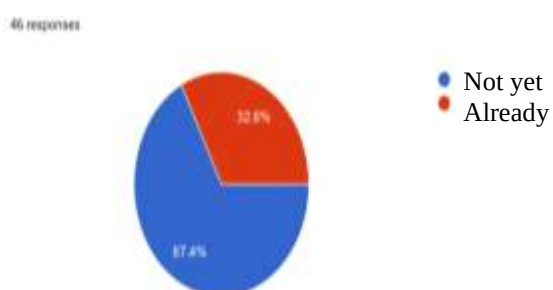


Figure 3. The research output of lecturers and/or students has been in the form of patents

- d. Compile a patent description and register it with the Center for IPR, LPPM Unesa. The results of the questionnaire reported that 60% of respondents had compiled a patent description and registered it through the Center for IPR, LPPM Unesa Surabaya and the rest had never, as shown in Figure 4.

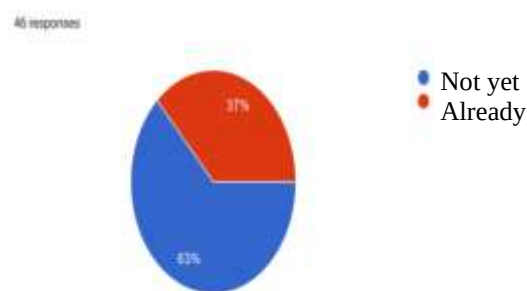


Figure 4. Compiling a patent description and registering it with the Center for IPR, LPPM Unesa

- e. Reasons for respondents who do not have a patent. It was reported that the reasons of respondents did not have research outputs in the form of patents were: 1) respondents did not know how to compile or arrange a patent description (22 people or 47.8%) and 2) did not understand how to compile and manage files accompanying the patent (23 people or 50.0%). The rest are respondents under 10 people (< 16%) who feel that the patent processing/registration fee is too expensive, even though for this case the respondents are free of charge (free) and paid by the institution if they transfer their IPR to the institution, there is no time or opportunity to compose a patent description, research is still in its early stages so that there are no new innovations that can be patented, and process of patent registration takes a long time. For more details, it can be seen in Figure 5 below. In fact, respondents (100%) consciously, know and believe that the patent is very useful. This is in line with the results of Herjanto's research (2010)¹⁰ which reports that respondents are generally familiar with patents, but the technical understanding of the term of patent protection and the criteria for inventions that can obtain patents is still relatively lacking.

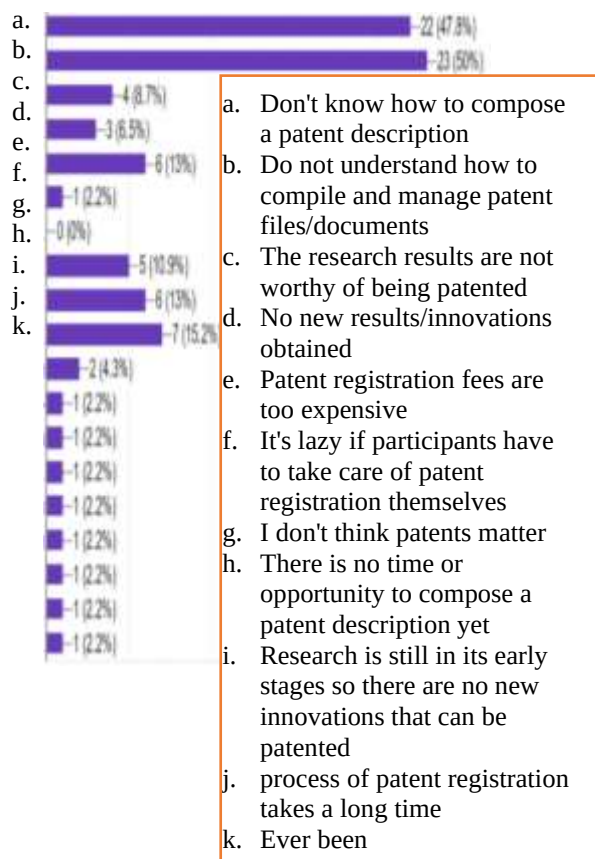


Figure 5. Reasons for respondents who do not have a patent

f. Suggestions for LPPM in the context of increasing patent acquisition from the research results of Unesa lecturers. Suggestions obtained for LPPM in order to increase patent acquisition from the research results of Unesa lecturers can be explained as follows: 1) workshops/trainings/patent drafting should be held periodically (27 respondents; 77.1%), 2) participants should not be only lecturers, but also students (19 respondents; 54.3%), 3) LPPM should facilitate the preparation of patent files/documents and its registration (22 respondents; 62.9%), 4) there is a special research scheme whose output is patent (9 respondents; 25.7%), 5) there are presenters from the fields of social science/humanities/economics who have received patent certificates (12 respondents; 34.3%), 6) LPPM needs to make circulars/brochures/leaflets of patent drafting activities (8 respondents; 22.9%), 7) provided funds managed by LPPM for patent management

and registration (10 respondents; 28.6%), 8) provided awards/gifts that received patents (registered or granted/certified) (12 respondents; 34.3%), 9) there are several examples of patent descriptions that have potential patents (12 respondents; 34.3%), 10) Center for IPR, LPPM should be more proactive (6 respondents; 17.1%), and only 2 respondents who asked for the mediation process for his patent descriptions. Furthermore, it can be studied as shown in Figure 6.

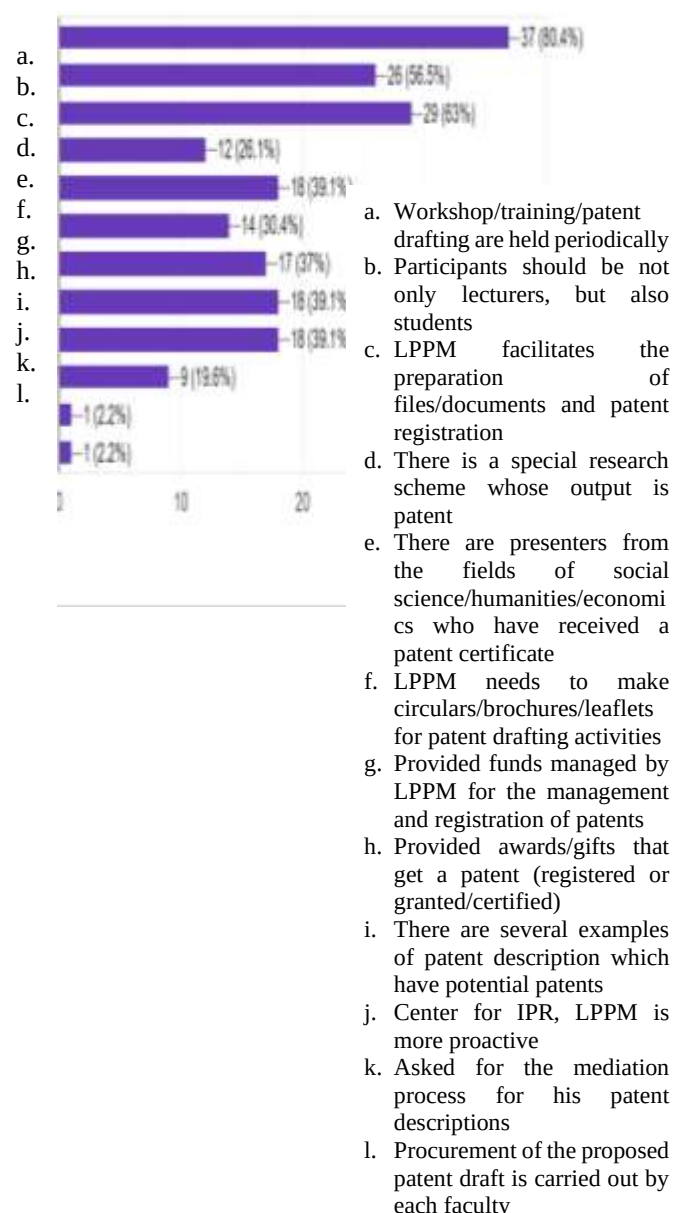


Figure 6. Suggestions for LPPM in order to increase patent acquisition from the research results of Unesa lecturers

B. Preparation and Implementation of Patent Drafting Workshop

1. Coordinating with the Chair/Secretary of LPPM related to the patent drafting workshop plan.

Coordination with the Chair/Secretary of LPPM regarding the preparation of the workshop has been carried out since June 2022. The topics discussed in the coordination include: a) the date of the workshop, the names of the presenters from the Directorate General of Intellectual Property, Ministry of Law and Human Rights, Republic of Indonesia, the implementation of patent drafting workshop (online), preparation of the rundown of the workshop, the names of the PIC teams of IPR involved, and including the budget prepared for the workshop.

2. Preparing and sending a letter of application for presenters for assistance in drafting patents to DJKI Jakarta.

After it was agreed, finally, on July 12, 2022, an application letter regarding the application for online patent drafting was sent to the Director of Patents, Layout Designs of Integrated Circuits, and Trade Secrets, the Directorate General of Intellectual Property, Ministry of Law and Human Rights (called DJKI), Republic of Indonesia where the letter was written in the second week of August 2022, it is hoped that the patent drafting workshop can be carried out by asking 5 presenters with expertise in the fields of science (chemistry, physics, and biology); informatics; sosial and humanity; machinery; and electrics. However, after waiting until the deadline (second week of August 2022), another option was carried out, namely to seek and invite presenters from non-DJKI, namely the Association of Indonesian Intellectual Property Centers (called ASKII). The coordination with public relations officer (Sie Humas) of ASKII regarding to the preparation of the patent drafting workshop had been conducted well.

3. Preparing materials, draft invitations, schedules, and places in order to facilitate the implementation of the workshop and coordinate with Sie Humas ASKII.

The results of coordination with Sie Humas ASKII, finally got 5 presenters, namely: 1)

presenter 1 (Information Technology), 2) presenter 2 (mechanics and machinery), 3) presenter 3 (electronics), 4) presenter 4 (science), and 5) presenter 5 (Art and Humanities).

4. Checking and perfecting the materials and concepts of the invitation letter for the implementation of the workshop to the participants.

Materials and concepts for the invitation letter for the implementation of the workshop to the participants have been prepared and at the same time a letter of application from the presenters to each institution where they work. In this case, a whatsapp group was also created to facilitate coordination and information related to the workshop.

5. Preparing the committee for the workshop at LPPM with the ad hoc team of Center for IPR, LPPM.

The establishment of a committee for the implementation of the workshop has been carried out with the ad hoc team of Center for IPR, LPPM by preparing a Letter of Assignment along with the Event Rundown.

6. Providing online assistance (break out room) to revise the participant's patent draft.

The workshop activity has been carried out by starting with the delivery of material by the two main speakers online in the plenary session. Next, mentoring sessions are carried out in groups of 5 groups (break out of 5 rooms). The results of the participant's patent drafting assistance after responding to input and suggestions from the resource persons will be asked as evidence of activities.

7. Completing the results of the patent drafting activity and submitting (the report) to the Chairman/Secretary of LPPM through the Center for IPR.

Give participants the opportunity and time for approximately one or two weeks to revise their patent draft and prepare an activity report to the Chair/Secretary of LPPM.

8. Preparing all of files/documents accompanying the patent and further doing application for patent

registration to the DJKI [9] system to obtain a patent registration number.

For the patent draft that has been revised based on suggestions from the presenters, the following documents need to be completed with the documents required for the patent registration application. Through the Center for IPR, LPPM, patent registration is carried out online to the DJKI system and paid for by Unesa.

The patent titles that were successfully accompanied during the patent drafting workshop, namely: 1) Yoghurt Daun Kelor dan Proses Pembuatannya, 2) Proses Pembuatan Gudeg Instan dengan Bahan Tambahan Jamur Tiram, 3) Suplemen Pisang untuk Membantu Menurunkan Gejala Mood Swing: Depresi, Amarah, Kebingungan, Ketegangan dan Kelelahan, 4) Antena Mikrostrip dengan Modifikasi Patch dan Ground Plane untuk Aplikasi Ultrawideband (UWB), 5) Kombinasi Ekstrak Etanol Kayu Secang dan Jahe Merah sebagai Agen Antiinflamasi terhadap Penghambatan Denaturasi Protein BSA (Bovine Serum Albumin) dan Proses Pembuatannya, 6) Syzyginin B dari Ekstrak Metanol Kulit Batang Jambu Semarang (*Syzygium samarangense*) sebagai Antikanker Payudara dan Antiinflamasi secara *In Silico*, 7) Bahan Bakar Biodiesel Minyak Biji Karet dan Solar, dan 8) Proses Pembuatan Senyawa Azo Dari Kloramfenikol. Of these eight titles have been registered to the DJKI [9] system.

Meanwhile, the following 5 titles are still in the process of applying for registration, namely: 1) ID-Digital Sebagai Ekstensi e-KTP untuk Identitas Online yang Secure, 2) Proses Produksi dan Formulasi Simbiotik Ternak Ruminansia Berbasis Tepung Selulosik, 3) Proses Pembuatan Gel Berbahan Hidroksiapatit dan Ekstrak Daun Sirih Hijau (*Piper Betle* L.) sebagai Antiplak Gigi, 4) Printed Circuit Board Skor Pertandingan Pencak Silat Berbasis Smart Pirates Menggunakan Internet of Things (IoT), and 5) Formula Kornet Udang Angkak dengan Kombinasi Garam Kuring dan Beras Angkak.

9. Informing the patent registration application number to the patent drafting participants.

The number of patent applications that have been successfully registered to the DJKI system has been informed to the participants (inventors).

10. Distributing a questionnaires of participant response after the workshop is over.

To what extent has the workshop activity been going well, it is necessary to evaluate its implementation using the <https://forms.gle/qStpGgKojUTMotxA8> platform which was adopted and adapted from <https://formulir.kemdikbud.go.id/view.php?id=7537307>) [10]. The aim of the questionnaire is to find out the responses of participants to the overall workshop activities and the results can be explained as follows.

As many as 29 respondents have filled out the questionnaire and the results can be explained as shown in Table 3 and Table 4 below.

Table 3. Evaluation of presenters in the patent drafting workshop

No	Aspects	Presenter				
		1	2	3	4	5
1.	Material mastery	(%)	(%)	(%)	(%)	(%)
	a. Less	0	0	0	0	0
	b. Enough	3.4	0	0	3.4	3.4
	c. Good	27.6	37.9	31	27.6	31.1
	d. Very good	69.0	62.1	69	69.0	65.5
2.	Clarity of Substance Presentation					
	a. Less	0	0	0	0	0
	b. Enough	3.4	0	3.4	3.4	3.4
	c. Good	34.5	34.5	34.5	31.1	31.1
	d. Very good	62.1	65.5	62.1	65.5	65.5
3.	Quality of language use					
	a. Less	0	0	0	0	0
	b. Enough	3.4	3.4	0	3.4	3.4
	c. Good	34.5	34.5	37.9	41.4	24.1
	d. Very good	62.1	62.1	62.1	55.2	72.5

No	Aspects	Presenter				
		1	2	3	4	5
4.	Attendance discipline					
	a. Less	0	0	0	0	0
	b. Enough	3.4	0	0	3.4	3.4
	c. Good	24.1	37.9	31	24.1	24.1
	d. Very good	72.5	62.1	69	72.5	72.5
5.	Interaction with participants					
	a. Less	0	0	0	0	0
	b. Enough	3.4	0	0	6.9	3.4
	c. Good	27.6	31	27.6	27.6	27.6
	d. Very good	69.0	69	72.4	65.5	69.0

Observing Table 3, it appears that all presenters received good and very good scores for all aspects of the assessment which included: material mastery, clarity of substance presentation, quality of language use, attendance discipline, and interaction (communication) with participants. Meanwhile, respondents' evaluation (assessment) of the implementation of the workshop can be presented in Figures 7, 8, 9, 10, and 11 below.

a) Timeliness of the implementation of activities

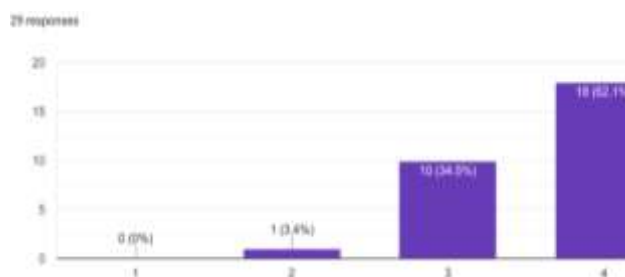


Figure 7. Timeliness of the implementation of activities

b) Committee services to event participants

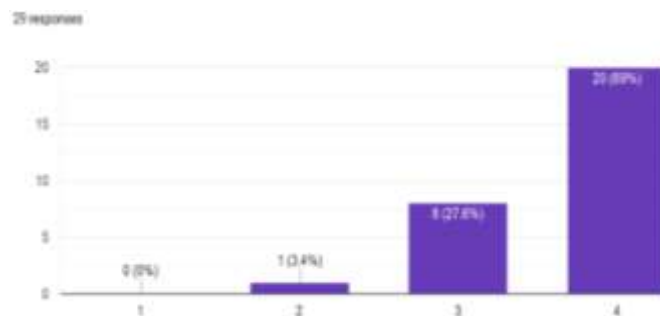


Figure 8. Committee services to event participants

c) The relationship between the theme and the material presented

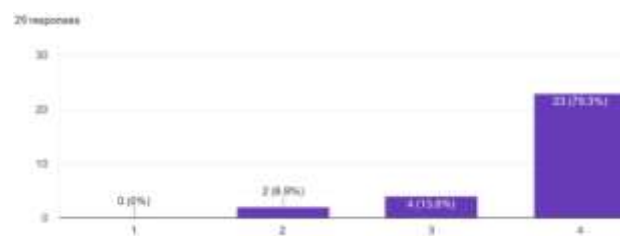


Figure 9. The relationship between the theme and the material presented

d) Activity facilities and infrastructure

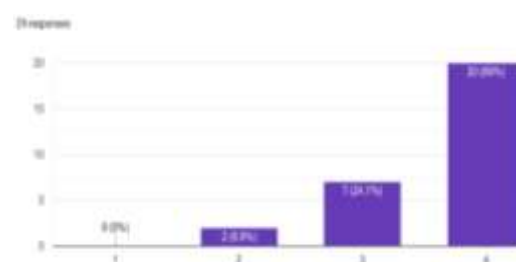


Figure 10. Activity facilities and infrastructure

e) Information delivered by the committee



Figure 11. Information delivered by the committee

Looking at Figures 7, 8, 9, 10, and 11, it appears that all respondents gave an assessment between good and very above 90% which includes: timeliness of the implementation of activities, committee services to event participants, the relationship between the theme and the material presented, activity facilities and infrastructure, and information delivered by the committee. This means that the implementation of the patent drafting workshop has been declared successful. Also, it is suspected from the number of patents that have been successfully assisted and registered to the DJKI⁹ system, although not all of them have been.

There are some suggestions or comments given by respondents, including: please improve and need to improvise especially assistance with patent descriptions; hopefully it can be done every semester; the implementation is good; it is better to be routine in holding patent workshops; similar activities should be carried out with a number of larger participants; hopefully the presenters are more competent; it is better to hold it continuously, everything has been done well; if this kind of activity can be done every semester; hopefully it will be even better; be done more often, corrected patents will be returned immediately for review further processing; it is necessary to provide special assistance for the social and humanities field; hopefully there will be assistance for Unesa lecturers who will apply for a patent; please submit a patent draft to be handled until it gets a certificate (granted); the implementation time for patent drafting is too short, especially to break out the room; need further activities to do it again with the provision of information well in advance, so that it can prepare a patent draft; hopefully in the future it will be even better; no suggestions/comments; it's good enough, hopefully (this activity) will get better in the future; and in the future it's better to do it at the beginning of the month.

4. CONCLUSIONS

Priorities, themes, and research focus at UNESA cannot be separated from the 2017-2045 National Research Master Plan (RIRN) following Presidential Regulation of the Republic of Indonesia Number 38 of 2018, that there are 10 priority research areas, namely food, energy, health, transportation, product engineering, defense and security, maritime affairs, social humanities, advanced materials, and other research fields. Of the 10 focuses, UNESA determined 6 national leading research namely leading research in the fields of sports and health, arts and culture, disability; science and technology; social humanities, and education. Three of the six areas of focus, namely sports science, arts, and disability, are UNESA's mainstays.

In accordance with RIRN, UNESA's research and community service roadmap was also prepared from 2020-2045. At the end of the research roadmap, in 2041-2045 sports science will become a world-class reference. Meanwhile, the leading research on disability and art is a reference for the Asian level. Supported by 6 national research excellence. To become a productive country, we must be able and independent in terms of mastering science and technology. This is where the role of research is needed and for this, our country must increase the quantity and quality of its research. Entrepreneurship is a mindset that uses creativity and innovation to boost the economic value of a product or the results of research or invention. It is this research-based entrepreneurship that can change Indonesia from a consumer country with minimal added value to a productive country with high added value and ultimately have an impact on increasing people's welfare. Universities must change their vision and mission from just learning universities or research universities to becoming entrepreneurial universities, namely universities that apply the results of their research for the benefit of the business world or the wider community. PKM in the 2040-2045 period is expected to increase the number of fostered partners, from 2000 partners to 2000 fostered partners. These fostered partners are expected to be examples of UNESA's success in managing community service activities in Indonesia. So that UNESA can be a reference in managing community service

AUTHORS' CONTRIBUTIONS

In this article, Darni contributes to writing, SEC as editor, LS and NN contributes to analyzing the data.

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The Process of Making Fiber from Soybean Inside

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ABSTRACT

Utilization of natural fiber from soybean husk waste in the processing of dairy, tempeh, and tofu is very suitable to be development. Soybean husk waste has not had too high economic value, it can be used for making soybean husk fiber. Fulfillment of basic ingredients to produce environmentally friendly materials, a basic material made from natural vegetable fibers was developed. This fiber has two categories, namely one with protein origin and the other with cellulose origin. Fiber derived from protein comes from vegetable proteins such as corn, soybeans, beans, etc. Soy-based processed products are a good source of vegetable protein, and dietary fiber, have high oligosaccharide content, contain vitamins and minerals and can reduce the risk of coronary heart disease, and carcinogenesis type diabetes, reduce negative symptoms due to menopause and improve bone health. The soybean seed husk contains a lot of crude protein 17.98%, crude fat 5.5%, crude fiber 24.84%, and metabolic energy 2898 kcal/kg. We clean the soybean husk by soaking it using guides for 2 hours, 3 hours, and 4 hours, then dried it. After that, we puree the dimensions, we give alkali treatment by soaking in NaOH solution, then drying at room temperature. For fiber from soybean husk that has been dried, we add cellulose to increase the strength of the fiber. The more mixture of soybean husk composition, the lower the mechanical properties of the fiber. The more mixture of cellulose composition, the mechanical properties of the fiber will be harder and more ductile. The longer the heating process in the manufacture of fiber dough, the more ductile the mechanical properties of the fiber will be. either.

Keywords: soybean husk, natural fiber, waste utilization.

1. INTRODUCTION

Utilization of natural fiber from soybean husk waste in the processing of dairy, tempeh, and tofu is very suitable to be development. Soybean husk waste has not had too high economic value, it can be used for making soybean husk fiber. Eco-friendly fiber made from soybean husk dregs also has a soft and light material, can reflect light, does not wrinkle and does not shrink easily, is UV resistant, and is also antimicrobial. Fulfillment of the basic ingredients to produce environmentally friendly fiber-making materials, a basic material made from natural vegetable fibers was developed. This fiber has two categories, namely one with protein origin and the other with cellulose origin[1]-[4]. Fiber derived from protein comes from vegetable proteins such as corn, soybeans, beans, etc. Soy-based processed products are a good source of vegetable protein, dietary fiber, high oligosaccharide content, contain vitamins and minerals, and can reduce the risk of coronary heart disease, and

carcinogenesis type diabetes, reduce negative symptoms due to menopause and improve bone. The soybean seed husk contains a lot of crude protein 17.98%, crude fat 5.5%, crude fiber 24.84%, and metabolic energy 2898 kcal/kg. Soybean has a high protein content, and this fabric is very receptive to natural dyes, so there is no need for synthetic dyes[5]-[7].

2. METHODS

Flowchart of the process of making tempeh and tofu, from Soybean husk waste can be seen from the flow chart in the figure 1. In this research the Soybean husk dregs in the soybean processing industry in the Sidoarjo area. The research variable consist of Independent variable is Soybean husk composition (100 grams, 125 grams, 150 grams) with Immersion time (1 hour, 2 hours, and 3 hours). However the dependent variable is Wettability test and variable control is dimensional uniformity of soybean raw materials.

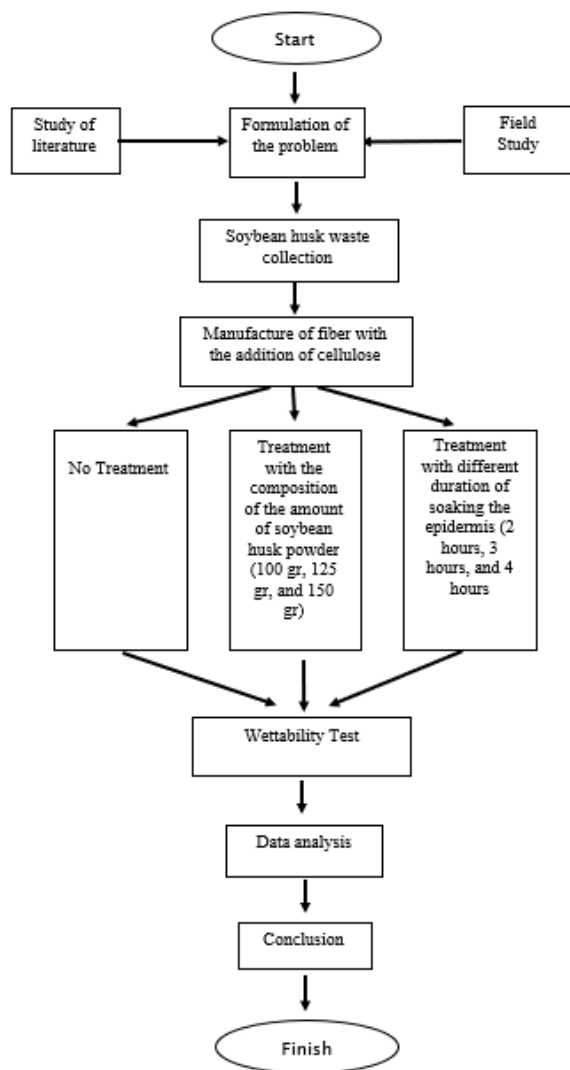


Figure 1 Research Flowchart

3. RESULTS AND DISCUSSION

The process of making natural fiber from soybean husks requires several stages that require patience and thoroughness. The stages are as follows:

1. The process of preparing tools and materials



Figure 2 Research Tools and Materials

The materials used in this research are solid waste tofu (soybean husk), aquadest, NaOH, cellulose.

2. Preparation of raw materials for soybeans used by tofu and tempeh entrepreneurs.



Figure 3 Soybeans

3. Soybeans are cooked at a temperature of 80 0C for approximately 2 hours.



Figure 4 Cooking Soy Beans

4. After that, we soak the cooked soybeans in cold water, so that the skin peels off easily.
5. We rub the soybeans that have been soaked in cold water using our hands or other tools so that the skin of the soybeans can be peeled off from the soybeans.



Figure 5 Soybean Aris Skin

6. We clean the soy bean husk that is still wet with water, and then soak it with distilled water for 2 hours, 3 hours, and 4 hours. Then we dry the skin of the soybeans.

7. Tofu solid waste drying process



Figure 6 Drying the Soybean Ari Skin

8. The drying process is carried out by drying in the sun, until the soybean husk has become dry and there is no visible water content in the soybean husk.

9. Material reduction process



Figure 7 Shrinking Soybean Ari Skin Size

10. The process of reducing the soybean husk is done by grinding until smooth or using a blender.

11. After that, the results of refining the soybean husk are filtered, to obtain a uniform dimension of the soybean husk.

12. The alkaline process is carried out by mixing the skin of soybeans that have been smooth and dry as much as (100 grams, 125 grams, and 150 grams) mixed with 12% 1000 ml NaOH solution.

13. The process of heating at a temperature of 80 oC and stirring slowly and constantly for 60 minutes.

14. After that, the process of filtering and rinsing again is carried out to obtain uniform dimensions of soybean husk.

15. Heating drying process.

16. Cellulose mixing process.



Figure 8 Mixing Soybean Ari Skin with Cellulose

17. Mixed material printing process



Figure 9 Fiber from Soybean Arid Skin

18. The process of drying the prints using heating or sunlight.

4. CONCLUSION

The conclusions of this study are:

1. The more soybean husk mixture, the lower the mechanical properties of the fiber.
2. The more mixture of cellulose will make the mechanical properties of the fiber will be harder and more ductile.
3. The longer the heating process in the manufacture of fiber dough, the more ductile the mechanical properties of the fiber will be.

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Comparison of Cultured *S.Aureus* and *E.coli* DNA Concentrations on Growth Media of Luria Bertani and Nutrient Broth

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ABSTRACT

This study aimed to describe the comparison of cultured *S.aureus* and *E.coli* DNA concentration on growth media of Luria bertani and Nutrient broth. *S.aureus* and *E.coli* bacteria that have been cultivated on Luria Bertani (LB) and Nutrient Broth (NB) media, after measuring their absorbance values at a wavelength of 620 nm, have quite high absorbance values. For *S. aureus* bacteria which are gram-positive bacteria, Luria Bertani (LB) media is the best medium for cultivation, because the absorbance value is 1.324 ± 0.500 , while *S. aureus* cultivated on Nutrient Broth (NB) growth media has a lower absorbance value. ie 1.047 ± 0.500 which means the highest cell density or optical density (OD) for *S.aureus* was cultivated on Luria Bertani (LB). The highest DNA concentration was found in NB *E.coli* isolates at 9.50 ng/μl. The best level of DNA purity was found in the isolates of NB *S.aureus*, which was 1.89 based on the A value of 260/280, while for the isolates LB *E.coli*, NB *E.coli*, and LB *S.aureus* were also good, but there were few contaminants so that A score of 260/280 produces a value below 1.8 and more than 2.0.

Keywords: DNA, cultivated, culture media, *Staphylococcus aureus*, *Escherichia coli*

1. INTRODUCTION

Escherichia coli bacteria are normal bacteria in the intestines, but in abnormal numbers become pathogenic bacteria [1]. These bacteria are the cause of acute diarrhea at all ages. These bacteria stick to the intestines and produce toxins that can damage the mucosal cells of the small intestine [2]. *Staphylococcus aureus* is a Gram-positive bacterium that often infects humans and animals [3]. This bacterium is a bacterium that causes infection in general which always shows increased resistance to various types of antimicrobials [4].

Luria Bertani media is often used for the cultivation of *Escherichia coli* bacteria and other microorganisms that are not too difficult to culture. This medium is often used for genetic and molecular studies of microorganisms. Luria farming is also a medium rich in nutrients such as peptone, nitrogen compounds, amino acids, vitamins, sodium chloride, and other growth factors needed by microorganisms [5]. Nutrient Broth (NB) is a universal medium used to grow bacteria in general [6].

Molecular level analysis with DNA as the object begins with extraction. The DNA extraction process is

to obtain pure DNA with a high concentration so that it can be used for further molecular analysis such as PCR, RLFP, and RAPD[7] [8]. Good extraction is supported by the results of the quantity of DNA extract obtained. 260 and 280 nm waves. DNA purity was determined by calculating the ratio of absorbance at A260 and A280. A DNA molecule is said to be pure if its absorbance ratio ranges from 1.8 to 2.0 [9].

Information on the concentration and purity of *S.aureus* and *E.coli* DNA that was cultivated on the growth media of farmed Luria and nutrient broth is very necessary to determine the degree of contamination and whether the sample is good for use in the next stage. Therefore, measurements were made on the quantity, concentration, and purity of genomic DNA.

2. MATERIAL AND METHODS

The number of bacterial cells that have been cultivated on growth media, then measured Optical Density (OD) using a Spectrophotometer-UV-Vis at a certain wavelength.[10] in their research measured the optical density of *Escherichia coli* at the same wavelength of 600 nm. Different wavelengths used to measure Optical Density (OD) were carried out by [7]

for *Pseudomonas aeruginosa* and *Staphylococcus aureus*, namely 492 nm. The DNA isolation process is a process to remove DNA from the cell mass and other components in the cell [3].

The quality of isolated DNA can be seen from the level of purity and concentration. DNA purity can be measured at wavelengths of 260 nm and 280 nm and DNA is said to be pure if the A260/A280 value is 1.8 - 2.0. The degree of contaminants is a factor that can affect the purity of DNA. If the value obtained is below 1.8, it indicates DNA contamination with protein or contaminants with phenol [8].

The calculation of DNA concentration can also be done using the NanoDrop tool. [3] in their research used Nanodrop to measure DNA concentration by dripping 1µl of sample on a NanoDrop device that was connected directly to a computer.

Tools and materials are sterilized first. All materials and tools were put into an autoclave and sterilized at 121°C for 15 minutes with a pressure of 1 atm. Preparation of Luria Bertani Broth, Miller (LB) media by suspending 25 grams of LB media (Appendix 1) in 1 liter of distilled water which was homogenized by heating. The homogenized LB media was sterilized for 15 minutes by autoclaving at 121°C, pressure 1 atm.

Bacterial isolates of *S. aureus* and *E. Coli* were recultured by inoculating one full ose into the Nutrient Agar (NA) medium. The bacterial isolates were then incubated for ± 24 hours at a temperature of 25°C-30°C until colonies were formed.

Bacteria that had been grown in Nutrient Agar (NA) media were re-grown in 1 ml on LB and NB media, then incubated for 24 hours at 30°C. The incubated cultures were then completely re-grown on 5 ml of LB and NB media and incubated for 24 hours. The incubated cultures were then analyzed using spectrophotometry with a wavelength of 600-620 nm.

The bacteria that had been grown in LB and NB media were then centrifuged in a 500 l tube at a speed of 10,000 g for 1 minute. The supernatant was discarded, then the cell pellet underwent several steps such as cell resuspension with the addition of *resuspension Buffer*(Gram-positive), Cell lysis, Column Activation (Optional), Column loading, Primary washing, Secondary washing, and DNA elution by adding the Elution Buffer to the center of the column. The DNA formed was stored at 4°C or -20°C.

Bacterial DNA samples were calculated for concentration and purity using a spectrophotometer. DNA samples were measured at wavelengths of 260 nm and 280 nm. The level of DNA purity is calculated from the ratio of the wavelength of A260 to A280 (A260/280). Purity values for DNA that were categorized as pure ranged from 1.8 to 2.0.

This research is observational. The data from DNA isolation using the Kit method from Jena Bioscience (2021) was then quantitatively tested using a spectrophotometer with 3 replications. The data was obtained in the form of absorption (absorbance) of DNA at a wavelength of 260 nm and 280 nm.

3. RESULT AND DISCUSSION

Based on the research that has been done, data is obtained in the form of absorbance values at a wavelength of 620 nm. The absorbance value was used to analyze the bacterial cell density or Optical Density (OD) of two different growth media, namely Luria Bertani (LB) and Nutrient Broth (NB) media. Other data is in the form of DNA isolated from *S. aureus* and *E. coli* bacteria using the Kit from Jena Bioscience. The isolated DNA was then analyzed quantitatively using Nanodrop to determine the concentration and purity of the isolated DNA.

Cell density or Optical Density (OD) using Spectrophotometry-UV Vis will produce data as shown in Table 5.1.

Table 5.1 Results of Absorbance Measurement of Optical Density (OD)620 *S.aureus* and *E.coli* values on LB and NB Media.

MEDIA	AVERAGE ABSORBANCE OD ₆₂₀ ± SD
LBK	0,000 ± 0,000
LBSA	1,324 ± 0,500
LBEC	1,370 ± 0,500
NBK	0,000 ± 0,000
NBSA	1,047 ± 0,500
NBEC	1,382 ± 0,000

Information:

LBK : Media Luria Bertani as control

LBSA: Luria Bertani Media with *S. aureus* bacteria culture

LBEC: Luria Farming Media with *E.coli* bacteria culture

NBK: Media Nutrient Broth as control

NBSA: Nutrient Broth Media with *S. aureus* bacteria culture

NBEC: Nutrient Broth Media with *E.coli* bacteria culture

In general, bacterial growth media can be divided into two types, namely universal growth media and selective growth media. The universal bacterial growth media that are often used in the molecular analysis are Luria Bertani (LB) and Nutrient Broth (NB) media. Luria farming media (LB) is a medium consisting of various nutrients such as peptone, nitrogen compounds, amino acids, vitamins, and sodium [5]. Nutrient Broth (NB) media is also a universal medium that is often used for the cultivation of various types of bacteria. Nutrient Broth (NB) media consists of beef extract as a carbon source and peptone as nitrogen [6].

S.aureus and *E.coli* bacteria that have been cultivated on Luria Bertani (LB) and Nutrient Broth (NB) media, after measuring their absorbance values at a wavelength of 620 nm, have quite high absorbance values. For *S. aureus* bacteria which are gram-positive bacteria, Luria Bertani (LB) media is the best medium for cultivation, because the absorbance value is 1.324 ± 0.500, while *S. aureus* cultivated on Nutrient Broth (NB)

growth media has a lower absorbance value. ie 1.047 ± 0.500 which means the highest cell density or optical density (OD) for *S.aureus* was cultivated on Luria Bertani (LB) media. For *E.coli* bacteria which are gram-negative bacteria, Nutrient Broth (NB) media is the best medium for cultivation. The *E.coli* test bacteria used in the analysis were at least 108 cfu/ml or about 0.138 absorbance value at a wavelength of 620 nm. The data shows that *E.coli* cultivated with Nutrient Broth (NB) media has a higher absorbance value than *E.coli* cultivated on Luria Bertani (LB) media with a good Standard Deviation (SD) value of 1.382 ± 0.000 which means there is no difference after repeated measurements.

S.aureus and *E.coli* bacteria whose average absorbance value of OD620, had been measured were DNA isolated using the Kit from Jena Bioscience. DNA isolation using Kit is an alternative that is often used in molecular analysis. This method has several advantages such as easy to use and fast results. The steps in DNA isolation consist of cell isolation, cell wall and membrane lysis, extraction in solution, purification, and precipitation.

S. aureus and *E. coli* bacteria that had been grown on Luria Bertani (LB) and Nutrient Broth (NB) media were then isolated to obtain their DNA. The DNA sample is then tested quantitatively using Nanodrop which will produce data as shown in Table 5.2.

Table 5.2 Quantitative DNA Test Results

No .	Samp le	Concentrati on (ng/μl)	A 260	A 280	A 260/280
1.	NBEC	9,50	0,190	0,118	1,61
2.	LBEC	4,50	0,089	0,039	2,27
3.	NBSA	2,70	0,054	0,029	1,89
4.	LBSA	-0,20	-0,004	-0,003	1,58

Information:

LBSA: Luria Bertani Media with *S. aureus* bacteria culture

LBEC: Luria Farming Media with *E.coli* bacteria culture

NBSA: Nutrient Broth Media with *S. aureus* bacteria culture

NBEC: Nutrient Broth Media with *E.coli* bacteria culture

The highest DNA concentration was found in NB *E.coli* isolates at 9.50 ng/μl. The best level of DNA purity was found in the isolates of NB *S.aureus*, which was 1.89 based on the A value of 260/280, while for the isolates LB *E.coli*, NB *E.coli*, and LB *S.aureus* were also good, but there were few contaminants so that A score of 260/280 produces a value below 1.8 and more than 2.0.

DNA of *S. aureus* and *E. coli* bacteria that have been isolated and then analyzed for concentration and purity. The highest concentration of DNA was found in *E. coli* DNA which was cultivated on Nutrient Broth (NB) media with a concentration of 9.50 ng/μl, and the lowest concentration of isolated DNA was found in *S. aureus* DNA cultivated on Luria Bertani (LB) medium with a concentration of -0.20 ng/μl, which is considered as no DNA has been isolated from the medium. The absence of DNA from *S. aureus* bacteria can be caused by various factors, one of which is the Kit method used in DNA isolation. [10]-[14] states that DNA isolation using a kit cannot guarantee the DNA isolation process can be successful.

The value of the purity of the isolation of *E.coli* DNA on Nutrient Broth (NB) 1.61 and Luria Bertani (LB) 2.27 media was not good. The same thing also happened to the purity value of *S. aureus* DNA isolation in Luria Bertani (LB) 1.58 media, while the purity value of *S. aureus* DNA isolation in Nutrient Broth (NB) 1.8 media had a fairly good and decent quality. to be used in further analysis. According to Septiani and Pendrianto (2018), DNA has good quality if the purity value of bacterial DNA obtained is high, ranging from 1.75 to 1.9. The low value of purity (<1.75) indicates that it is contaminated by the presence of protein, whereas if the value of the purity of bacterial DNA obtained is more than 1.9, it indicates that the DNA isolation results are contaminated with organic compounds, such as ethanol[15]-[16].

4. CONCLUSION.

The highest DNA concentration was found in NB *E.coli* isolates at 9.50 ng/μl. The best level of DNA purity was found in the isolates of NB *S.aureus*, which was 1.89 based on the A value of 260/280, while for the isolates LB *E.coli*, NB *E.coli* and LB *S.aureus* were also good, but there were few contaminants so that A score of 260/280 produces a value below 1.8 and more than 2.0.

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The Effectiveness of Various Concentrations of Alcohol as Preservative of Bamboo Shells (*Ensis leei*) and Blood Clams (*Anadara granosa*)

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ABSTRACT

Laboratory activities and/or field practicum activities are one of the important activities. Preservation of specimens is an activity that is often carried out. Preservation of specimens is intended to maintain the condition of living things as they are in nature and their morphological structure (only slight changes) and free from bacteria and fungi that can cause decay. Bivalves are one of the best-preserved laboratory specimens. Bivalves that are often encountered in the field include blood clams (*Anadara granosa*) and bamboo shells (*Ensis leei*). Preservation of bivalves was carried out by dry preservation method and wet preservation using 70% alcohol. The purpose of this study was to determine the effectiveness of various concentrations of alcohol preservative solution for bivalves specimens. The research stages included dilution of alcohol solutions with various concentrations (90%, 85%, 80%, 75%, and 70%), bivalves sampling, preservation of bivalves samples in the laboratory, care and observation of bivalves specimens. The effectiveness of the alcohol solution was seen from the turbidity of the alcohol and the morphology of the bivalves. The data were analysed by quantitative descriptive method. The results of this study alcohol with a concentration of 70% effectively used as a preservative for blood clams and bamboo shells.

Keywords: *Alcohol concentration, Preservatives, Bamboo clams, Blood shells*

1. INTRODUCTION

Laboratory activities and/or field practicum activities are one of the important activities to be carried out. One of the practicum activities that are often carried out is the preservation of specimens. Preservation of specimens is intended to maintain the state of living things as in their habitat and the morphological structure (in this case only slight changes) and free from bacteria and fungi that can cause decay [1]. The SITH ITB Zoological Museum uses a collection storage method with a preservation method to reduce evaporation [2]. In addition, specimen preservation is also used as a learning medium for students, for example in the effectiveness and efficiency of practicum implementation. For example, the effectiveness and efficiency of the implementation of learning and practicum activities, as carried out at the Taxonomy

Laboratory of the Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya.

In the learning process and the function of specimens as learning media, preserved specimens in the laboratory must be in good condition, therefore, periodic maintenance of preserved specimens is necessary. Treatment of preserved specimens can be done in 2 ways, namely by wet preservation and dry preservation. The wet preservation method is carried out by preserving the specimen in a preservative liquid. Wet preservation is usually done for animals/plants whose size is large enough, or animals that have a soft body structure by being immersed in a preservative solution. While the dry preservation method is carried out by drying the preserved specimens until the water content becomes very low so that the destroying organisms do not work. Dry preservation of sufficiently large

preserved specimens in intact form is usually carried out by drying in the sun or in the oven. Small preserved specimens such as spores, powders extracts, fungi, plankton and slices of tissue or organs are preserved in the form of preparations microscopic (slides).

Bivalves are one of the best-preserved laboratory specimens. Bivalves that are often encountered in the field include blood clams (*Anadara granosa*) and bamboo shells (*Ensis leei*). In the laboratory, these types of bivalves are preserved by dry preservation (bivalve shell preservation). Preservation of wet specimens is rarely performed in bivalves. Research conducted by [3], preservation of shellfish specimens wrapped in cotton or cloth that has been soaked with formalin (2%) or alcohol (70%). After that the specimen is placed in a thick plastic bag and then stored in a plastic container or box to be brought to the laboratory. In the laboratory, it is transferred to a bottle that already contains a preservative solution (70% alcohol).

Wet preserved animals or wet collections use a preservative liquid, namely 70% alcohol. This liquid has antibiotic and antiseptic properties suitable for long-term preservation. This method is carried out so that wet-preserved specimens are not contaminated with bacterial spoilage organisms that can enter and live in the specimens. This method changes the preventive policy of wet collection preservation which used to use 4% formalin in the 1990s [2]. [4] showed that the shrimp preserved with 70% alcohol were overgrown with fungus. Therefore, this research is needed on the effectiveness of various concentrations of alcohol solution in this case with a higher concentration of alcohol solution as a preservative for bivalves specimens. Parameters of the effectiveness of the use of alcohol solution can be seen from the change in color, turbidity of alcohol, and morphological changes of preserved specimens.

2. RESEARCH METHODS

The type of research used is an observational experiment, namely by conducting experiments on preserved bivalves specimens with various concentrations of alcohol and observing for 3 months. Bivalvia sampling was carried out on the southern coast of Madura Island. Preservation and treatment of bivalves specimens was carried out at the Taxonomy Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, State University of Surabaya. This research was conducted from May to July 2022. The variables of this research included diluted alcohol content, namely alcohol with levels of 90%, 85%, 80%, 75%, and 70%. As well as the types of preserved bivalves, namely blood clams and bamboo shells, Parameters of the effectiveness of alcohol content as an appropriate preservative were measured from the turbidity of the alcohol (the longer the alcohol

concentration became turbid, the better the alcohol was used as a specimen preservative) and the physical changes of bivalves specimens. The research was carried out with the following stages.

2.1. Alcohol Dilution

Alcohol dilution with various concentrations ranging from the highest concentration to the lowest concentration, starting from a concentration of 90%, 85%, 80%, 75%, and 70%. The alcohol dilution formula follows the formula: and 70%. The alcohol dilution formula follows the formula: and 70%. The alcohol dilution formula follows the formula:

$$M1 \times V1 = M2 \times V2$$

2.2. Bivalve Specimen Collection

At this stage, the bivalve specimen used is a new specimen. Bivalve specimens used were feather clams, blood clams, bamboo shells. Bivalve specimens that have been obtained are put in a cool box, previously filled with blue ice to prevent spoilage when traveling to the laboratory. (3) Preservation of Bivalves Specimens, Bivalves that have been obtained are brought to the Taxonomy Laboratory to be preserved with alcohol in a preservation jar. Bivalve specimens were preserved for 1 x 24 hours. After being preserved with alcohol for 1 x 24 hours, the alcohol is replaced with a new one. (4) Treatment and Observation of Bivalves Specimens, Bivalvia specimens that have been replaced with alcohol are then arranged and observed for 3 months. Observations were made by paying attention to the alcohol turbidity and bivalves morphology, The data was collected by observing once a week on preserved bivalves specimens. Observations are made by filling in the instrument/observation table. The data obtained were analyzed by quantitative descriptive methods by describing the results of the collected observation tables.

3. RESULTS AND DISCUSSION

A1B1 Treatment (blood clams with 70% alcohol concentration), alcohol was turbid after the first turn until the second day. On the third to tenth day, the alcohol remains clear. On the first day of observation, the shell of the blood clams was slightly opened and a precipitate of crushed mussel meat was formed. In the A1B2 treatment (bamboo shells with 70% alcohol concentration), it was not much different from the A1B1 treatment. During the first 24 hours, a precipitate is formed from the crushed flesh of bamboo shells. The shell of the bamboo clam is exposed and the flesh of the bamboo clam is rough.

Table 1. Table of Observations of Blood Clams and Bamboo Shells with Alcohol Concentrations of 70%, 75%, 80%, 85%, and 90%. Short cut keys for the template

Specimens Day	The alcohol turbidity			Bivalves morphology		
	1	5	10	1	5	10
A1B1	Cloudy, yellowish (+)	Limpid	Limpid	Slightly open shell (1 out of 10 pieces, a crumbled shellfish precipitate forms)	Slightly open clam shells (2 of 10)	Slightly open clam shells (3 of 10)
A2B1	Cloudy, yellowish (++)	yellowish (+)	Limpid	Slightly open shell (2 out of 10 pieces) a crumbled clam meat precipitate formed	Slightly open clam shells (3 out of 10)	Open clam shells (4 of 10 pieces)
A3B1	Cloudy, yellowish (+++)	yellowish (++)	Limpid	Slightly open shell (1 out of 10 pieces) a crumbled clam meat precipitate formed	Slightly open shell (3 out of 10 pieces) a crumbled clam meat precipitate formed	Open clam shells (4 of 10 pieces)
A4B1	Cloudy, yellowish (+++)	yellowish (++)	Limpid	Slightly open shell (1 out of 10 pieces) a crumbled clam meat precipitate formed	Slightly open shell (3 out of 10 pieces) a crumbled clam meat precipitate formed	Slightly open shell (4 out of 10 pieces)
A5B1	Cloudy, yellowish (++++)	yellowish (++)	Limpid	Slightly open shell (1 out of 10 pieces) a crumbled clam meat precipitate formed	Slightly open shell (4 out of 10 pieces) a crumbled clam meat precipitate formed	Slightly open shell (5 out of 10 pieces)
A1B2	Cloudy, yellowish (+)	Limpid	Limpid	At the bottom of the specimen jar formed deposits of crushed bamboo shell meat. The shell has opened.	No precipitate is formed, rough textured meat	No precipitate is formed, rough textured meat
A2B2	Cloudy, yellowish (++)	yellowish (+)	Limpid	At the bottom of the specimen jar formed deposits of crushed bamboo shell meat. The shell has opened.	No precipitate is formed, rough textured meat	No precipitate is formed, rough textured meat
A3B2	Cloudy, yellowish (++)	yellowish (++)	Limpid	At the bottom of the specimen jar formed deposits of crushed bamboo shell meat. The shell has opened.	No precipitate is formed, rough textured meat	No precipitate is formed, rough textured meat
A4B2	Cloudy, yellowish (+++)	yellowish (+++)	Limpid	At the bottom of the specimen jar formed deposits of crushed bamboo shell meat. The shell has opened.	No precipitate is formed, rough textured meat	No precipitate is formed, rough textured meat
A5B2	Cloudy, yellowish (++++)	Yellowish (+++)	Limpid	At the bottom of the specimen jar formed deposits of crushed bamboo shell meat. The shell has opened.	No precipitate is formed, rough textured meat	No precipitate is formed, rough textured meat

Information:

A1B1 = alcohol 70%, blood clams

A2B1 = alcohol 75%, blood clams

A3B1 = alcohol 80%, blood clams

A4B1 = alcohol 85%, blood clams

A5B1 = alcohol 90%, blood clams

A1B2 = alcohol 70%, bamboo shells

A2B2 = alcohol 75%, bamboo shells

A3B2 = alcohol 80%, bamboo shells

A4B3 = alcohol 85%, bamboo shells

A5B4 = alcohol 90%, bamboo shells

A2B1 treatment (blood clams with 75% alcohol concentration) in the first 24 hours, the color of the alcohol was cloudy yellowish. The alcohol was then changed daily until the fifth day. On the sixth day, the alcohol is clear. The A2B2 treatment (bamboo shells with 75% alcohol concentration) was also not much different from the A2B1 treatment. The first 24 hours during the alcohol preservation process became cloudy and more meat deposits were formed than in the A1B2 treatment. On the fifth day, the alcohol was still yellowish in color. At the turn of the sixth day until

now, the alcohol alcohol remains clear.

A3B1 treatment (blood clams with 80% alcohol concentration) in the first 24 hours experienced more turbidity than A3B1 treatment. At the fifth turn the color of the alcohol remained yellowish but not as dense as the second, third and fourth days. The shell of the blood clam in the first 24 hours is slightly open. The specimen bottle also formed more precipitate than the A3B1 treatment. Treatment A3B2 (bamboo shells with an alcohol concentration of 85%) until the change of alcohol on the sixth day, the alcohol was yellow although not as thick as the change of the first day to the fifth day. The shells of the bamboo shells are all exposed. The flesh of the bamboo shells has a rough texture.

A4B1 treatment (blood clams with an alcohol concentration of 85%) in the first 24 hours was cloudy and dark yellow in color, there were deposits from shellfish meat. Alcohol continues to be replaced every day, at the turn of the fifth day, alcohol is clear yellow. Alcohol was changed daily until the eighth day. A4B2 treatment (bamboo shells with an alcohol concentration of 85%), in the first 24 hours, the alcohol was thick yellow and cloudy. The flesh of the bamboo shells was crushed so that a precipitate formed at the bottom of the specimen jar. On the next day there was no precipitate but the alcohol was yellow until the seventh day. The flesh of the bamboo shells has a rough texture.

The treatment of A5B1 (blood clams with 90% alcohol concentration) in the first 24 hours of alcohol was thick yellow and a white precipitate formed at the bottom of the specimen jar, and the shells were slightly open. Alcohol continued to be replaced until the ninth day. On the tenth day of observation, more and more blood clam shells were opened, but the alcohol was already clear in color so it didn't need to be replaced anymore. In the A5B2 treatment (bamboo shells with 90% alcohol concentration), in the first 24 hours the alcohol was dark yellow, a white precipitate was formed at the bottom of the specimen bottle from crushed bamboo shell meat. The shell of the bamboo shell is also exposed. The flesh of the bamboo scallops is coarsely textured. Alcohol continued to be replaced until the ninth day. On the tenth day of alcohol change, the alcohol is clear in color.

In this study, the higher alcohol concentration, the more turbid the alcohol solution was, so the alcohol in the specimen bottle needed to be changed every day. This is because the alcohol which was originally clear, becomes yellow after mixing with the preserved specimens. In addition, the higher alcohol concentration causes the preserved specimens to wrinkle. Alcohol is a good preservative but alcohol has the disadvantage that it dehydrates the specimen and dissolves certain pigments such as proteins and lipids from the specimen [5]. Alcohol also causes shrinkage of the specimen so that the texture of the specimen becomes rough. Alcohol at higher concentrations acts as a dehydrator which means it removes and replaces water in cells, tissues, or whole-body specimens with alcohol. Alcohol is hypertonic so it causes the water or solution in the specimen to shrink, this is known as crenation. Crenation is the event that the concentration of the solution outside the cell is higher than the concentration of the solution inside the cell.[6]. The reduced water causes changes in the protein in the specimen and causes texture specimens become rough [7]. In line with research [8] Ethanol concentrations at or above 90% make insects more fragile and result in more shrivelling, but insects with stronger or sclerotized exoskeletons actually retain more of their appendages at higher concentrations. However, insect morphology is severely damaged if allowed to dry.

4. CONCLUSION

Alcohol with a concentration of 70% is effective as a preservative solution in bamboo shells and blood clams. A higher alcohol concentration makes the color of the alcohol as a preservative change so that the alcohol is replaced more often. The meat of the bamboo mussels becomes rough after being preserved and the fragile condition of the mussel meat is separated from the shell so that a precipitate is formed. The shell of the blood clam was slightly exposed. Researchers hopes there are further studies related to alcohol concentrations lower than 70% alcohol or other preservatives as preservatives for specimens in the laboratory due to the inefficient and economical use of alcohol.

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Synthesis and Characterization of *Aloe vera* – Chitosan – Snail Mucus as *Staphylococcus aureus* Anti-bacterial Topical Treatment

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ABSTRACT

An open wound not treated immediately and properly can cause an infection. It is primarily caused by the bacteria activity that grows in the wound, such as the growth of *Staphylococcus aureus*. This study aims to synthesize and characterize aloe vera gel, chitosan and snail mucus as anti-staphylococcal aureus. In this study, the synthesis of aloe vera gel, chitosan and snail mucus were carried out with variations concentrations of snail mucus. The resulting gel preparations were characterized physically and chemically. It was shown that the functional group of the gel preparation experienced a wave number shift, indicating a chemical reaction between aloe vera, chitosan and snail mucus. The antibacterial test showed that the diameter of the highest inhibition on the growth of *Staphylococcus aureus* was in a ratio of 1:1:1 *in vitro*.

Keywords: *aloe vera-chitosan-snail mucus; Staphylococcus aureus; anti-bacteria*

1. INTRODUCTION

Staphylococcus aureus is a gram-positive bacterium that becomes a leading cause of 20 - 50/100,000 bacteraemia cases which 10% - 30% of patients succumb to the infection annually [1-2]. Its infection can be superficial and invasive due to its ability to adapt its metabolic activity and virulence response in numerous host tissues [6-8]. Traditionally, nostrils were considered the predominant location of the *S. aureus*, with 20-30% of the adult human. However, it can be found in many skin sites, including the intestine [2-3]. It can infect nearly all host tissue and causes countless apparent skin infections and probably millions of severe infections globally [4-5]. The range of infections are from moderate skin infections such as abscesses, wound infections and furuncles to systemic disease due to epithelial protective layer breaches that can be life-threatening. Besides, due to cuts, *S. aureus* infection also can be found in diabetic patients, which can be life-threatening, and alternative natural based-treatments are critical [9-11].

Aloe vera is a medicinal plant that belongs to the Liliaceae family and has been used in traditional medicine for more than 5,000 years. Due to its high

antimicrobial activity, it has been used as a topical medication for skin infections, from cuts to bacterial infections. High antimicrobial activity was observed against gram-positive bacteria *Staphylococcus aureus* and *Bacillus subtilis*, also gram-negative bacteria *Pseudomonas aeruginosa* and *Escherichia coli* [15-17]. Previously, it was found that its antimicrobial activity can inhibit the growth of *Bacillus subtilis*, *Staphylococcus aureus*, *Mycobacterium tuberculosis*, *Streptococcus pyogenes* and *Salmonella paratyphi* [12-14]. Another traditional medication that is known to have antimicrobial activity is snail mucus.

Chitosan is a polysaccharide with the structure of - (1,4)-2-amino-dioxy- β -D-glucose, which is synthesized by deacetylation of chitin from crustaceans. The applications of chitosan in the medical world include wound healing. The chitosan solution 2% accelerates the wound healing process both macroscopically and microscopically. Many research results report that chitosan has the potential to accelerate wound healing because of its non-toxic, bioactive, biocompatible, antibacterial, antifungal to biodegradable properties [19]. In this study, we would like to investigate the potential natural based-topical treatment for *S. aureus* infection by

combining aloe vera with chitosan and snail mucus as an alternative treatment.

2. METHOD

2.1. Synthesis of Aloe vera Gel Preparations in Combination with Chitosan

Aloe vera stems are washed under running water and separated between the green bark and gel. Next, it is blended and placed in a sealed container [19]. 1.5% chitosan solution (w/v) was prepared with 1% CH₃COOH solution (v/v). For Aloe vera (Av) combined with chitosan (K) gel preparation, 80 grams of aloe vera were synthesized. There are three variations of these combinations, AvK1, AvK2, and AvK3, whose formulation is presented in Table 1.

Table 1. Formulation of the aloe vera gel preparation in combination with chitosan and snail mucus

Materials	Concentration (%)					
	Av:Mu cus: K 1:1:1 (AvM K1)	Av:Mu cus: K 1:2:1 (AvM K2)	Av:Mu cus: K 1:3:1 (AvM K3)	A v	M	K
<i>Aloe vera</i>	10	10	10	3 0	0	0
Snail mucus	10	20	30	0	3 0	0
Chitosan 1,5%	10	10	10	0	0	3 0
Na-CMC	1	1	1	1	1	1
Glycerin	10	10	10	1 0	1 0	1 0
Propylene glycol	5	5	5	5	5	5
Demi water	100	100	100	1 0 0	1 0 0	1 0 0

Na-CMC powder was dissolved in a portion of demi water at 80 °C then glycerin and propylene glycol were added while stirring [20]. *Aloe vera* gel and 1.5% chitosan solution are added, then snail mucus and demi water is added until it reaches 80 grams and stirred until a homogeneous gel is formed. 1.25% (w/v) NaOH solution is added until it reaches a pH of 6.5-7.0. This treatment is carried out with the same procedure for each variation.

2.2. Organoleptic Test

An organoleptic test was performed to observe aloe vera gel preparations combined with chitosan and snail mucus with several parameters, including color, aroma, and texture.

2.3. Viscosity Measurement

Viscosity (η) is measured using a Hoppler viscometer by calculating the ball fall time (t). The Density (ρ) of the chitosan combination aloe vera gel preparation is obtained by calculating the fluid mass (m), which is the difference in the weight of the picnometer is fully charged with an empty picnometer and divided by the volume of the picnometer (V).

$$\rho = \frac{m}{V} \quad (1)$$

$$\eta = K_{bola} (\rho_{bola} - \rho_{fluida}) t \quad (2)$$

2.4. Functional Group Cluster Identification

The functional groups of aloe vera gel preparations in combination with chitosan and snail mucus were identified using a Fourier Transform InfraRed (FTIR) spectrophotometer.

2.5. Antibacterial Test of *Staphylococcus aureus*

All metal tools are sterilized with incandescent flames and cooled [20]. The non-metallic appliance was sterilized using an autoclave (wet heating) at 121°C for 15 minutes. Nutrient Agar (NA) was prepared from 2.8 grams of NB and 3.5 grams of agar dissolved in 350 mL of demi water. Liquid medium is prepared from 0.48 grams of NB dissolved in 60 mL of boiled demi water. Both media were homogenized and heated by using a hot plate and stirred. Erlenmeyer NA media is covered using cotton swabs and aluminium foil, then autoclaved at 121°C for 15 minutes. A 10 mL bacterial suspension prepared from 1 mL of *Staphylococcus aureus* stock was added to 9 mL of aseptically cooled NB liquid medium, then incubated at 37°C for 18 hours. 1 mL of bacterial suspension is put in a petri dish, and 25 mL of sterile liquid NA media is added. The substrate is allowed to stand in the aseptic laminar for 15 minutes until it freezes. 5 mm diameter disc paper is immersed in each sample with the same volume that has been injected and arranged on the media. Incubated at a temperature of 37°C for 18-24 hours, then measured the diameter of the clear zone formed using a ruler.

2.6. Statistical analysis

Statistical analyses of one-way ANOVA were performed using Prism 7 (GraphPad).

3. RESULT AND DISCUSSION

3.1. Characterization of aloe vera gel in combination with chitosan and snail mucus

Previous research by Susanti & Cahyaningrum 2020 successfully formulated the combination of aloe vera gel with chitosan for its antibacterial potential as a topical medication for skin infection [22]. In this study, snail mucus was added to this formulation in confidence it could add antimicrobial activity to the drug. It was observed that adding 1.5% chitosan with the addition of NA-CMC, glycerine and propylene glycol was effective. These combinations also do not cause irritation and dry skin.

Table 2. Organoleptic observation table from the formulation of aloe vera gel in combination with chitosan and snail mucus

Parameters	Av: Mukus: K 1:1:1 (Av MK)	Av: Mukus: K 1:2:1 (Av MK)	Av: Mukus: K 1:3:1 (Av MK)	Av	M	K
Colour	Yellow	Yellow-brown	Brown	Transparant-green	Brown-green	Clear yellow
Smell	distinctly scented	distinctly scented	distinctly scented	distinctly scented	distinctly scented	distinctly scented
Textures	thick	slightly viscous	slightly viscous	thick +	runny	Thick ++

Organoleptic tests were performed to observe the physical characteristics of the formulation. The higher the concentration of snail mucus, the more distinct the physical appearance compared with the other samples (Table 2). It became brownish, slightly viscous and had distinct smells. Viscosity and colour change might be caused by a higher concentration of snail mucus, which has a brownish colour and runny textures. Meanwhile, in lower concentrations of snail mucus, the colour is become more yellow, which might be caused by the colour of chitosan and has thicker textures from aloe vera. A less viscous texture is more favourable because it can help better the application of the gel to the infected skin.

To validate the viscosity observation, each gel formulation was measured by using viscometer. The larger the viscosity value, the gel is thicker and slower the flowing speed. It was observed that the viscosity of aloe vera in combination with snail mucus and chitosan has a smaller viscosity value of around 0.4 mPa.s (Table 3). Interestingly, the higher the snail mucus concentration, the viscosity value is hardly increased. This measurement did not correspond directly with the organoleptic observation, in which the higher concentration of snail mucus, the runnier the texture is. However, the viscosity value is similar across combinations, making the viscosity difference between combinations small.

Table 3. Observation of viscosity measurements

Samples	Av: Mukus: K 1:1:1 (Av MK)	Av: Mukus: K 1:2:1 (Av MK)	Av: Mukus: K 1:3:1 (Av MK)	Av	M	K
Density (g/cm ³)	1,8926	1,8933	1,8939	1,8909	1,8943	1,883
Kinds of ball	2	2	2	2	2	6
Ball's Constant (mPa.s cm ³ /g.s)	0,09	0,09	0,09	0,09	0,09	33
Ball's Density (g/cm ³)	2,2	2,2	2,2	2,2	2,2	8,1
Time of ball falling (s)	15,3333	16	16	193,667	16,3333	15,6667
Viscosity (mPa.s)	0,424211078	0,441648	0,440784	5,387622273	0,449378	3214,196

To validate the viscosity observation, each gel formulation was measured by using viscometer. The larger the viscosity value, the gel is thicker and slower the flowing speed. It was observed that the viscosity of aloe vera in combination with snail mucus and chitosan has a smaller viscosity value of around 0.4 mPa.s (Table 3). Interestingly, the higher the snail mucus concentration, the viscosity value is hardly increased. This measurement did not correspond directly with the organoleptic observation, in which the higher concentration of snail mucus, the runnier the texture is. However, the viscosity value is similar across combinations, making the viscosity difference between combinations small.

Next, functional group identification was determined by using FTIR. Identification of aloe vera (Av) gel functional groups showed stretching vibrations of O–H and N–H, which were at 3305 cm⁻¹ (Figure 1). There are C=O stretching vibrations seen in the absorption band of wave number 1631 cm⁻¹, C-H bending vibrations at a wavelength of 1449 cm⁻¹, and C-O stretching vibrations at a wavelength of 1046 cm⁻¹. The functional group of the Chitosan (C) gel was identified as having O–H and N–H stretching vibrations which were seen in the absorption band of 3356 cm⁻¹. C=O stretching vibration of the acetyl group was seen in the band of wave number 1636 cm⁻¹ and C-H bending vibration at a wavelength of 1427 cm⁻¹, as well as a C-O stretching vibration at a wavelength of 1040 cm⁻¹.

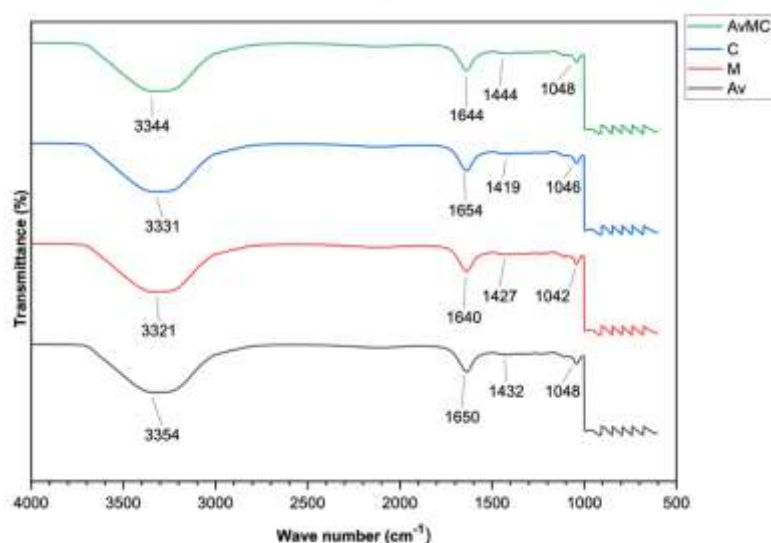


Figure 1. FTIR spectrum from measurements of the aloe vera: snail mucus: chitosan 1:1:1 (AvMC₁). Chitosan (C), Snail mucus (M), dan Aloe vera (Av)

Meanwhile, AvMC₁ gel, a combination of Aloe vera, chitosan and snail mucus, experienced a shift in the FTIR spectra as indicated by the O–H and N–H stretching vibrations at the wavelength absorption band of 3344 cm⁻¹. The C=O stretching vibration of the acetyl group was identified at a wavelength of 1644 cm⁻¹, the C–H bending vibration at a wavelength of 1427 cm⁻¹, and the stretching vibration of C–O at a wavelength of 1048 cm⁻¹. This observation shows that the combination of Aloe vera, chitosan and snail slime showed a shift in the spectra as indicated by the O–H and N–H stretching vibrations at the 3379 cm⁻¹. This characterization shows that the combination of aloe vera, chitosan and snail mucus has a favourable texture for topical medication even though there is a shift in the functional group spectra.

3.2. *Staphylococcus aureus* anti-bacteria test

Aloe vera and snail mucus were infamous for centuries as antibacterial agents used in traditional medicine. Aloe vera is known to have antibacterial activity and bacteriostatic against *Staphylococcus aureus* as a topical medication from various parts of the plant

with a wide range of concentrations. Likewise, snail mucus was also observed to have antimicrobial activity against *S. aureus*. After formulation and characterization of the aloe vera with chitosan and snail mucus, its antibacterial activity is tested using agar well diffusion methods. In this assay, a clear or inhibitory zone around the disc paper will be formed when the substance/drug has antibacterial activity against the tested bacteria. Upon the antibacterial assay, we observed that the equal ratio of chitosan, aloe vera and snail mucus give the largest clear zone (Figure 2). It means that this has the highest antibacterial activity compared with other combinations.

Meanwhile, with the higher ratio of snail mucus, the clear zone that formed is reduced significantly. This observation is unexpected because it was expected that the combination of higher snail mucus concentration would give the most significant inhibitory effect as a synergistic effect of antimicrobial activity from aloe vera and chitosan. However, this observation also shows an optimal concentration/ratio between compositions that would give the most effective antibacterial effects.

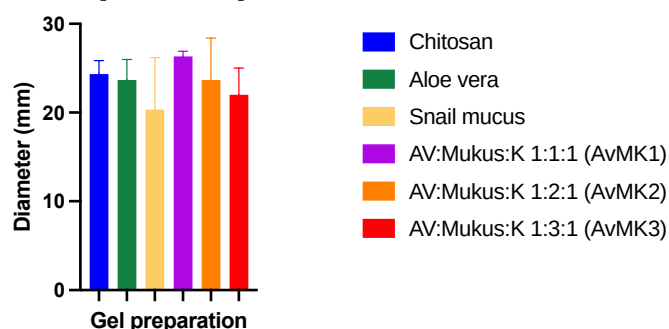


Figure 2. Clear zone observation from the agar well diffusion assays of *S. aureus* with formulation combination. (n=3 for each group, p-value <0.5)

Based on these observations, further research can find the optimal concentration or ratio between the composition to give the best form and most effective antibacterial effects. It is not only crucial for the *S. aureus* infection due to cuts but also for a skin infection caused by diabetes. Skin and soft tissue infections (SSTIs) are one of the skin infections caused by *S. aureus* often found in the limbs of diabetic patients. It could occur from mild to life-threatening infections, and sometimes amputations of the limbs are necessary to prevent a higher chance of morbidity. It becomes crucial to find a better natural-based medication for skin infections, especially those caused by *S. aureus*, as an alternative to chemical-based medicines.

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Training Load of Para-Swimming Athletes on Preparation Phase: National Champion Vs. Not

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ABSTRACT

The success of implementing the training program is supported by the role of the trainer in formulating a strategy for changing the training load in the training program, which aims to push the limits of adaptation and avoid overtraining, injury, and detraining. The study aimed to compare the internal training load of a group of para-swimming athletes who received medals vs. those who did not. The research method used in this study was a retrospective cohort (historical cohort). The research data used in this study is secondary data (historical data), which consists of collecting data on weight training swimming athletes for 13 weeks, and data provided by coaches and athletes during the training program. Subjects consisted of seven para-swimming athletes. The data analysis technique used is the mean, standard deviation, and different tests using Mann-Whitney. The results showed that there was a significant difference in the session rate of exertion (sRPE) between the two groups ($p < 0.000$), and there was a significant difference in the Arbitrary Unit (AU) between the two groups ($p < 0.000$), and there was no e. the difference in exercise duration between the two groups ($p > 0.000$). In conclusion, swimming athletes who do not get medals have a much higher internal training load than those who get awards.

Keywords: Athletes, Disability, Para Swimming, Rating of Perceived Exertion, Training Load

INTRODUCTION

The role of exercise periodization occupies the most crucial position in helping athletes achieve maximum performance. The coach systematically develops the training program by paying attention to and considering the training load (TL) setting and each athlete's recovery strategy, which helps push the limits of training adaptation and avoid the harmful effects of training. The negative impacts include overtraining, injury, and detraining [1]. Monitoring the training load is a reference for

coaches to develop correct and appropriate training programs for athletes. The success of implementing the training program is closely related to monitoring the training load carried out by the trainer. Therefore, monitoring the training load must be done, especially in the achievement sports environment. The smooth monitoring of the training load is supported by the professionalization of the trainer, support for sports science, and technological developments [2].

Monitoring the training load has a multi-dimensional nature, meaning that the implementation of monitoring the training load is carried out by combining training variables, which are divided into two, namely monitoring internal loads and external loads [3]. External training load monitoring includes monitoring the training load measured using distance, speed, exercise volume, power output, duration, and so on [4]. While the measurement of internal training load is measured using heart rate, biological, psychological stress, rate of exertion session (sRPE), and so on [5].

Previous research has stated that monitoring the training load is important, especially in the achievement sports environment. The application of a training load that is too heavy without paying attention to a good recovery strategy can trigger negative impacts, such as the occurrence of overtraining conditions. In contrast, applying a training load that is too light without applying the principle of progressive overload training can trigger detraining conditions [1]. Based on these conditions, proper manipulation of the training load is needed to produce maximum training results for athletes [6]. Conventionally, training load monitoring is measured using measurement variables such as strength, speed, repetitions, acceleration, and global positioning system parameters. These monitoring variables are called external training load monitoring [2]. At the same time, other studies focus on monitoring the internal training load, including measurements of heart rate, lactic acid, oxygen consumption, energy assessment (RPE), and RPE sessions (sRPE) [8].

Monitoring the training load can be carried out by utilizing equipment and technology, including heart rate monitors, GPS, and smartphone applications. This equipment is considered a contemporary measuring instrument and requires costs ranging significantly from hundreds to millions of rupiah depending on the number of athletes used [9]. Based on this, several previous studies provide recommendations for more straightforward exercise load monitoring. The measurement of the training load that is considered simple and easy to do is the

measurement using the RPE. Internal load monitoring using the RPE method was assessed as a valid, reliable, non-invasive, and accessible measurement [10]. Several previous studies used internal training load (TL) monitoring using a measuring instrument in the form of lactic acid and heart rate monitoring, a very commonly used measuring instrument [11]. Meanwhile, this study uses internal training load measurement parameters such as sRPE. An sRPE measurement method is a measuring tool that uses an objective measure of training load (time), which interacts with subjective load (RPE), resulting in an exercise load index in arbitrary units (AU) [12].

Previous research has stated that there is a discrepancy between the training program planned by the coach and that given to athletes who have the potential for adverse outcomes to occur in the training program that has been prepared [15]. Trainers need to pay attention to the interpretation of the sRPE data because if there is an error in the interpretation of the sRPE data, it can result in errors in the control and planning of other training programs [11]. The interpretation of the measurement of the training load in the exercise program is carried out correctly to balance strength and recovery strategies to produce positive exercise adaptations as a result of the training stimulus [16]. The interpretation of the training load is a challenge for the trainer because the results of monitoring the training load are used as a reference in preparing a good training program to produce a good training stimulus [17].

Monitoring the training load plays a significant role in planning and preparing exercise programs [16]. First, the training load assesses athletes trained as planned or as expected. Based on this, collaboration between coaching and creativity is needed that is carried out in harmony [18]. Based on this, it is vital to monitor the athlete's perception of effort and the implementation of the exercise program [17]. Furthermore, the training load monitors the athlete's response to the training program. Finally, the training load is used to regulate exercise stimulation to increase the effectiveness of the exercise to minimize the occurrence of exercise maladaptation [19].

Monitoring the training load is used as a daily control tool using athletes' and coaches' feedback. Daily control aims to improve the athlete's physical performance and prevent the risk of injury and the adverse effects of the given training [20]. One of the efforts made is to manipulate the training load on an exercise program that is structured to harmonize with the planned load. The trainer must be careful in implementing the measurement using the sRPE. The sRPE method is measured subjectively to measure the internal load of the training program that is structured and run and can serve as a tool to optimize the training process [21]. Therefore, this study aims to prove a difference between the training load felt by medal-winning athletes and athletes who did not win medals.

This study aims to identify TL monitoring practices in athletes and is the first to explore these concepts in an integrated manner in this population. Furthermore, this survey explores whether there is a difference in training load between the medal-winning and non-medalist groups. Therefore, secondary data on training load is required for data analysis. Based on this, data collection in the field requires the contribution of a swimming coach who is responsible for monitoring TL data collection.

METHODS

This study uses a retrospective cohort research method (historical cohort). This study design examines the risk factors and impact of interventions that have occurred in the past and before the start of the study. Therefore, the data in this study were obtained through historical records. The research data analyzed is secondary data (historical data), a collection of data on the athlete's training load for 13 weeks. During the data collection process, the contribution of coaches and athletes is needed.

The data collected include sRPE, AU, and duration of athlete training. The research subjects used were para-swimming athletes consisting of seven athletes. The purpose of the study was to prove that there was a difference in the internal training load between the para-swimming athletes who received medals and

the para-swimming athletes who did not get medals. Technical analysis of the data used is the mean, standard deviation, and different tests using Mann-Whitney.

RESULT

Table 1. Descriptive data of the training load of para-swimming athletes who won medals

	Min	Max	Mean & SD
sRPE	6,78	8,27	7,755 ± 0,591
AU	466,39	678,98	588,422 ± 81,089
Duration of training (minutes)	61,4	82,17	72,859 ± 7,914

The minimum, maximum, mean, and standard deviation of the training load for the group of para-swimming athletes who won medals on table one. The RPE scale ranges from 0 to 10 (0 being no power and 10 being maximum effort).

Table 2. Descriptive data of training load of non-medal para-swimming athletes

	Min	Max	Mean & SD
sRPE	8,35	8,76	8,552 ± 0,293
AU	683,36	692,2	687,780 ± 6,250
Duration of training (minutes)	77,92	80,14	79,030 ± 1,569

Based on table two, a set of training load data is explained by the group of para-swimming athletes who did not get medals. When compared to the average training load in

the medal-winning para-swimming group, as shown in table 1, the non-medal para-swimming athlete group had a higher average training load.

Table 3. The difference test between groups A and B

	Group		P
	Group A	Group B	
sRPE	7,755 ± 0,591	8,552 ± 0,293	0,00
AU	588,422 ± 81,089	687,780 ± 6,250	0,00
Duration of training (minutes)	72,859 ± 7,914	79,030 ± 1,569	2,00

Table three shows data on the average difference in training load between groups of para-swimming athletes group who got a medal (group A) and the para-swimming athlete group who did not get a medal (group B) showed data on the difference in average training load. The training load data collected included sRPE, AU, and exercise duration data. The table explains that the average training load in the para-swimming athlete group who did not get a medal (group B) was higher than the para-swimming athlete group who got a medal (group A). The table also explains that after a different test using the Mann-Whitney test. It is said that there is a difference in sRPE between group A and group B ($p < 0.000$), there is a difference in AU between group A and group B ($p < 0.000$), and there was no difference in exercise duration between groups A and B ($p > 0.000$).

DISCUSSION

An increase in the professionalism of athletes in achievement sports correlates with

an increase in the training load in terms of intensity and volume. Therefore, athletes' achievement success is closely related to preparing a careful training program. The successful implementation of the training program is supported by the role of the trainer in formulating a strategy for changing the training load in the training program, which aims to push the limits of adaptation and avoid overtraining, injury, and detraining [22].

Previous research has shown that a high training load without a good recovery strategy can lead to unwanted adverse effects. In contrast, the training load that does not pay attention to the principle of progressive overload training does not produce the necessary adaptation (detraining) [23].

Facts show that achievement is not only caused by internal training load interpretation factors (sRPE). The athlete's experience in the sport that is occupied and the flying hours possessed by the athlete determine the athlete's achievement [24]. In addition, each athlete's technical skills, technical efficiency, athlete psychology, and athlete's recovery strategy can affect physiological responses. Facts on the ground show that the average sRPE value in para-swimming athletes who did not get medals was more significant than the average sRPE value in the group of para-swimming athletes who got medals. This was due to the para-swimming athletes who got medals had better experience and flying hours than the para-swimming athletes who did not get medals. In addition, the para-swimming athletes who got medals had a better physical level than the para-swimming athletes who did not get medals.

So it can be concluded that a trainer not only quantifies the internal training load (sRPE) but needs to pay attention to other factors. Previous research has shown that monitoring of technical skills (biomechanics) in athletes is also necessary. The research subjects are para-swimming athletes with special body conditions [26]. Thus the measurement of internal training load (sRPE) must also consider biomechanical factors [27]. Previous studies have shown that the use of internal loads (sRPE) in combination with specific external loads in the preparation of an exercise program

increased training outcomes from week to week in swimmer training compared to using internal loads (sRPE) alone [24]. Based on this, it is recommended that coaches consider factors other than internal load monitoring in developing a strategy for changing training programs [28].

Furthermore, using more complex external load measures in this study may not be necessary; therefore, we suggest that coaches use simple measures to measure external loads, such as biomechanical elements possessed by athletes. In addition, it is advisable to measure other internal loads, such as the athlete's psychological recovery and recovery strategy. Internal loads such as SRPE are used to monitor exercise stress more optimally and individually in swimmers [27].

Previous studies have suggested optimizing swimming performance involves physical, physiological, and biomechanical changes [28]. Therefore, the success of an exercise program in achieving an athlete's achievement is not only supported by monitoring the internal training load but also by monitoring the external training costs. The relationship between training load and performance in sports has been studied for decades. The critical point of performance optimization is the prescription of training by the coach, physical trainer, or athlete. Programming involves various exercise modalities (i.e., the type of exercise regarding the physical quality that needs to be done), and the training load is adjusted [7]. The training load is usually separated into external loads determined by the athlete's work, regardless of the internal characteristics and internal loads that follow the psycho-physiological stresses imposed on the athlete in response to external loads.

Based on the description that has been described, it can be concluded that monitoring the internal training load (sRPE) is not the only determinant of an athlete's success in achieving athlete achievement. Monitoring the training load, particularly the internal training load (SRPE), can be used as a measuring tool to monitor ongoing programs aimed at determining recovery strategies and preventive

measures to prevent overtraining and detraining [29].

CONCLUSION

This study concludes that there is a difference in the internal training load (sRPE) between the athletes in the para-swimming group who received medals and the para-swimming athlete group who did not get a medal. Furthermore, the para-swimming athletes who did not get medals had a higher internal training load than those who got medals.

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Identification Of Student's Psychological Wellbeing On Pondok Pesantren

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ABSTRACT

The myriad of problems faced by freshmen, especially those related to psychological well-being, prompted this research. In Indonesia, each Islamic boarding school has different characteristics due to various regulations and curriculum models. For new students, this causes various inconveniences, learning challenges, adaptation challenges, and others. This study tries to determine the psychological well-being of students to assist in planning reinforcement and assist in solving problems presented by new students. The survey is a research methodology used in this study. The psychological well-being scale is the instrument used to collect data. According to research, 76% of first-year students struggle with mental health issues. New student concerns support these findings, including dissatisfaction with their student accommodations, their desire to return home, and their difficulty making friends. Some *pesantren* students show disobedient behavior towards the rules at the *pesantren*, frequently arrive late for several *pesantren* activities, and get frustrated quickly with their buddies.

Keywords: *psychological well-being, Islamic boarding school.*

1. INTRODUCTION

The educational institution *pesantren* stands out from other academic institutions due to one feature. The defining qualities in question are Islamic boarding school ideals that set the tone for *Kiai*, *ustadz*, and *santri*'s social interactions [1]. Both the modernization and the globalization trends have made inroads into boarding schools. For *pesantren*, this poses a unique difficulty. Islamic boarding schools are required to uphold their *pesantren* traditions to be considered "original" or "indigenous" Indonesian institutions [2]. However, with everything they provide, *pesantren* cannot resist modernization and globalization. This difficulty indirectly brings forward significant alterations in *pesantren*. Several Islamic boarding institutions accept students from madrasas, schools, and even colleges for the first time. According to Lukens Bull (2001), the four primary components of the curriculum seen in contemporary *pesantren* are general education (schools), character development, occupational skill training, and religious instruction (*ngaji*).

Student demographics, age, gender, instructor skill, *pesantren* ideals, *pesantren* culture, student issues, diversity of student characteristics, as well as other factors are among the distinctive features of Islamic boarding schools [3], [4], [5], [6].

Researchers conducted interviews with the Miftahul Ulum Jabung Islamic boarding school administration and gathered information about the issues of new students feeling uncomfortable in their new environment, challenges with adjusting, and learning challenges that caused many students to think out of place; some were frequently observed crying alone. Psychologically, they struggle with feelings of rejection and discomfort in an unfamiliar environment.

The Miftahul Ulum Jabung Islamic Boarding School aspires to be a premier institution of higher learning in studying religion, science, technology, and the humanities. Sukolilo Jabung Malang is where the Salafiyah Islamic Boarding School Miftahul Ulum is located. In 1348 H/1963, KH. Ahmad Badri Rofi'i created it. Students already resided in mukim in 1963 but were still restricted to the Sukolilo village area.

Problems with students will impede their growth and interfere with their ability to study. In 1989, Ryff created the psychological well-being theory. The term "psychological well-being" refers to a person's sentiments about daily life and the many activities they engage in daily when encountering several challenges and issues that oppose their particular mental state.

Ryff describes psychological well-being as the desire to explore one's potential [8]. This tendency may lead a person to give in to circumstances that lower their psychological well-being or to strive to change their living circumstances to enhance their psychological well-being [7].

From these various definitions, psychological well-being is an urge to explore one's potential and have the capacity for self-acceptance, personal growth, purpose in life, a positive relationship with others, environmental mastery, and the ability to decide one's actions (autonomy). This research is expected to be able to see in detail the indicators of psychological well-being.

2. METHOD

One of the methods is Miftahul Ulum Islamic Boarding School in Jabung Malang. It is envisaged that a deeper understanding of students' issues would improve the caliber of the most notable Islamic boarding school pupils in the Jabung Malang sub-district. This Islamic boarding school transformed from a *salafiah* to a *kalaf* boarding school. The survey research approach uses a relatively small sample to gather data on a broad population. Broad sample sizes are needed because survey research addresses complex problems involving a large population [9]. From the earlier perspective, a questionnaire is used to gather data from respondents in survey research. The term "survey" is typically used to refer to a sample survey, which gathers data from a sample of the population to represent the total population.

The survey approach has three key characteristics:

- 2.1 To define many elements and attributes of a population, such as knowledge, attitudes, beliefs, and talents, information data are gathered from vast groups of individuals.
- 2.2 Information data is gathered from the population by asking (written or verbal) questions;
- 2.3 Information data is gathered from the sample, not the population.

Several stages or processes of survey research and these general stages can be taken in outline or core points which are then incorporated into the steps of implementing survey research, namely.

- 2.1 Formulate the research problem and determine the purpose of the survey

- 2.2 Determine concepts and hypotheses and explore the literature.
- 2.3 Population and sampling.
- 2.4 Preparation of questionnaires and instruments.
- 2.5 Field work, including selecting and training interviewers.
- 2.6 Data processing.
- 2.7 Analysis and reporting.

The first step in the research process is to formulate the research topic, which is determined by conducting interviews and observing events at Islamic boarding schools. Investigations of earlier research support these findings. The researcher then chose the population and the number of samples used in the analysis. A total of 380 freshmen in junior high school were included in the study. Ryff's psychological well-being instrument is used [7]. Due to a large number of samples, data collection was done three times. Data cocollectionad was to be repeated once to ensure that the data were collected under the students' initial conditions. The data is then evaluated, and the percentage is determined using the instrument's indications

3. RESULT

The findings revealed a wide range in each hand's description of the Mambaul Ulum Islamic Boarding School students' proportion of psychological well-being markers. A desire to discover one's full potential as well as the capacity to accept oneself and the past (self-acceptance), grow personally (personal growth), have a purpose in life (purpose in life), and have positive relationships with others (positive relationships with others), be able to control their lives (environmental mastery), and be able to make decisions are all signs of psychological well-being (autonomy). The percentage of pupils who scored poorly on each indication is shown in the table below:

Table 1. Percentage data on each indicator

No.	Indicator	Percentage
1	Self-Acceptance	37
2	Personal Growth	45
3	Purpose In Life	58
4	Positive Relationship with Other	37
5	Environmental Mastery	68
6	Autonomy	56

According to study findings, 76% of students have issues with their psychological well-being. The outcomes of the provided instruments demonstrate this. New students' concerns support these findings,

including dissatisfaction with their *pesantren* accommodations, their wish to return home, and their difficulties making friends. Additionally, it appears from his conduct that he finds it challenging to engage in activities. He thus frequently arrives late for several *pesantren* activities, gets frustrated quickly with his buddies, and has little regard for others around him since they disobey the *pesantren* regulations.

4. DISCUSSION

The Darul Ulum Islamic Boarding School, which has the most severe difficulties with the state of social life, activity, and how to prepare for the future connected to the achievement of goals, is just one of the challenges in Islamic boarding schools that have been researched earlier [10]. In contrast, the Al Amanah Islamic boarding school has severe issues with study habits and how to stay healthy while living in *pesantren* [11]. The statistics of the Islamic boarding school in Aceh, Baitussahbri, illustrate several concerns, including how to enhance religious and moral awareness [12], violations of the cottage rules and difficulties adjusting, particularly for new female students [13], [14]

This state is a sign of the student's psychological well-being, a concern in Islamic boarding schools. Age, gender, socioeconomic level, social support, religion, optimism, emotional control, attachment, warm connections, and the accomplishment of life objectives are other factors that affect a person's psychological well-being, according to Ryff [7].

Religiosity is a crucial component that impacts psychological well-being, according to Lewis & Cruise [13]. Religiosity and religion impact psychological well-being [15]. According to the research mentioned above, Rafiq et al [16] claim that there is a strong positive association between them because spiritual growth can result in psychological well-being.

Another factor was also revealed by Gomez et al [10], which explains the relationship between personality factors, life goals, and age in influencing well-being. Wells [17] article describes various factors that influence psychological well-being, including sociodemographic factors (such as age, gender, marital status, socioeconomic level, and social relations), health factors (such as public health, physical activity, illness, etc.), death) and personality factors.

In addition to the previous criteria, [11] shows a favorable relationship between psychological well-being, self-esteem, and religion. According to Carver & Scheier [8], optimism is another component that influences psychological well-being. According to Pinquart & Sörensen [15], social support is a component that impacts psychological well-being. Figure 4.1 depicts the above-mentioned psychological well-being elements.

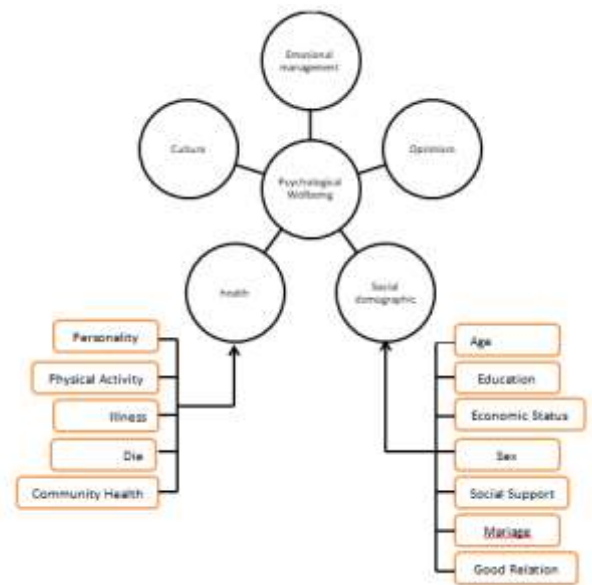


Figure 1. Factors that Affecting Psychological Well-Being

AUTHORS' CONTRIBUTIONS

AK carried out the literature survey, data collection, and data processing, and wrote the manuscript. MP revised the manuscript, checked the grammatical errors, and compiled the manuscript according to the provisions.

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