THE 21ST CENTURY PARADIGM IN SUPPORTING SUSTAINABLE DEVELOPMENT

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This “book chapter” is a compilation of scientific articles with the theme “The 21st Paradigm in Supporting Sustainable Development. The preparation of this "Book chapter" is one step in carrying out a gathering of ideas focused on developing scientific substance in the fields of education, assessment or evaluation techniques, character education, and fisheries. The ideas contained in this "Book chapter" include the following themes: 1) Literacy education, numeracy, higher order thinking skills; 2) potential local wisdom; 3) Class-based assessment or authentic assessment; and 4) fisheries technology. In the context of Sustainable Development Goals (SDGs), this book chapter supports the achievement of SDG 4 Quality Education, SDG 2 Zero Hunger, and SDG 14 Life Below Water.

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The author realizes that the contents of this "Book chapter" are still far from perfect, therefore constructive suggestions and input will be welcomed by the author to improve this work. The author hopes that this work can support 21st century education and SDGs in realizing the nation's ideals, namely a happy and prosperous Indonesian society and supporting sustainable development.

Kupang, 25 August 2023

Editors:
Nurdiyah Lestari, S.Pd., M.Pd
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EDITOR'S FOREWORD

The 21st century brings about complex and very rapid technological changes. To face the challenges of change in the 21st century, skilled personnel or human resources are needed in their fields. This requires complex problem solving, critical and creative thinking, with mental self-driving, self-power, which are known as 21st century skills.

The development of technology, information and communication as well as science in the 21st century has given rise to new challenges for human life. Entering the 21st century, technological advances have entered various aspects of life, including in the field of education. National Education in the 21st century aims to realize the nation's ideals, namely a prosperous and happy Indonesian society, with an honorable and equal position with other nations in the global world. This leads to the formation of a society consisting of quality human resources, namely individuals who are independent, willing and capable of realizing the ideals of their nation (BSNP, 2010).

In accordance with the 21st century paradigm, broader thinking and imagination are needed to support all activities that play a role in it. The era of globalization requires the appearance of Indonesian people to be of high quality, and able to keep up with world developments. Therefore, active participation is needed in all fields, namely agriculture, trade, industry, technology, health and education. Efforts have been made according to their respective fields to support sustainable development.

Problems related to the 21st century are still problems that must be answered through formulating the meaning of life, solving disputes/conflicts, and alleviating poverty related to increasingly limited natural resources. A broad understanding of the 21st century paradigm will become a strong foundation for efforts to help people with a more optimistic attitude. Attention to various fields other than education is a step in supporting sustainable development, which in this case is also related to an effort to develop a region. The definition of regional development is a way to develop a region in a comprehensive, synergistic and participatory manner. Comprehensive is meant to involve all demographic, geographical, socio-cultural, economic, political and human resource capacity factors in a certain geographical area. This is also carried out synergistically by involving all parties, including the government, community elements, and entrepreneurs who are taking part in sustainable development efforts that are being carried out with long-term goals.

Facing increasingly stringent challenges, hard work is needed so that all educational goals can be achieved. Therefore, the Ministry of Education, Culture, Research and Technology is committed to realizing education for sustainable development by prioritizing the creation of development that is environmentally friendly (environmentally sound), economically viable and socially acceptable. In light of this, it is necessary to consider a curriculum that is in line with sustainable development goals. It is necessary to design the integration of principles, values and practices related to sustainable development in education and learning. This is done in order to prepare for the golden generation, namely a generation that is creative, innovative and productive, capable of high-level thinking, character, who is proud to be an Indonesian nation. Strategies, plans and processes to achieve this must be a multi-stakeholder process at the local and national levels involving civil society, academics and community groups engaged in business.

Indonesian people of the 21st century who are of high quality need to be prepared so that the direction of nation and state development can be better laid out. Efforts to empower Indonesian people include efforts to increase quality, resilience and independence so that they are better able to respond to the many changes in conditions and situations that exist. Characteristics of high quality Indonesian people are also highly desirable which describe humans and their culture (morals, morals and manners) as well as their relationship to environmental life (population, politics, economics, social and nature).

The Partnership for 21st Century Skills (P21) includes several definitive skills that students must master, one of which is learning and innovation skills. The aim of learning and innovation skills is to prepare students so that they are ready to face complex life situations and work environments, where these skills consist of creativity and innovation, critical thinking and problem solving, communication and collaboration. Technology is needed that provides easy access to information, because it will have a big impact on students being able to think and act creatively in solving their problems (Jahnke & Liebscher, 2020). With these various opportunities and conveniences, students are required to be able to critically process the information they receive.

In the 21st century, education is becoming increasingly important to ensure students have learning and innovation skills, skills in using information technology and media, and being able to work and survive using life skills. This shows that learning in the 21st century must be carried out explicitly by practicing various skills, accompanied by appropriate

assessment strategies. Therefore students are required to be able to manage all the information they receive critically. Learning with reference to 21st century skills should be carried out with a supportive learning model, and assessment of skills with assessment strategies, as well as various examples of rubrics that can be used to access 21st century skills.

One of the important things according to the 21st century paradigm that cannot be ignored is about character education. This is because technological progress which is a positive impact and a characteristic of 21st century skills can lead to the emergence of a character crisis. Thus, a strong character education foundation is needed, because the more advanced technology can lead to the fading of character values in students. Education that prioritizes or instills character values in the 21st century will be able to form a quality generation, able to live independently in everyday life who can later become good human beings who have principles of truth that can be accounted for. Character education has a higher meaning than moral education. Character education is not only related to the problem of right or wrong, but how to instill habits or (habit) about the good things in life.

The 21st century skills consist of (1) life and career skills, (2) learning and innovation skills, and (3) Information media and technology skills. These three skills are summarized in a scheme called the 21st century knowledge-skills rainbow (Trilling and Fadel, 2009). Adaptation is carried out to achieve conformity of the concept with the capacity of students and the competence of educators and education staff. To develop 21st century learning, teachers must initiate a step of change, namely changing traditional teacher-centered learning patterns to student-centered learning patterns (Instruction should be student-centered).

According to Wagner (2010), the life skills needed in the 21st century are (1) critical thinking and problem solving abilities, (2) collaboration and leadership, (3) agility and adaptability, (4) initiative and an entrepreneurial spirit, (5) able to communicate effectively, and (6) able to access and analyze information, and have curiosity. The 21st century demands education to prepare students who are able to face global economic competition. Therefore, teachers must really prepare learning designs according to the 21st century paradigm. The intended learning design is one that is in line with curriculum demands, uses 21st century skills or is in line with national character, and uses technology that is appropriate to the competencies to be achieved in learning. Considering that 21st century learning makes students able to think critically, learning should be designed to prioritize high-level thinking skills, starting from application, analysis,

evaluation and creation. Teachers must always apply varied learning approaches and models to equip students with skills related to 21st century skills. This must be done considering that Indonesian students are still ranked 62nd out of 70 countries, with results obtained being 403rd out of 493 countries (OECD, 2018). In the 2018 Program for International Student Assessment (PISA) test, Indonesia was ranked 72nd out of 79 countries that took the test with a score of 398. Factors that influence students' low scientific literacy are because so far learning has not connected learning with problems in real life.

The survey results of the ASEAN Business Outlook Survey (2014), state that Indonesia is a destination country for foreign investment and has even become one of the main destinations in the ASEAN region. The survey results indicate the unfavorable fact that Indonesia has low-skilled and cheap labor. When compared to other countries, which have more skilled and trained personnel, it is feared that they will not be able to compete and lose better job opportunities. This is what encourages Education in Indonesia to prepare programs that prepare graduates who have higher skills, one of which is 21st century skills.

The basic idea of education is to build humans so that they can survive, protect themselves from nature and regulate relations between humans, especially when education is faced with an era where everyone must compete in various sectors of life in the 21st century. Thus, the implementation of education in the 21st century must always be adaptive to changing times. Learning is done not by giving subject matter to students by the teacher, but students are required to find the meaning of the subject matter given. Students are expected to be able to find the relevance of subject matter to one another, and to issues that are developing in society. Learning is given widely to students, through information technology without boundaries, without barriers, and time. In general, it can be said that the steps to prepare learning are in accordance with the 21st century.

First, the teacher's task in preparing learning according to the 21st century. In accordance with the 21st century education or learning paradigm, the teacher functions as a facilitator, and class manager. The teacher starts learning by first preparing a lesson plan, combining the targets in the national curriculum, developing 21st century skills or national character and using technology in the classroom.

Second, include elements of Higher-Order Thinking Skills (HOTS). Learning that is appropriate for the 21st century is provided by presenting problems to students, by prioritizing critical thinking skills. The step taken by the teacher is to provide problems according to the issues around the

students that must be resolved. Through learning guided by the principles or stages of application, analysis, evaluation and creation.

Third, the application of varied strategies, approaches and learning models. Teachers' efforts to apply various models or approaches are highly recommended in 21st century learning. The hope is that students can easily understand the various concepts given and that students' literacy will increase. Various models that can be applied include Problem Based Learning, Inquiry Based Learning, Flipped Classroom, Collaborative Learning, and Experiential Learning Models.

Fourth, integrate information technology into the learning process. Teachers must master technology in carrying out the learning process in the current era. Learning is not recommended to be carried out conventionally which will make students feel bored and bored following the material presented by the teacher. However, this can be done easily if supported by adequate facilities and supported by the teacher's ability to carry it out.

This book chapter was prepared with the theme "21st century paradigm in supporting sustainable development", with the aim of describing the efforts that have been made to support sustainable development from various fields, not only in the field of education. The material contained in this book chapter illustrates that literacy is very important to apply, so that students are able to face the challenges of a rapidly changing world that requires students to be able to solve every existing problem. In fact, it's not just literacy, but numeracy literacy is also one of the things that must be considered in the learning process. Considering the low level of scientific literacy, if not immediately addressed, it will have an impact on the low quality of human resources and will hinder the progress of science and technology in Indonesia. Literacy in schools is implemented through various learning components that must be designed or prepared by teachers. The application of scientific literacy in science learning should be carried out using scientific inquiry to foster the ability to think, work and behave scientifically and communicate it as an important aspect of life skills.

Literacy that is trained to students also includes environmental literacy, where environmental literacy is described in local customary wisdom which can be used for learning for students at school, as well as for the community so that it can be applied as an environmental conservation effort. On this occasion, local wisdom was described not only as the local wisdom of the people on the island of Timor, NTT, but also the people of the Bajo tribe in Sulawesi. Local wisdom contains values including

the local wisdom value of peace and the local wisdom value of prosperity. The details are the local wisdom values of peace which were found to consist of: politeness, honesty, social solidarity, harmony and conflict resolution, commitment and positive thinking. Meanwhile, the values of local wisdom for prosperity that were found consisted of: hard work, education, mutual cooperation, and cultural preservation and creativity. According to Wagiran (2011), various analyzes of the role of local wisdom really determine the progress of a nation, and in Indonesia the values contained in local wisdom help advance society. Furthermore, local wisdom appears as a guardian or filter of the global climate that affects human life.

Learning carried out by teachers, according to research results, is greatly influenced by the choice of various models, approaches and strategies. Through several articles contained in this book chapter, it is hoped that we can provide an explanation of the concept of 21st century learning as well as describe a 21st century learning model that can be used as a reference, in improving students' ability to think critically, creatively, and improve collaboration skills as well as communication.

Apart from the education sector, the supporting factors for sustainable development are seen from other sectors or fields. On this occasion, an example was given in the fisheries sector which is expected to support sustainable development in Indonesia. The goal of sustainable development is to ensure continued benefits for future generations by prioritizing the principles of responsibility, economic efficiency and social justice. The government has signed the 2030 Agenda on sustainable development considering the increasingly strong determination of society to support sustainable development in all fields.

Finally, we hope that this book chapter will be useful not only for academics, but also for the wider community because this book chapter contains solutions to problems that are useful in the development of science and technology. Hopefully this book will be the forerunner to the emergence of further studies and developments in line with this theme.

Kupang, 25 August 2023

The Editors Editors
Nurdiyah Lestari, S.Pd., M.Pd
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CHAPTER 1

THE 21ST CENTURY ORIENTED LOCAL WISDOM LEARNING MODEL IN IMPROVING STUDENT SCIENCE LITERACY

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INTRODUCTION

The 21st century is characterized by very rapid developments in human life, including Science and Technology (IPTEK). In the 21st century, the demand for a knowledge-based workforce is increasing (Chen & Osman, 2017). 21st century learning is expected to be able to produce Human Resources who have the ability to think critically, creatively and innovatively, the ability to solve problems, be able to adapt to the environment and information technology, make decisions, and have a strong and positive character is a characteristic of 21st century learning. The ability to be able to make connections between subject matter and issues that occur in society, as well as the ability to solve problems is a demand in the globalization era for today's students. Likewise, the challenge of a rapidly changing world requires students to be able to solve any existing problems, and one of the conditions for adaptability in this regard is through scientific literacy. Scientific literacy will be effective if achieved through education or learning, therefore science must be learned by children from an early age (Holbrook & Rannikmae, 2007; Redhana, 2019).

Science education depends on the learning used in each country. Through science education, students can be involved in the impact of science in everyday life and the role of students in society. By applying

science concepts in science education, Indonesian students are expected to be able to solve real-life problems in the 21st century. According to Winaryati et al (2018), The characteristics of the 21st century will produce the character of 21st century learning, and will have an impact on the assessment of the 21st century. This is shown in humans living in the 21st century who have striking characteristics including multitasking, multimedia, online social networking, online info searching, gameonline.

21st century learning is a learning transition where the developed curriculum guides schools to change the learning approach from teacher centered to student centered. However, it is not just an approach that is needed in educating the younger generation in the 21st century, a learning model and skills are needed to match the competencies to be achieved. As a system consisting of several interrelated components, learning should use a learning model as a pattern or plan in forming a curriculum, one of which is science learning. Systematic methods of inquiry, enable us to understand them better through science.

Scientific literacy is one of the important skills to be developed in the 21st century. The National Research Council states that the set of scientific competencies required for scientific literacy reflects the view that science is an ensemble of social and epistemic practices common to all sciences, which frames all competencies as actions (Depdikbud, 2017). According to Sengul (2019), Literacy is open and always changing. Based on initial research that has been conducted, the low level of student scientific literacy is due to the fact that so far many teachers have not implemented various models, methods or approaches in the learning process. Research result Setiawan et al., (2017), stated that the local wisdom-based science module developed was appropriate for improving students' scientific literacy skills both theoretically and empirically. Scientific literacy has a major contribution to the development of science, and has a major impact in the social, cultural and economic fields. According to Gormally (2012), indicators of scientific literacy include identifying valid scientific opinions, conducting effective literature searches, understanding research design elements and how they impact findings/conclusions, making graphs appropriately from data, solving problems using quantitative skills, including basic statistics, understanding and interpret basic statistics, and make inferences, predictions and draw conclusions based on quantitative data.

Scientific literacy views the importance of thinking and acting skills that involve thinking domination and using scientific ways of thinking in recognizing and responding to social issues, and making productive citizens

(Pratiwi, 2019; Yacoubian, 2018). Students with low literacy become less responsive to the problems around them. Low scientific literacy, if not immediately addressed, will have an impact on the low quality of human resources and will hinder the progress of science and technology in Indonesia. A teacher's success in using resources to promote knowledge, different skill profiles, and accepting and adopting current values and literacy has a range of meanings (O'toole et al., 2020). A positive attitude determines the quality of the learning process (Bušljeta, 2013).

Learning will be meaningful one of them by utilizing local wisdom as a source of learning. Local wisdom contains various good values originating from local culture which has received recognition from the majority of society regarding its superiority and goodness (Khotimah & Digna, 2021). Local wisdom-oriented education plays a role in determining the progress of a nation, and the diversity of an area or environment is one of the important concerns in curriculum development. This is because local wisdom is a way of life, knowledge, and is a strategy in the form of activities carried out by the local community in responding to various problems in meeting their needs. Therefore, the values of local wisdom are expected to be able to make students not only know knowledge or concepts in learning, but can implement them directly according to the conditions of the surrounding environment. Environmental education through local wisdom is expected to increase students' literacy.

The capital of East Nusa Tenggara Province is Kupang which is on the island of Timor, has local wisdom to be developed as a source of learning. In facing the challenges of change in the globalization era, human resources are needed who have the quality of empowerment, and are able to overcome various complex dilemmas as a result of world changes, including having strong leadership, responsive, multitasking, nationalist-patriotic, steady performance, multi-relationship, creative and innovative (multi-talented). Therefore, learning should be done contextually so that learning becomes meaningful (meaningful learning). Local wisdom as a learning resource can be integrated into Biology learning through the steps of the scientific method, so that students are able to understand concepts easily. Science skills are expected to make students active, develop a sense of responsibility, improve learning, and research methods. "Mamar" which is the local wisdom of the people of Timor Island, East Nusa Tenggara is expected to be integrated into class X high school Biology lessons, so that students are able to connect the material being studied with real life and contemporary issues.

Indonesia has a low literacy rate because it ranks in the results obtained, namely 403 out of 493 countries. In the 2018 PISA test, Indonesia was ranked 72nd out of 79 countries that took the test with a score of 398. This shows that this score is far from the average score. The average scientific ability of Indonesian students is only limited to the ability to remember and recognize scientific knowledge based on simple facts. Students have not been able to communicate and relate various scientific topics, let alone apply complex and abstract concepts in everyday life (Huryah & Sumarmin, 2017).

Learning with local wisdom which is synonymous with authentic learning experiences determines student success in 21st century skills. Effective communication and high productivity are key components of the 21st century. Students must have the ability to think critically and creatively in solving existing problems. Biology learning which is designed according to the syntax of the model developed, and designed by utilizing the surrounding natural resources is one of the solutions related to increasing students' scientific literacy.

The way to broadly understand the literacy curriculum studied in formal schools encourages students to be able to participate productively in the community (Abidin et al., 2017). The learning model that supports the 21st century educational paradigm is a problem-based model and in accordance with constructivism theory, where students will experience learning in a meaningful way. Biology learning that is designed and will be applied to class X students is supported by various models, namely experiential learning, multiliteracy, and ecopedagogy based on local wisdom in the form of "mamar" into a model called ELM Eco EA. Research on environmental education based on local wisdom on the island of Timor aims to increase students' scientific literacy and equip students with 21st century skills that have never been implemented so far. This is necessary to support sustainable development, especially in relation to local wisdom-oriented learning resources that are integrated in the secondary school curriculum.

DISCUSSION

The research begins with a preliminary study, which can be used as a problem analysis. Preliminary studies carried out include analysis of needs/problems, analysis of the potential of local wisdom of the people of Timor Island, curriculum analysis and analysis of Biology learning in high school. Problems were discovered from the results of observations at school, the results of FGDs with teachers, interviews or deep interviews

and observations with owners of "mamar" gardens in several locations, as well as based on literature studies. The results of the initial analysis were carried out based on literature studies and field studies used in compiling tools, instruments, media and teaching materials using the local wisdom-oriented ELM Eco EA model. The tools, instruments, media and teaching materials used have been validated by experts in their fields and by practitioners.

Scientific literacy is measured, the validity and reliability of the questions are analyzed. The validity of the questions was analyzed using the quest program, while the reliability of the questions was analyzed using Cronbach Alpha with the help of SPSS version 22. The results of the validation of the scientific literacy test instrument included 20 multiple choice questions, all of which were declared valid. The category of item validity refers to the validity classifier proposed by Guilford (1956). The reliability of the scientific literacy instrument is calculated by Cronbach alpha with an alpha value of 0.741 which indicates that the instrument is reliable in the good category.

The Kolmogorov Smirnov test was used to test the normality of the data in this study. Table 1 shows that based on the pretest and posttest values of the experimental class and control class, a significance value of 0.053 and 0.083 was obtained for the control class, while for the experimental class it was 0.060 and 0.062 (p> 0.05), and it can be concluded if the data obtained is normally distributed.

Table 1. One-Sample Kolmogorov-Smirnov Test

		Pre test_ control	Posttest control	Pretest Experiment	Posttest Experiment
N		151	151	151	151
Normal Parameters[a,b]	Mean	49.0217	60.0725	46.0596	71.8212
	Std. Deviation	9.27792	8.96028	10.24059	9.65200
Most Extreme Differences	Absolute	.115	.107	.108	.107
	Positive	.115	.106	.092	.105
	Negative	.107	-.107	-.108	-.107
Kolmogorov-Smirnov Z		1.348	1.261	1.325	1.318
Asymp. Sig. (2-tailed)		.053	.083	.060	.062
a. Test distribution is Normal.					
b. Calculated from data.					

Based on Table 1, it is known that the mean value of scientific literacy in the experimental class is 71.82, while in the control class it is 60.07. This shows that the experimental class using the ELM-EcoEA model is better than the conventional model. The low scientific literacy of students in the

control class is because students are not trained to develop scientific literacy in the learning process.

In addition to the normality test, before analyzing the model differences between the experimental class and the control class, a homogeneity test was carried out with the aim of testing whether the data variances of the two groups were homogeneous. The homogeneity of the variance of the data from the two groups is a prerequisite for producing an accurate calculation of the variance test. Table 2 shows the results of the research data homogeneity test.

Tabel 2. Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
1.970	1	287	.162

The results of the Levene test in Table 2 show that the sig value of scientific literacy is 0.162 which is greater than 0.05. This means that the variance of each pair of groups is homogeneous. After carrying out the normality test and homogeneity test, the next step is to look for differences between the scientific literacy of the experimental class and the control class.

Table 3. Dependent Variable: Science literacy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	9952.677[a]	1	9952.677	114.378	.000	.285	114.378	1.000
Intercept	1254313.231	1	1254313.231	14414.826	.000	.980	14414.826	1.000
Class	9952.677	1	9952.677	114.378	.000	.285	114.378	1.000
Error	24973.448	300	87.015					
Total	1301875.000	302						
Corrected Total	34926.125	302						

a. R Squared = .302 (Adjusted R Squared = .300)

b. Computed using alpha = .05

Table 3 shows that the ELM Eco EA model, which is a local wisdom-oriented 21st century learning model, is better than the conventional model as a control class. The model developed includes both cognitive aspects and skills that support 21st century learning. Research result Ongardwanich, et al (2015) in his research explains 21st century skills, namely life and career skills, learning and innovation skills, information media and technology skills. The developed ELM Eco EA learning model is expected to be able to provide students with an understanding of proper

environmental management. The model is expected to be able to provide students' understanding into real life events which are part of scientific literacy. Measurement of scientific literacy ability is very important for increasing scientific literacy and can improve the quality of education in Indonesia. Learning that focuses on scientific literacy is learning that is in accordance with the nature of science which is not only oriented towards knowledge but also towards the process of integrating concepts and practice as well as the achievement of a scientific attitude. Teachers can take advantage of the environment to implement scientific literacy so that students better understand learning and avoid boredom. Scientific literacy is a knowledge and understanding of scientific concepts and processes that will enable a person to make decisions with the knowledge they have, as well as being involved in matters of state, culture and economic growth. Scientific literacy can be applied by utilizing the environment in material about living things and their life processes.

Scientific literacy can be increased through the integration of local wisdom into learning models that contain a number of scientific phenomena in science learning (Hadiprayitno, et al., 2020). Local wisdom can be interpreted as the view of life and knowledge of certain communities in solving their life problems. This means that there are noble values of virtue in local wisdom whose people are still traditional. Local wisdom is the basic knowledge of life obtained from experience and the truth of life, in the form of abstract and concrete, balanced with the nature and culture of a particular community group (Mungmachon, 2012). Local wisdom can be integrated into learning materials and is a form of efforts to preserve local wisdom itself. This can be proven through traditional educational practices which have proven effective in solving life's problems and preserving the environment. The local wisdom of the island of Timor in the form of mamar, which is a forest owned by the community, is believed to protect the availability of water sources and has magical religious value (Talan, 2018). Mamar's important roles include forest conservation, creating a micro climate and economic context. Learning through the ELM Eco EA model and utilizing the "mamar" learning resource is expected to be able to make students understand knowledge through inquiry using real problems explored from the environment around the students.

Basically, being literate in this information age means being able to engage in various literacy practices, as well as being able to describe various literacy skill sets in a variety of literacy domains. In the field of science, literacy means the ability to understand, think and apply scientific

concepts and perspectives in various events. One of the factors that causes low scientific literacy is the choice of learning resources. Scientific literacy in science learning is mostly still limited to textbook or text material. Instead of direct learning, scientific literacy learning is more teacher-centered. Scientific literacy that only relies on textbooks or texts has not fully touched students' souls. Apart from learning resources, one of the steps to increase student literacy is the use of various appropriate learning models.

There is no one learning model that is the best among others, because each learning model is said to be good if it has been tested to teach certain material. Various supporting models chosen for learning include ecopedagogy, experiential learning models, and multiliteracy. There are various reasons why this model was chosen, including that the pedagogical method has been more successful than other methods in helping students develop according to 21st century skills. Related to multiliteracy, it is a way to understand more broadly the literacy curriculum studied in formal schools and encourage students to participate productively in the community. Likewise, through experiential learning, students can feel learning becomes more meaningful (Abidin, et al., 2017; Mawas & Muntean, 2018). The components for developing the ELM Eco EA model are as shown in Table 4.

Table 4. ELM Eco EA Model Development Components

Development components	Description
Learning theory and supporting components	Constructivism Theory, Experiential Learning Theory, Piaget's Cognitive Development Theory, David Ausubel's Meaningful Learning Theory
	Environmental Education
	Local wisdom-based learning
	The local wisdom of the island of Timor "Mamar"
Sintax	The syntax or steps of the ELM Eco EA learning model consist of stages: a) Orientation; b) Concrete experiences (emotions); c) Reflective Observation (watching); d) Hypothesis; e) Abstract Conceptualitation (thinking); f) Guiding investigations; g) Communicating the results of the work (Presentation)
Social Systems	Learning is done contextually, with communicative, collaborative, problem-solving principles
Reaction Principles	In learning the teacher acts as a facilitator
Support System	Syllabus/lesson plan using model syntax, model books, modules, interactive multimedia, learning resources (mamar), assessment instruments

Instructional Impact	Increasing students' scientific literacy and life and career skills
Companion Impact	Students have a sense of responsibility and high self-confidence

Source: results of researcher elaboration

Table 4 shows the components of the model development used in this study. Research based on environmental education is guided by learning models supported by several educational theories, including constructivism theory, experiential learning theory, Piaget's developmental theory, David Ausubel's theory of meaningful learning. The learning model consists of the ELM Eco EA model syntax which consists of seven steps (syntax) of the model, which is applied contextually using the "mamar" learning resource, with environmental change material. This is in line with research Koutsoukus et al (2015), which states that the methods used in environmental education will be more targeted if they use field training, projects, or guided inquiry methods and support students in understanding real world problems. In accordance with the syntax in the model, investigation, it shows that learning trains students to carry out investigations related to environmental problems in the form of mammals whose management is still traditional, not yet using modern technology, is a problem that students must solve.

Experiential learning in education aims to integrate exclusive thinking in students' daily lives and install environmental values. for the experiential learning model needs to be applied to improve the ability to think creatively and think critically in making scientific reports because experiential learning is included in scientific learning. This experiential learning model has the following advantages: 1) Improving student learning about disaster management, encouraging their ability to do important work, and being respected. 2) Improve problem solving skills. 3) Making students more active and successful in solving complex problems, 4) Increasing collaboration, 5) Encouraging students to develop and practice communication skills. 6) Increase students' abilities in managing resources. 7) Provide experience for students to manage carrying out real actions and allocate time for problem solving. 8) Provide real learning experiences, 9) Make the atmosphere more fun (Kolb & Kolb, 2017). Another supporting model is the multiliteracy model, which is closely related to students' scientific literacy. This can be seen from students' ability to work together, collaborate, in teams and the ability to solve existing problems. The multiliteracy learning model is a learning model that aims to improve 21st century learning skills and a deep understanding of

various scientific concepts, processes and attitudes in accordance with the disciplines being studied.

Low student literacy can be caused by several factors, including learning activities that focus more on Biological concepts, and activities that involve scientific processes are still lacking. Another factor is related to the teaching materials used that have not been designed using learning steps that ask students to find learning concepts independently with real problems, but only contain material, examples of problems, and problem solutions. The low scientific literacy abilities of Indonesian students will have an impact on the low quality of learning. Thus, creative learning creativity and innovation are indispensable for teachers in learning according to the competencies and frameworks of the 21st century.

CONCLUSION

Efforts to improve the quality of education in Indonesia with 21st century competencies should be carried out as early as possible. Therefore, teachers need to design learning in accordance with increasingly competitive global competition, because scientific literacy is a provision for students to face various challenges in the global era as an effort to understand science, solve problems so that student achievement will increase and have an attitude and sensitivity to oneself and the environment. Selection of learning resources, which are not contextual, is a factor in students' low scientific literacy, bearing in mind the purpose and role of learning resources not only to make the educational process more interesting but also to encourage more active learning. The results showed that the 21st century learning model with local wisdom orientation could increase the scientific literacy of high school students on Timor Island or significantly influence students' scientific literacy. The increase in students' scientific literacy is higher in learning with the ELM Eco EA model compared to the conventional model.

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CHAPTER 2

IMPROVING COLLABORATION SKILLS BY STEM-BASED DISCOVERY LEARNING MODEL

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INTRODUCTION

In the current era of the Industrial Revolution 4.0, science and technology are developing very quickly and rapidly. Over time, the need for human resources for routine matters has decreased due to the use of machines, robots and the help of the development of information technology tools. Therefore, the skills that students need to survive in today's developing world are "the 21st century skills" that answer the demands and challenges of an ever-changing era. According to Zubaidah (2019), the 21st century skills consist of creative thinking, critical thinking and problem solving, collaboration and communication, known as the 4Cs.

Education plays an important role in creating a better generation that is able to compete internationally with modern technological advances. Education in the 21st century requires different skills that a person must have to actively participate in future challenges to enter the labor market. In the world of education, efforts have been made to develop 21st century skills. Some of these efforts have been implemented by making the 2013 Curriculum into an independent learning curriculum based on the 21st century learning to create a critical and confident generation in the era of globalization. So complex are the competenciens that must be competencies that learners must have, then is this 21 st century learning there is a change in the learning paradigm, namely, from the paradigm of teaching to the paradigm of learning. This means previously learning was only centered on the teacher while now learning is centered on student, in this case the teacher is no longer the only learners, in this case the teacher is no longer the only source of learning but moresource of learning but more directed as a facilitator in the learning

process (Mariati et al, 2023). Is also in line with the Ministry of Education and Culture's 2016 policy that the competency standards for high school/vocational school graduates must include the ability to think critically, act creatively, productively, independently, collaborate and communicate (Ismayani, 2016).

Collaboration skills are considered important in learning, as they can support academic performance and promote a healthy sense of sociality and democracy in learners. Collaboration skills can also provide knowledge through others which also increases a person's abilities and skills (P21 in Almaida et al., 2019). Collaboration skills are the ability to work together, establish synergy, adjust to various roles and responsibilities, and appreciate diversity (Arnyana, 2019). This makes students feel valued and trusted. They will be confident in both the educational and personal domains. Therefore, the learning process at school is not only student-centered and teacher-centered but there is collaboration between the two in the learning process. Collaboration is a certain type of social interaction and literacy process where group members can be active and formative in working on problems (Lee, in Husain et al, 2019). Initial observations by researchers at SMA Negeri 3 Kupang showed that more guidance was needed to improve and develop students' collaboration skills properly. The application of the discovery learning with the STEM approach has also never been used before, as this topic is rarely used in the learning process in school.

One of the many learning materials, which is considered to have an important role in the education system is physics. According to Simbolon and Sahyar (2015), physics as a branch of natural science is a subject that is not effective if studied and emphasized only on theory and mathematics, but the emphasis should be placed on building knowledge and its application in everyday life. The goal is to help students solve a wide variety of physical problems, practice communication skills, work in groups, solve problems given by teachers and problems faced by students in everyday life.

STEM is currently being talked about a lot, especially in education. One reason is the ever-increasing demands of civilization. Learning through the STEM approach requires efforts not only to acquire basic knowledge, but also to generate new knowledge and design innovative results (Goldman et al., 2001). STEM is also believed to be able to train students' thinking skills in depth so that they can see opportunities based on the knowledge they have from meaningful learning activities (Ryoo & Winkelmann, 2021). In addition, STEM is also believed to be able to train

students' thinking skills in depth so that they can see opportunities based on the knowledge they have from the results of meaningful learning activities. STEM is a learning approach that combines aspects of science, technology, engineering and mathematics in learning activities. Integrating several disciplines into one subject aims to ensure that students are not only knowledgeable, but competent and able to apply these concepts in everyday life. The application of STEM in learning activities is based on the 4Cs of creativity, critical thinking, collaboration and communication to help students find innovative solutions to real-world problems and successfully communicate them. The purpose of STEM in education is in line with the demands of the 21st century education, proving that learners have scientific and technological knowledge from reading, writing, observing, and doing wisdom, and are suitable to develop their pre-existing abilities and apply them in dealing with problems in daily life related to STEM fields of wisdom.

One way to improve students' collaboration skills in the learning process is by applying the STEM-based discovery learning model. According to Anitah (2009), discovery learning is a learning that involves students in problem solving for the development of knowledge and skills. The discovery learning model can improve students' critical thinking when they discover problems independently, and encourage more active participation in discovering concepts, principles, so that they have experiences that allow them to discover principles or concepts. Using discovery learning can guide students to improve 21st century skills and emphasize on critical thinking process and analysis. STEM-based discovery learning model can increase the effectiveness of meaningful learning and produce varied learning. Discovery learning is learning and self-discovery, in the teaching and learning system, the teacher presents the material not in its final form, but students are given the opportunity to seek and find it themselves. Discovery Learning is an effort to find the truth through one's own experience, this discovery effort can aim to find a conception and solve a problem. The operation of the discovery model has an engagement relationship with students. The implication of the discovery learning model for students is that there is an increase in the intellectual power of learners so that they reveal new ways to succeed and students will learn to organize and handle problems and try to find results for their own problems. According to Kurniasih et al (2014), the discovery model is a literacy process that occurs when tasks are not presented with tasks in their final form but students are anticipated to organize themselves. Discovery Learning is a learning model where in the learning process at school the

teacher does not deliver the material at the end but provides problems for students to solve in total. The discovery learning model is a model that is included in the science literacy model and is also suitable for developing the creative thinking power of students who have a high IQ (Intelectual Quotion). Using discovery learning can guide students to improve the 21st century skills and emphasize critical thinking and analysis processes as well as collaboration skills.

Previous research conducted by Indiasmita (2020) on the effect of the STEM project-based learning model on students' collaborative skills and learning outcomes, concluded that students' collaborative skills in the experimental class were in the good category and the control class was in the moderate category. Then research conducted by Muhammad and Dwi (2021) related to STEM-based physics learning research to develop collaboration skills can facilitate students in developing collaboration skills more optimally.

The purpose of this study is to apply a discovery learning model with a STEM approach to improve students' collaboration skills on static fluid material. This encouraged the researcher to conduct a study with the title "Application of discovery learning model with STEM approach to improve collaboration skills of SMA Negeri 3 Kupang students".

DISCUSSION

The data in this study were obtained from giving instruments to both classes, namely the collaboration skills observation sheet. The observation instrument will be carried out by the observer based on the collaboration skills rubric. The data that has been obtained from the provision of observation sheets in experimental and control classes is then analyzed to determine the description of student collaboration skills. The collaboration skills of experimental and control class students were obtained from the observation results. Observations were carried out every meeting by one peer of the researcher using observation guidelines that had been prepared by the researcher. Data on students' collaboration skills were obtained from the experimental class with the treatment of the application of the discovery learning model with the STEM approach and in the control class with the treatment of the application of the discovery learning model based on a collaboration skills rubric that uses 2 indicators which include contributions and problem solving with a score of 1-4 as the observation criteria. Data on the value of observations of student collaboration skills in experimental and control classes will be displayed in the following Table 1 and Figure 1.

Table 2. Data on the percentage of collaboration skills of DL+STEM group and DL group

Meeting	Group DL + STEM		Group DL	
	Percentage	Criteria	Percentage	Criteria
I	71%	Collaborative	70%	Collaborative
II	81%	Very Collaborative	75%	Collaborative
III	89%	Very Collaborative	80%	Collaborative
Average	81%	Very Collaborative	75%	Collaborative

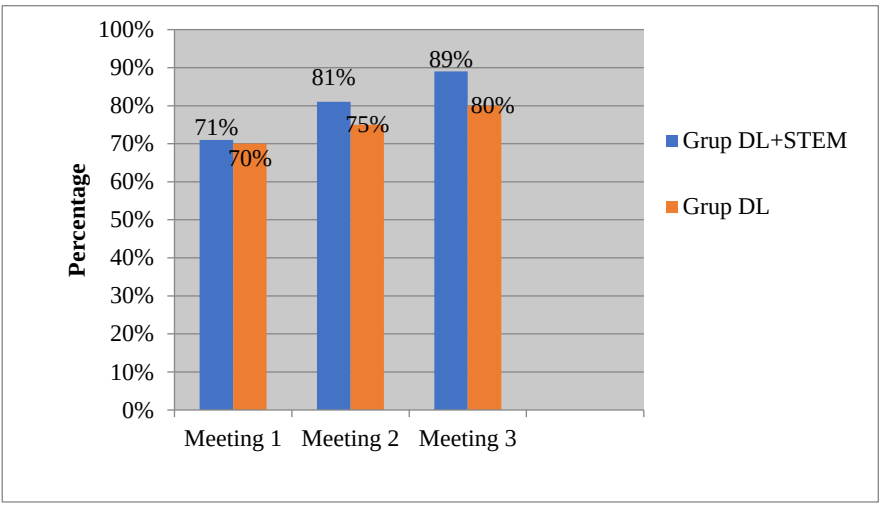

Figure 1. Diagram percentage of collaboration skills

Based on the diagram above, it can be seen that students' collaboration skills in the experimental class treated with the Discovery learning model with the STEM approach continued to increase from meeting I to meeting III with the average percentage of students' collaboration skills in the experimental class was 81% with a very collaborative category. Whereas in the control class with the treatment of the discovery learning model without STEM, it continued to increase from meeting I to meeting III with an average percentage of student collaboration skills of 73% in the collaborative category. These results show that students in the experimental class with the application of the discovery learning model with the STEM approach are much more active than students in the control class with the application of the discovery learning model without STEM.

Based on the results of the study, it shows that the collaboration skills of the experimental class are higher than the control class. This is obtained from the percentage increase in collaboration skills from meeting I to meeting III, researchers obtained data on the increase in student

collaboration skills in experimental class 1 with the application of the discovery learning model with the STEM approach and experimental class 2 with the application of the discovery learning model without STEM. In experimental class 1, meeting I, students' collaboration skills reached 71%, and increased in meeting II to 82%. Then again experienced an increase at meeting III, namely 88%. While in the experimental class 2, the first meeting of students' collaboration skills reached 70%, and increased in meeting II to 74% and also increased in meeting III to 77%. The final average result of student collaboration skills for experimental class 1 was 81% with a very collaborative category and experimental class 2 was 73% in the collaborative category. This shows that applying the discovery learning model with the STEM approach can facilitate students to collaborate. On the other hand, the discovery learning model without STEM also facilitates students to collaborate but this learning model does not emphasize students to work actively in teams to solve the problems at hand. In addition, when looking at the increase in each indicator of collaboration skills in general has increased every meeting both experimental class 1 and experimental class 2. However, the indicator that greatly improved in collaboration skills was the contribution indicator in experimental class 1.

The difference in achievement in the collaboration skills of students in experimental class 1 and experimental class 2 is because in the learning process of STEM-based discovery learning, students are trained to be able to solve a problem using the steps in the STEM-based discovery learning model. Learners must compromise with their group members so that they are able to make temporary answers regarding several pictures in the form of pollution problems in the student worksheet. Learners are also trained to identify problems based on real problems that students find in everyday life, collect data and students are able to collaborate in teams to complete the design of the products they will work on to answer the problems they face, process data to conclude characteristics in collaboration. It will build their spirit to be more responsive and active, careful in solving problems. While the application of the discovery learning model without STEM, students work in groups to answer the hypothesis that has been set and search for a lot of literature to answer problems on worksheet without being required to collaborate actively in designing a concept to answer problems faced by students in everyday life.

This shows that using the STEM-based discovery learning model trains students to work together in teams and exchange ideas that can provide critical input and ideas and are willing to accept input from other team members to create optimal solutions. This is also very influential with

the syntax of the STEM-based discovery learning model, namely data collection-engineering where students are encouraged to take an active role in the learning process, and this syntax provides opportunities for students to work independently or in small groups. In small groups, students learn to collaborate with their peers and develop skills to work together to achieve a common goal. By working together in groups, students can also learn to respect differences of opinion, seek mutually beneficial solutions, and develop social skills that are important in everyday life. In conclusion, providing opportunities for students to work independently or in small groups, while still supervising and providing guidance if needed, is a very important syntax and has a great influence in improving students' collaboration skills in the discovery learning model. In STEM (Science, Technology, Engineering, and Mathematics), technology and engineering are a very influential or prominent part in improving students' collaboration skills. In technology and engineering, students are often given tasks that involve problem solving or product design, which require collaboration and cooperation in groups to achieve a common goal. In this case, students learn to listen to and understand each other's perspectives, develop ideas together, divide tasks and responsibilities fairly, and work together to complete assigned tasks. In conclusion, technology and engineering are very influential in improving students' collaboration skills. In technology and engineering, students often work in groups to complete assignments or practicums, and learn to cooperate and respect different opinions in achieving a common goal. This helps students build social skills and develop solid team relationships.

CONCLUSION

Based on the results of data analysis and discussion above, it can be concluded that students' collaboration skills on static fluid material with the application of the Discovery Learning learning model with the STEM approach has an average percentage value of 81% with a very collaborative category. These results are higher than the class with the discovery learning model without STEM which obtained an average percentage value of 75% in the collaborative category.

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CHAPTER 3

DIAGNOSTIC ASSESSMENT DESIGN IN BIOLOGY SUBJECT DIFFERENTIATION LEARNING

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INTRODUCTION

When students enter the classroom, they bring a variety of diverse cultural backgrounds, learning styles, interests, abilities, and multiple intelligences. The diversity of students in a class can produce significant challenges for teachers when it comes to meeting the needs of all students. Some students may find lessons too easy while others find them too difficult, some may find topics interesting while some find them boring, so different instructions are needed (differentiated learning) or known as differentiated learning to reach each student and approach lessons in a suitable way. with their learning styles, interests, abilities, or multiple intelligences they have.

Learning that is done with the principle of differentiation is considered effective for increasing student involvement in the learning process and has an effect on increasing academic achievement. Learning that is carried out with the principle of differentiation seeks to accommodate students who are diverse based on their talents, interests, and learning needs (Marlina et al., 2020), this is in accordance with what was conveyed by Morgan (2014) that basically the learning process can be maximized its success if done through differentiation learning. Differentiated learning will be able to develop students' talents and interests more optimally (Chandra, 2019).

Differentiated learning is most often implemented in reading, writing and science classes, but is rarely applied to other subjects including science (Eady, 2008; Tobin & Tippet, 2014). Designing differentiated learning requires readiness in the form of classrooms that are challenging

and safe and supports a focus on disciplinary knowledge, teachers must also be prepared to use a variety of methods, including classroom, small group and individual settings and teachers use time, space, materials and instructional strategies in ways that flexible to address a wide variety of learner needs. (Tomlinson, 2005). Even though the preparation is quite busy, the results obtained by finding ways to involve students in utilizing different student interests will make students more successful (Tomlinson, 2008). Learning that is tailored to the needs of students is able to help students become focused, motivated and independent learners. Differentiated instruction is student aware teaching, in this case students not only learn essential content but are also increasingly responsible for their own lives as learners.

In determining differentiation instruction, of course, accurate information is obtained from students, so that an initial assessment or diagnostic assessment is needed. Diagnostic assessment is an assessment at the beginning of learning which if carried out properly the teacher can evaluate students' strengths, weaknesses, knowledge and skills before starting learning (Leighton, 2014; Macdonald, 2017). Before creating meaningful and efficient learning designs, we need to know what students know about a particular topic. When used effectively diagnostic assessments can pinpoint appropriate aspects of development in an individual as well as identify learning difficulties and isolate specific misconceptions that students may have.

Several studies have shown that teachers still have difficulties in carrying out diagnostic assessments, including difficulties in making appropriate instruments and a lack of time in mapping out results (Febrianti, 2023; Laulita 2022; Zulaiha, 2022). Efforts are needed to find the initial conditions for students so as to enable the differentiation learning treatment to be carried out appropriately. Based on the presentation submitted, this study aims to obtain relevant sources of information related to the design of diagnostic assessments and the types of instruments that can be used to determine the condition of students to facilitate teachers in mapping differentiated learning instructions, especially in biology subjects.

DISCUSSION

Relationship of Diagnostic Assessments with Summative and Formative Assessments, and examples of Diagnostic Instruments

Large-scale international assessment programs such as Trend in International Mathematics and Science (TIMSS), Program for International

Student Assessment (PISA), Progress in International Reading Literacy Study (PIRLS) have had a huge impact on the development of the education system. In various aspects of the assessment has inspired the introduction or expansion of the national assessment program. Previously, summative assessment was widely used because it was able to evaluate students' abilities in general and could be submitted for making assessment decisions, however, summative tests had various drawbacks, including tending to emphasize final results, lack of objectivity, limitations in feedback to students in general, too long a time between test administration and feedback, also has an impact on student and teacher stress (Saeki et al.,

This deficiency has provided support for educational assessment alternatives and shifted the focus of attention from summative assessment to formative assessment (Bennett, 2011; Shread and Chambers, 2014) or also called assessment for learning (Black et al, 2003; Heitink et al, 2016).

There are various ways to assess using formative assessment, but the general characteristics of this assessment are being able to accommodate students' learning needs, facilitate understanding in certain contexts and provide direct feedback (Black et al, 2004, Good, 2011). In addition to formative assessments, diagnostic assessments can be categorized as assessments for learning. Diagnostic, formative and summative assessments are three different assessments that can be combined to obtain an ideal assessment (Figure 1).

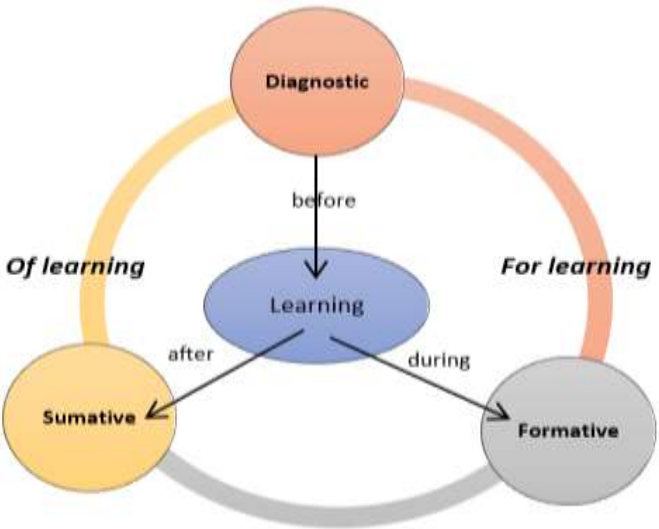


Figure 1. Diagnostic, summative and formative assessment relationships

The results of diagnostic assessments can help teachers formulate differentiation or personalized learning for individuals and can also assign students to small group learning. Interpreting information from students requires a professional assessment, because it is possible for students to answer questions in a certain way. As for examples of strategies for collecting diagnostic assessment information in biology subjects, they include:

Table 1. Forms, activities and diagnostic assessment instruments

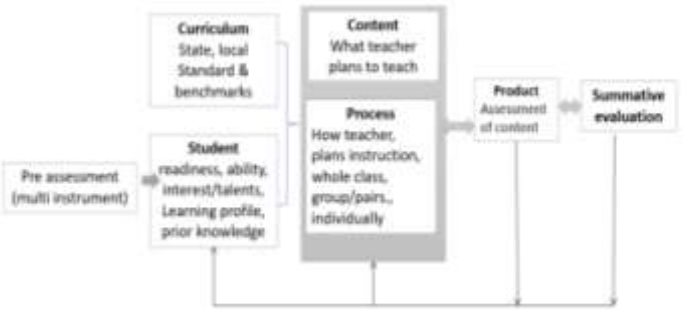
Form	Activity	Instrument
Observation	Direct observation	Journal of observation, checklist
Surveys	Questionnaire filling	Questionnaire
Interview	Interview	Interview guide sheet
Performance	Doing simulations, writing, drawing, demonstrating, making products, collecting portfolios	Observation sheet
Pre-test	Question filling	Pre-test questions
Journal	Keep a journal	Journal rubric
Graphic organizer	Create concept maps, concept charts, flowcharts, smart art	Organizer graphic rubric
Wordsplash	Mention words related to the learning that will be carried out	-

The benefits of a diagnostic assessment include: 1) guiding learning with clear goals and objectives, 2) helping to create an effective curriculum in order to improve student learning outcomes, 3) helping learning to be more efficient, 4) creating a conducive learning environment, 4) in learning diagnostic assessment differentiation provides opportunities for teachers to carry out individual-based instruction

Diagnostic Assessment Design in Biology Subject Differentiation Learning

Differentiated learning (Differentiated instruction) is a teaching philosophy based on sociocultural theory which states that social interaction can fundamentally influence the development of cognition according to Lev Vygotsky (1978). Another theory is the Zone of Proximal Development (ZPD), which was also developed by Vygotsky. ZPD theory is a gap between potential development and actual development, the explanation is that there is a zone where students are cognitively ready for a specific task and students can be successful with the support of their social system. There is a zone when students are cognitively ready including collaborative learning, discourse, modeling and scaffolding (Tomlinson, 2001).

Dedicated teachers, consciously or unconsciously, will carry out differentiating treatments to realize their commitment to educating their students. In distinguishing content, processes, and teaching products, consideration of student readiness, interest profiles and learning are required (Tomlinson & Imbeau, 2023). Differentiated learning suggests that teachers must know their students, it is almost certain that it is impossible for teachers to create relevant learning content for students, if teachers do not know their students (Littky, 2004). The design of the diagnostic assessment by taking into account the process and product content is shown in Figure 2.



Adopted fromTomlinson & Imbeau, 2023

Figure 2. Diagnostic Assessment Design

In the application of diagnostic assessment to differentiation learning in Biology subjects, it was described in the research of Shafira et al (2023) carrying out qualitative descriptive research on differentiated PBL learning based on learning styles in Serang City, the results obtained were that students with an auditory learning style tended to like making podcasts or short videos, while students who have a visual learning style tend to choose the final product in the form of posters, illustrated stories or comics to explain the results of observations, then students who have a kinesthetic learning style have products by demonstrating the activities they have done using tools to explain activities exploring the ecosystem in school environment.

As for Mac Donald's research (2017) explains how teachers use pre-assessments to make decisions about student grouping and different learning instructions in biology learning protein synthesis material. In this study designed an advanced scale (Students demonstrate the ability to model protein synthesis and use conceptual understanding through the application of protein synthesis in real-life scenarios)*, professional*(Student

can recognize the essential elements of protein synthesis and demonstrate the ability to model protein synthesis including distinguishing similarities and differences between DNA and RNA, modeling how DNA makes mRNA in the nucleus through transcription, modeling how mRNA, rRNA, and tRNA are used to make polypeptides in the ribosome through translation), approaching (Students can recognize the important elements of protein synthesis including: identification of key terms: transcription, translation, amino acids, polypeptides, RNA, DNA, nucleus, ribosome, the relationship between codons and anticodons, the relationship between mRNA, rRNA, and tRNA, how to read a chart codons to identify amino acids, similarities and differences between DNA and RNA, and beginning (Siswa has limited understanding of protein synthesis and cannot recognize critical elements or complete an accurate model without support). The results of the research allow the teacher to design instructional groupings of students and tiered based on their levels.

Similar research was conducted by Mavidou (2019) who carried out differentiation instructions on genetic material. There are 12 genetic materials, one of which is mitotic material, the description of the process and product content is shown in Table 2.

Table 2. Differentiation learning on Mitosis material

Concept	Session Content (Session Objectives)	Processes (Methods of Implementation)	Products (Assessment Tools)
Mitosis	Explain the purpose of Mitosis and Interphase 2. Explain the steps of Mitosis and Interphase 3. Describe the link between mitosis and cancer	Introduction: Class Discussions about the purpose of Mitosis and its important ▪**Logical-Mathematical** Activity: Calculating the Mitotic Index in normal cells division and in cancerous cells, and calculating the duration of the cell cycle ▪Audio-Visual Activity: A group of students will watch a video to summarize the steps of Mitosis ▪Kinesthetic Activity: A group of students will construct 2 models of cell division for plant and animal cells ▪Linguistic Activity: A group of students will summarize different case studies on different ways of dealing with people having cancer ▪Closure: Summary and follow-up questions	**Logical-Mathematical** Activities: Worksheets ▪**Audio-Visual Activities:** Making a power point presentation summarizing the steps of Mitosis ▪Kinesthetic Activities: Constructing the models ▪Linguistic Activity: Case Studies Report and presentation

Adopted from Mavidou (2019)

Schifl's research (2016) used levels to differentiate students' abilities in Biology (Table 3):

Table 3. Competence and learning level of differentiation

Competence	Levels	
Naming of natural phenomena	1.	Naming natural phenomena using everyday language
	2.	Naming natural phenomena using certain scientific terms
	3.	Naming natural phenomena using scientific terminology
Describe nature	1.	Describe natural phenomena using everyday language
	2.	Describe natural phenomena using scientific terminology
	3.	Describe natural phenomena using basic concepts
Describe information with using various types logical representation	1.	Describes information in a given representational structure
	2.	Recognizes the main criteria of representing and describing information
	3.	Depict information using self-chosen representations
Formulate hypotheses	1.	Formulate a hypothesis from the given problem
	2.	Formulate a hypothesis of a particular problem with respect to the influencing factors
	3.	Formulate a hypothesis from a given experiment with respect to the influencing factors and their variations
Planning an experiment	1.	Reproduce a given experiment plan
	2.	Plan an experiment with a given instrument for measurement
	3.	Plan experiments independently

CONCLUSION

This study describes how to design a diagnostic assessment in differentiation learning in biology subjects. In addition to the design, the form of the instrument is also conveyed and how examples of differentiation learning can be carried out with backgrounds, learning styles, ability levels and material content. In its implementation it is very important to pay attention to the alignment of content, processes and products to support the success of differentiation learning.

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CHAPTER 4

LEARNING FROM SEA NOMADS: ENVIRONMENTAL LITERACY IN THE LOCAL WISDOM OF THE BAJO TRIBE

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INTRODUCTION

Indonesia is an archipelago that has a high diversity of cultures in terms of ethnicity, culture and language, and a wealth of natural resources. Indonesia is the world's largest archipelagic nation which has a sea area of around three quarters, covering an area of 7.9 million km^2 which unites 17,504 islands with 95,161 km of coastline (Tahara, 2014). Indonesia have around 51.000 km^2 coral reef and lying at the center of Coral Triangle ecoregion (Purba et al., 2019), it's represented high marine biodiversity. Indonesia is the epicenter of the world's marine biodiversity (Purba et al., 2019). Even in eastern Indonesia there are more than 500 species of reef-building corals and 1650 species of fish (Cleary, 2019). The paradigm of Indonesian society in the development of settlements is mostly still oriented to the mainland or Landward Oriented Development (Capalulu, Waani, & Rengkung, n.d.). Human activities such as overexploitation of reef fisheries, anchors and ship grounding, and coral mining have identified damage marine ecosystems (Elliott, Mitchell, Wiltshire, Manan, & Wismer, 2001). The love for the sea is not as deep as the love for the land so sometimes we don't know how to treat the sea wisely. How to treat sea wisely can be seen in the mirror from the Bajo Tribe which has an important role towards a maritime country.

The name "Bajo" or "Bajau" is groups of people who move their lives, spread in the territorial waters. Bajo tribe is known as a formidable sailor and maritim communities who live in coastal areas (Basri et al., 2017). Their life is dependent on the coral reef ecosystem for food (Crabbe et al., 2004). However, history is more familiar with the Makassar Tribe, the Bugis Tribe, or the Mandar Tribe, as kings in the ocean. Bajo people are said to have been part of the Royal Srivijaya Navy. Thus, the toughness and skill of navigating the ocean is clearly undeniable. A number of anthropologists noted that Bajo people fled to the sea because they avoided war and riots on land. Since then, boat people have emerged who fully live on water

(Tahara, 2014). Bajo Tribe is represented Indonesia's maritime heritage (Acciaoli, 2006). Foreign researchers usually use names such as Sea Peoples, Sea Nomads, Sea Gypsies, Boat Nomads, Nomadic Boat Peoples and so on. They call themselves "Sama People" which means tribe (Crabbe, 2006). Total Bajau population in Indonesia estimated over than 170.000 and mostly live in eastern Indonesia, such as Sulawesi, Maluku, Papua, and Nusa Tenggara (Clifton & Majors, 2012). Outside of Indonesia they are found on the west coast of Malaysia, Thailand, Myanmar under the name Mewken or Moken and in the Sulu Islands, Philippines (Indrawasih & Antariksa, 2003). Bajo tribe is one of local communities who engage in activities align with marine conservation (Clifton & Majors, 2012). Life that is friendly to the sea makes them have marine local wisdom that should be a lesson for the community in protecting the sea.

Bajo Tribe generally has a local wisdom on knowledge and management system that is inherited and developed continuously for generations. Local wisdom is the heritage of ancestors in the values of life that are united in the form of religion, culture and customs. Indonesian Law provides an understanding of wisdom, namely the noble values that apply in the way of life of the community to protect and manage the environment in a sustainable manner. Forms of wisdom that exist in society can be: values, norms, beliefs, and special rules. The function of local wisdom includes conservation and preservation of natural resources; human resource development; cultural and scientific development; as advice, belief, literature and taboos; ethical and moral meaning; and means to maintain the sustainability of culture, as well as to maintain its sustainability. Wisdom is also known as local or indigenous knowledge, intelligence, or genius which forms the basis of cultural identity (Artanto, 2017b). The values of local wisdom contained in a social system of society, can be lived, practiced, taught and passed down from one generation to another which at the same time shapes and guides the patterns of daily human behavior, both towards nature.

In order to maintain life, the Bajo tribe still retains the principle of life of their ancestors by living at sea or on the coast of the sea. The sea is the most comfortable place for their survival. They used to do all kinds of activities of life at sea. Because of being in the sea, the activities carried out certainly cannot be separated from things relating to the sea (Uniawati, 2011). Coasts and oceans are very important for human life. The human population with permanent activity in the region of 100 km from the coast is 33% of the world's human population and continues to increase to 50% in 2030 (Hermawan, 2017). Coastal and marine sustaining almost half of

basic human needs, such as food needs from fisheries. Coastal and marine loads are increasing with increasing human and natural activities, so knowledge and behavior are needed to maintain the balance of the marine ecosystem.

Bajo tribe has emotional closeness to marine natural resources which bring up real behavior considering ecological in their daily lives. The proximity of the Bajo people to the sea and the coast allows them to have a variety of local knowledge about natural phenomena as provisions when going to sea. They learn self-taught from their predecessor generation (Artanto, 2017b). It can be interpreted that the Bajo tribe has wisdom in the form of traditions, rules or hereditary practices which are practiced, maintained and obeyed by the Bajo people in maintaining and utilizing the coastal area in a sustainable manner. Although the development of science is progressing, local knowledge about natural phenomena owned by the Bajo people is still a reference for them in living their lives at sea. The ethics, customs and culture system of the Bajo tribe has proven to be able to make the Bajo people able to survive and live in harmony with the coastal and oceanic areas that are their livelihoods until now. Local wisdom and knowledge are the result of a very long process from generation to generation.

Bajo tribe wisdom toward marine environment is a form of environmental literacy. Environmental conditions that continue to change as a result of human activity require people who have environmental literacy. Environmental knowledge and attitudes are components of a broader concept known as environmental literacy (Ramdas & Mohamed, 2014). People who are environmentally literate are people who have basic skills, understanding, and feelings for human relations with the environment (Erdogan & Ok, 2011). Environmental literacy can be defined by having the required perceptions and competencies of the health and environment system to be active in developing the necessary actions about the environment. Individuals are expected to use their knowledge and concepts in daily life. The term "environmental literacy" was first used by Marcinkovski (1991) and this term is defined by UNESCO as knowledge, attitude and active participation about the environment. Environmental literacy is demonstrated when individuals have the knowledge, skills and dispositions to engage, individually and collectively, to support sustainable natural and cultural systems (Evers, 2018). Environmental literacy is confirmed by the Environment Education and Training Partnership (EETAP) that an environmental literate person knows what he will do for the environment, he knows how to do that (NAAEE, 2000). North American

Association of Environmental Education (2011) said that a person's environmental literacy status can be measured based on the criteria of environmental literacy components, namely: knowledge, cognitive skills, attitudes and responsible behavior towards the environment (behavior) (Nasution, 2016). This article will describe the form of environmental literacy in the local wisdom of the Bajo Tribe that can be used for learning by communities so that it can be applied as an effort to preserve marine ecosystems.

DISCUSSION

The Bajo tribe are skilled with marine issues and their lives depend entirely on the sea. Attachment to the sea is reflected in the song they often hum "*Dilaoku kallumangku-Ma bukoknu busayangku lepaku-Ma bittaknu tummuangku dalleku"* which means "My sea my life-on your shoulder I paddle my shoulder-in your stomach found my fortune" (Poedjowibowo, 2013). The closeness to the sea makes a lot of lokal wisdom that reflects environmental literacy. This environmental literacy they get from the education of their ancestors who from the beginning of life at sea. Here are some environmental literacy of the Bajo Tribe.

1. Knowledge literacy the importance of marine ecosystems

The main basis of literacy is knowledge. Bajo tribe have enough knowledge about the sea, so they know how to treat the sea well. Bajo fishermen understand the sea with various perspectives, namely: (1) the sea as *sehe* (best friend); (2) sea as *tabar* (medicine); (3) the sea as *anudinta'* (food); (4) sea as *lalang* (transportation infrastructure); (5) the sea as a *pamunang ala' baka' raha'* (source of good and evil); and (7) the sea as the *Mbo Madilau* (the Bajo ancestral place that controlled the sea) (Nur, 2004)*, Mbo Madilau* as sea spirit that are central of Bajo belief system (Clifton & Majors, 2012). Bajo belief in the importance of the role of the sea for their lives is what drives many beliefs, values, actions, and even myths developed to protect the sea.

2. Diving skills without damaging

The Bajo tribe are reported to have experienced genetic adaptation so they have amazing diving skills. Melissa A. Llardo et. al. (2018) said that the Bajo have the ability to dive freely without the aid of tools for 13 minutes. Their diving ability can reach a depth of 70 meters. The ability to hold a breath that is very long when compared to ordinary humans is possible because of the genetic adaptation of the influence of diving habits

to catch fish, octopus, or crabs only use spears and without diving aids. Research of Ilardo et al., (2018) prove that the spleen of the Bajo tribe is 50% larger than the Saluan tribes who are not accustomed to diving. The spleen is the most important organ that plays a role in diving activities. The spleen releases more O_2 into the blood when the body holds its breath in water. Llardo also discovered the PDE10A gene in the Bajo tribe that is not found in the Salean Tribe. The PDE10A gene is known to regulate thyroid hormones which control the size of the spleen. Bajo people with diving skills without diving equipment certainly reduce the risk of ecosystem damage. The Bajo tribe searches for marine biota using only spears without modern diving equipment that are at greater risk of damaging the marine ecosystem. Divers who using diving equipment have been investigated having an impact on coral reef damage. Worachananant, Carter, & Hockings, (2008) stated that 66% of divers damaged coral reefs in just 10 minutes of observation and divers contacted coral reefs on average 97 times per hour. Dearden et al. (2007) research explain that almost 30% of divers witnessed perceived negative impacts on the reef by their dive group. Diver activities that can damage coral reefs include direct contact with the reefs such as trampling, kicking, holding on to, kneeling or standing on the coral, reef walking, snorkelling, diving facilities (fins, oxygen cylinders, etc.), and water pollution due to powerboats (Dearden et al., 2007). This negative impact will minimize with Bajo Tribal diving.

3. *Pamali* tradition as an effort to conservation of marine ecosystems

The sea is life for the Bajo. This is reflected in the cosmology of the Bajo tribe " Mbo *kita ne lino baka isi-isina, kita neje manusiana mamikker iyya batingga kole'ta mangelola iyya*" which means "God has given the world and all of its contents to humans, so we must think and manage it with good and wise" (Basri et al., 2017). The Bajo tribe has a philosophy that they will never experience hunger or poverty, because the sea is the source of life. They believe that their ancestors came from the sea, lived in the sea, and as *mbombongana lao* (ruler of the sea) that can provide sustenance, goodness, health, and protect people from disaster. Bajo tribal ancestors have a philosophy "*kadampaannu kampo maiga-iga, pugai allou mabunda ana'umputa*" which means "love the marine environment for the future of our children and grandchildren". This reflects the high sense of Bajo ownership of the sea, so they always try to preserve the sea. One of their wisdoms to preserve the sea is *pamali*.

There are *pamali* or restrictions of Bajo tribe sea activities that must be considered and not violated. It's designated a taboo activity (Lowe,

2003) include fishing, non human creature, and forbidden activities (Simonin, 2015). *Pamali* also concerned with the sustainability of the ecosystem and the safety of individuals and the Bajo community. *Pamali* included: (1) not catching marine products on the reef in sandy soil in the form of a delta because this place is believed to be the abode of *Mbo* or Lord of the Sea; (2) prohibition of catching animals which are considered as embodiments of *Mbo*, such as octopus, pomfret, kulintang, kunyu boe (a type of turtle), dolphins, and sharks. Aside from being considered an incarnation animal, pomfret, according to Bajo people, is a past fish that deserves to save its ancestors when it has an accident at sea. Therefore, Bajo people consider animals as human friends; (3) maintain attitudes and actions that can cause Mbo to be angry with them. The Bajo believes that if they violate the Pamali, they will get punishment or curse from *Mbo*, such as serious illness, death, drowning in the sea, being strangled, and so on. The death of someone when fishing for the Bajo tribe is a sign of spiritual action and warning for others. If karma or punishment does not occur directly to the person concerned, then the karma or punishment will occur to their family, children, or grandchildren (Basri et al., 2017). Pamali's understanding bring up the concept of self-conscious behavior called *empe diri* (four-self) in the management of marine resources. There are *tahan diri* (self-endurance), *ngatonang diri* (self-awareness), *angga' diri* (self-conception), and *matappa diri* (self-confidence) (Basri et al., 2017). Self-endurance means not being greedy in searching, can not justify any means to damage marine environment. The Bajo believe that they are the chosen people who are destined to inhabit and protect the sea. They consider themselves the descendants of the Sea Gods, who are tasked with managing the sea (Basri et al., 2017).

4. Wisdom in taking natural resources

The Bajo has knowledge and skills for environmentally friendly fishing. In fishing they use traditional fishing gear such as *rompoh, pempeso,* and *bhala* (Ode & Basri, 2011). These equipments is environmentally friendly for coral reefs. *Rompoh* is made of bamboo and coconut leaves. Bamboo is shaped like a raft, at the bottom and side of *rompoh* is laid coconut leaves, fish gather in that place. Nets installed around the *rompoh*. *Pempeso* is made of woven bamboo or rattan which is usually dissolved on the seabed around coral reefs by considering the safety aspects of the *pempeso* when being lifted from the seabed. In one part of the *pempeso,* stone or iron is usually stored to facilitate the sinking of the seabed. *Pempeso* is also tied with a long rope and tethered in a boat

or tree and then kept for several hours or left overnight and pulled out the next day. *Bhala* is a traditional cage for fishing. In hunting marine biota, they dive using spears. Local Bajo rules in fishing are choosing mature fish. Another form of local fishing wisdom is "bapongka" which is a group of fishing activities for several weeks or monthly using a traditional boat called *leppa* or *sopek*.

The Bajo people realize that mangroves are important ecosystems. The use of mangroves by the Bajo is very wise, they take firewood from dried branches. In boat making, the Bajo tribe uses wood which they plant themselves (Indrawasih & Antariksa, 2003). The attitude of environmental literacy is strongly reflected in this behavior. The Bajo is aware of the importance of mangroves as a place for spawning of some marine biota. If the resources have started to decrease, they will move to another place so that the lack of resources can develop first. Bahtiar (2012) explain about "*Ongko*" which is Bajo local wisdom in arranging fishing grounds or locations based on the habits of a person or group of people. With this system Bajo people do not scrambling with each other about location.

5. Construction of eco-friendly houses

Bajo tribal houses in the form of houses on stilts above sea level at a depth of between 1 to 8 meters, housing between residents connected by wooden bridges. Pole houses and bridges are built using wood from waterproof plant species (local name *Gopasa*) taken from outside the mangrove area. Before that, the community used old and dead plants (local name *Posi-posi*) taken from the mangrove forest area (Artanto, 2017). Bajo community behavior diverts the use of wood from the mangrove area to preserve mangrove ecosystems. Damage to mangrove ecosystems is realized to have an impact on the life of seagrasses and coral reefs, and subsequently the loss of marine biota (species of reef fish), and in turn damage to coastal ecosystems can disrupt the main livelihoods of the community (Utina, 2012).

6. Bajo law of the sea

The Bajo tribe has a customary marine law that aims to protect the marine ecosystem. In this case, the Bajo tribe developed the *Mamia Kadialo* tradition. *Mamia Kadialo* is a tradition of grouping people and the boat that used when they go to sea for a certain period of time. There are 3 groups, namely; *palilibu*, *bapongka*, and *sasakai*. *Palilibu*, is a habit of going to sea using a *soppe* boat that is driven by oars. The group only takes a day or two days and then returns to the settlement to sell catches and

some catches are enjoyed with their family. *Bapongka* or *babangi* is a fishing activity for several weeks to months using a large boat ± 4x2 m^2 called *leppa* or *sopek*. In this group, often involving families and children. The most important thing during *bapongka* is to abstain from the taboo (Ramli, Santosa, & Hidayati, 2018).

During the *mamia kadialo* there are abstinences that should not be done by the sailors and their families who are left behind. That abstinences are do not throw into sea water: sea cucumber washing water, wood charcoal or kitchen ash, butt or ash of cigarette, chillies water, ginger and orange juice, and also the prohibition of washing cooking equipment on ships. So, if there are washing water and the materials, it will be collected and then released on land. There is also abstinence from eating turtle meat, because turtles are believed to help Bajo tribal who have experienced a disaster. Bajo tribal parents prohibit family members from fishing and catching other biota around the coral clusters (*pangroak sappa*), except they perform certain rituals by preparing dishes for the ancestors (Utina, 2014). Each group of corals has a certain pile of corals believed by Bajo Tribal to be the *jage* house (guard post), a place for coral watchman spirits (Indrawasih & Antariksa, 2003). These abtinences in *mamia kadialo* have positif impact to marine ecosystem sustainability. Prohibition of waste disposing into marine can be marine pollution and threatening the life of biota (Purba et al., 2019). Throw out kitchen ash, cigarette ash, chili water, and ginger water can kill jellyfish (Artanto, 2017a). Washing water and cooking utensils containing charcoal and soot can cause turbidity, which can threat seagrass life and coral reefs (Utina, 2014). Prohibition kills turtles and approach certain clusters of coral reefs that are contains preservation value to support the existence of marine ecosystems. The sea law in the form of Pamali during *mamia kadialo* is a local wisdom of the Bajo tribe which shows knowledge and attitude of environmental literacy.

7. The role of tribal social structures

Bajo tribe has a social structure called *parika*. *Parika* is an institutional system that already exists in the Bajo Tribal fishermen group. A *parika* is someone who has a higher mystical ability than others, considered as a guardian and advisor in determining the fishing location and time. *Parika*'s appointment is based on heredity, self-maturity, and the ability to lead other fishermen. *Parika* for group members is *henangkara* meaning someone who is followed or a role model because they have an ability to determine the time to install the equipment and the size of the

fishing gear to be used. Local wisdom that reflects environmental literacy in this case are *parika* provides time for fish to lay eggs till give birth and give fishing limitation based on certain time conditions agreed upon by traditional leaders and community leaders (Saniati, 2013: 6). In the *Parika* system, if there is a violation between fisherman, a warning will be given to the violating fishermen.

8. Rare marine biota conservation

Bajo tribe has environmental literacy in the form of knowledge about rare or almost extinct marine biota. They even conserve rare marine life through traditional ceremonies called *sangal*. This traditional ceremony is held during the famine season of fish and other marine species. They will release species whose population is declining, for example, they will release turtles when the turtle population decreases and they will release tuna when the tuna decreases (Sartini, 2012). This ritual is also often performed before harvest in an effort to *tolak bala* (avoid disaster). *Sangal* ceremony is a very valuable conservation effort to maintain the balance of the ecosystem and maintain the preservation of marine wealth.

9. Support for marine protected areas

Many Bajo tribes who live in Marine Protected Areas (MPA) or National Parks provide support in conservation efforts. MPA management that involve local communities will be greater in the impact of coral reef preservation (Elliott et al., 2001). The Natural Concervacy (TNC) explain that the success of marine conservation depends on the active involvement of people whose lives are linked to the natural systems we try to conserve (Pauwelussen, 2015). In 2006 the Bajo tribe in the Wakatobi MPA made a joint agreement with the aim of protecting *Tubba Dikatutuang* conservation area. The ancestors of the Bajo tribe have given a message that sacred places must be protected properly because the fish resources in those places are very abundant. So according to them there is a trust value of the Bajo tribe that is in harmony with the management of conservation areas, including: (1) prohibited from fishing in conservation areas in excessive amounts; (2) fishing is not allowed to fish that are laying eggs: (3) prohibition of all forms of fishing activities in protected area; (4) prohibition of anchor laying in protected area because it will damage the reef: (5) prohibition from fishing of protected fish. These efforts are aim to maintain population balance and species regeneration. In this protected area there are agreed restrictions on not managing fisheries products. Sanctions if fishermen make arrests in protected area are: (1) violation I

(minor): still in the form of reprimand and socialization; (2) violation II (moderate): if caught again will be returned in the village; (3) violation III (severe): a fine in the form of money in the amount of Rp. 2,000,000 to be submitted in the sub-district (Hasrawaty, Anas, & Wisudo, 2017).

The existence of local wisdom in the form of a sacred site also supports the conservation in protected areas. Bajo tribes save natural sites in conservation areas. This circumcision has been passed down from generation to generation and is still ongoing. Hasrawaty et al. (2017) said that community compliance to the sacred sites is an important part of conservation, although from a broad aspect it is not so large, but its impact is very important in ensuring biodiversity conservation. Another support for sustainability in conservation areas is showed by several communities that form community awareness groups. This community awareness group held several programs such as raising awareness of the dangers of plastic waste and planting mangroves in damaged mangrove ecosystems.

CONCLUSION

Bajo tribe or commonly known as Sea Nomads has a variety of local wisdom that reflects environmental literacy, including knowledge about the importance of marine ecosystems, diving skills without damage, the Pamali tradition that is believed to be indirectly an effort to conserve marine ecosystems, wisdom in utilization of natural resources with environmentally friendly equipment, the construction of environmentally friendly homes, the law of the Bajo fishing that is believed to be disastrous if not adhered to, the role of tribal social structures in determining the good time and location of fishing, conservation of rare marine biota through traditional ceremonies, and support for conservation area through several community activities.

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CHAPTER 5

NUMERACY LITERACY ON THE PROCESS OF STUDENT MATHEMATIZATION IN TERMS OF COGNITIVE STYLES OF FIELD DEPENDENCE AND FIELD INDEPENDENCE

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INTRODUCTION

Junior high school mathematics learning aims to make students have the ability to communicate mathematical ideas clearly. This ability needs to be improved so that students' understanding of mathematical concepts increases. One way to see students' communication skills is to see the process of students solving math problems (Fatmawati, Ralmugiz and Syarief, 2022). Problem solving requires an in-depth understanding of concepts that are now needed in curriculum reviews to support sustainable development, especially in the field of education (Menzie-Ballantyne, K., & Ham, 2022). Based on *Organisation for Economic Co-operation and Development* (OECD) the process of solving mathematical problems is described in mathematical literacy which is referred to as a mathematical process (OECD, 2022). The process of mathematical literacy is the process of reasoning mathematically and using concepts, procedures and facts, as a tool to describe and predict certain situations (OECD, 2017). Components such as problem solving, critical thinking, communication, collaboration, and innovation are contained in mathematical literacy skills (Anwar, 2018). This assessment of literacy skills is carried out in the Program for International Student Assessment, a program for the assessment of international students aged 15 years.

Numeracy literacy is closely related to real problems so it is important for students to have. But in reality, the math literacy score of junior high school students in Indonesia is still far below the global average math literacy score during the span of 2012 to 2018. The latest data released by the OECD states that from 2015 to 2018 the mathematical literacy score of Indonesian students is 379 points while the global average score is 489 points. This shows that junior high school students in Indonesia are still low in their ability to solve math problems.

The attempt to solve a real problem using a mathematical concept is then returned in the initial context called the process of mathematization (Sari, 2015). The process of student mathematization can be divided into two parts, namely horizontal mathematization and vertical mathematization (Amala and Ekawati, 2016). The use of these two processes varies based on the characteristics of students in solving problems.

The characteristics of students in solving problems are called cognitive styles (Junita, 2016; Nurdianasari et al., 2015; Rahardjo, 2015; Yekti et al., 2016). Based on psychological aspects, students' cognitive styles are divided into two, namely Field Dependence and Field Independence (Kozhevnikov, Evans and Kosslyn, 2015).Students with field dependence cognitive style need the help of clear instructions in the learning process while students with field independence cognitive style can solve problems without the help of instructions.

Several studies were conducted to improve students' mathematical literacy skills because PISA results showed low scores (Ayuningtyas, 2017; Syahlan, 2015; Yunika Putra & Hartono, 2016). However, these results do not show in more detail the location of students' shortcomings in the mathematization process. Students who take part in the program are students with the age of 15 years who are generally at the junior high school level. This is the basis for the author to conduct research. This study was conducted to answer problems regarding the quantitative literacy process of junior high school students in the process of mathematization in terms of cognitive styles, field dependence and field independence. Based on the background that has been explained, the formulation of the problem in this study is how the numeracy literacy process of junior high school students in the process of mathematization is viewed from the cognitive style of field dependence? and how is the numeracy literacy process of junior high school students in the process of mathematization viewed from the cognitive style of field independence?

This study was conducted to answer problems regarding the numeracy literacy process of junior high school students in the process of mathematization in terms of cognitive styles, field dependence and field independence. Contribution to the literature is to provide a point of view regarding the process of numeracy literacy of students in the process of mathematization. In addition, it is also useful as a teacher's consideration in the learning process related to students' cognitive styles.

DISCUSSION

Based on the results of this study, the following is a summary of the numeracy literacy process of FI students and FD students in the mathematization process

Table 2. Numeracy Literacy Process of FI and FD Students in the Mathematization Process

Numeracy Literacy Indicators	Description	Mathematization					
		FI			FD		
		Formulate	Apply	Evaluate	Formulate	Apply	Evaluate
Interpretation	Recognize the main idea	√	-	-	-	√	-
	Understand the relationship between ideas	√	-	-	-	-	-
	Reasoning with data	-	√	-	-	-	-
	Read picture patterns	√	-	-	√	-	-
	Recognize the sources of error	√	-	-	-	-	-
Representation	Convert information to mathematical form	√	√	-	-	√	-
	Describe/rewrite ideas	-	-	√	-	-	-
Calculation	Add, subtract, multiply, divide and manipulate mathematical numbers and symbols	√	√	-	-	√	-
Apply/Analysis	Describe a relationship and combine several elements into a whole.	-	√	-	-	√	-
	Parse relevant information elements, determine relationships between relevant elements, and determine points of view about the	-	√	-	-	-	-

	purpose of learning information						
Assumption	Make and evaluate important assumptions in estimation, modeling, and data analysis	-	√	-	-	√	-
Communication	Explain ideas orally and in writing with real objects, pictures, graphs or algebra.	√	√	√	-	√	-
	Re-express a mathematical description or paragraph in one's own language	√	√	√	√	√	√

The numeracy literacy process is a student's effort in working on mathematics problems. This process can be seen when students interpret, represent, calculate, application/analysis, assumptions and communication. There is a difference between the numeracy literacy process of students with field independence cognitive style and students with field dependence cognitive style.

Students with a cognitive style of field independence in the aspect of interpretation explain information in the form of pictures using equations, numbers, symbols and words both written and spoken. Students write down equations after understanding the pattern of a given picture. The relationship obtained from the equations and patterns of images is then expressed in the form of numbers and symbols. The essence of the questions given by students is short and clear so that it is easy to understand. This shows students reasoning using data in the process of formulating situations mathematically. Students also recognize their mistakes and work to correct them in the process of applying. In contrast to field independence students, field dependence students on the interpretation aspect explain information in the form of pictures using words orally. Students do not write down information in the process of formulating situations mathematically but explain it during the interview session. Students do not yet recognize the general shape of a given picture pattern making it difficult for students to make connections between the picture and the general pattern formula

FI students in the aspect of representation convert a form of information in the form of pictures into the form of numbers, tables, and

spoken words in the process of formulating and applying. Images containing symbols and x with a specific pattern are converted into numeric form using equations. The results of these calculations are written into tables and explained back orally. Students describe the method used to change the form of images to the form of numbers and tables clearly. While FD students in the aspect of representation change a form of information in the form of pictures into the form of tables and spoken words in the process of applying. Images containing symbols and x with a certain pattern are converted into table form by counting the number of symbols in the image.

Students with a cognitive style of field independence in the calculation aspect perform calculations such as addition, multiplication and division in the process of formulating and applying. While students with a cognitive style of field dependence on the calculation aspect perform calculations such as addition and multiplication only in the process of applying.

FI students in the application/analysis aspect explain and combine two elements, namely image patterns and formulas, into a single unit and elaborate the information to solve problems in the application process. While FD students in the application/analysis aspect explain and combine two elements, namely table data and formulas in the process of applying.

Students with a cognitive style of field independence in the aspect of assumptions provide assumptions and their reasons for the process of applying. Similarly, students with a cognitive style of field dependence on the process of applying give assumptions but do not give reasons.

FI students in the communication aspect explain ideas orally and in writing and express their ideas again using their own sentences in the process of formulating, applying and evaluating. While FD students in the communication aspect explain ideas orally and in writing in the process of applying and expressing their ideas again using their own sentences in the process of formulating, applying and evaluating.

Some of the differences above show that in the process of formulating FI students are easier to process information or ideas compared to FD students (Baiduri, 2015). In addition, FI students separate relevant information and are more analytical in solving problems (Yekti, Kusmayadi and Riyadi, 2016; Udiyono and Yuwono, 2018). This is supported by the results of previous studies that showed the level of visual, verbal, image and logic skills of FI students was higher than FD students (Nur and Nurvitasari, 2017).

In the process of applying, the strategies used by FI students are more varied than FD students (Alvani, 2016). FI students use two ways to solve problems. The first way is the method written on the answer sheet and the second way is used to cross check the answer from the first way. While FD students only use one way, namely counting symbols on picture patterns. The calculations performed showed that FI students performed number operation calculations and number manipulation more complex compared to FD students. It is like the results of research of Yekti (2016) which states FI students are able to apply algebraic operations and algebraic manipulations.

Students with a field dependent cognitive style have difficulty solving problems. Some difficulties are experienced, for example, when determining relevant information in the problem and making relationships between elements. Witkin et al (1977) argues that the character of FD students requires help or guidance in solving problems. The difficulties experienced by students can also be caused by students' lack of understanding. Previous research showed a greater percentage of misconceptions of FD students compared to FI students (Irawan, Riyadi and Triyanto, 2012).

If the six aspects of numeracy literacy of FI students are compared to FD students, then FI students stand out more compared to FD students. This is slightly different from previous research which showed only the representation and communication aspects of FI students were better compared to FD students(Junita, 2016). This can be because the aspects studied in previous studies are still limited.

The difference in character of FI students and FD students is a characteristic of each individual in solving problems (Rayner, 2015). This difference can be used by teachers to get to know the character of students. If the teacher understands the profile and potential of his students, then the teacher can use the information in learning practices to determine which learning model or strategy suits the character of the student.

CONCLUSION

First, the numeracy literacy process of field independence students in the process of mathematical aspects of interpretation recognizes the main idea, understands the relationship between ideas, reasoning with data, reading and understanding the mathematical form of image patterns, and recognizing the source of error. On the representation aspect, students convert information into other mathematical forms and redraw ideas. In

the calculation aspect, students calculate quadratic, multiplication and division forms. In the application aspect, FI students explain the existing relationships and combine elements into a single unit and parse and make relevant information relationships. In the aspect of assumptions, students make assumptions with strong evidence and reasons. Meanwhile, in the communication aspect, FI students explain their ideas and convey them in writing and orally using their own sentences.

Furthermore, the numeracy literacy process of field dependence students in the mathematical process aspects of interpretation recognizes the main idea and reads picture patterns. On the aspect of representation FD students convert information into mathematical form. In the calculation aspect, FD students perform calculations in the form of squares and sums. In the application/analysis aspect, FD students combine elements into one unit. FD students on the assumption aspect make assumptions but are not accompanied by strong evidence or reasoning. While in the communication aspect, FD students explain ideas and convey their ideas in writing and orally, although the explanations given are less consistent

Based on the results of research on the numeracy literacy process of junior high school students in the mathematization process, researchers share suggestions to parties who want to conduct further research to review students' numeracy literacy skills. In addition to measuring how much the level of student ability, it can also show which indicators need to be improved. In addition, the problems used can also be added and more varied not only using images, equations and tables but also other forms such as graphs, diagrams, and so on.

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CHAPTER 6

THE LOCAL WISDOM VALUE OF DAWAN PEOPLE IN *USIF GUNAWAN* FOLKLORE

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INTRODUCTION

Dawan is a large community in Timor Island. They are known as *atoin meto* or *atoin pah meto*. *Atoin* is derived from the base word *atoni* means "man", "person", and "human", while *meto* means "dry". *Atoin meto* can be interpreted as people from dryland (plain) (Hajar & Purniawati, 2020). Dawan people have very diverse traditions and cultures. One of them is oral tradition. UNESCO (Hutomo, 1991) explains that oral tradition is those traditions that have been transmitted in time and space by the world and act. This means the inheritance of oral tradition occurs orally to produce a certain pattern based on the time and acts of the heirs. As part of oral tradition, oral literature contains literary-valued of oral texts. This makes oral literature different from other community traditions such as customary law, dance, food, and so forth. As (Yetti, 2011) stated that oral literature is a kind of cultural product, created and inherited orally and passed down from generation to generation through mnemonic devices. It evolves through society's development, including rhymes, proverbs, folk tales, songs, and so on. The forms of oral literature are very diverse, namely folk literature, traditional expressions (proverbs and proverbs), traditional questions (puzzles), folk poetry (rhymes, poems, thimbles, etc.), and folk prose, myth, legend, and fairy tales (folktale), as well as folk songs. These

literatures in Indonesian society may become an identity because it contains various local wisdoms.

Oral literature has elements of local wisdom because it was born and developed from generation to generation in society. Oral literature is a form of literature that is spoken orally and its dissemination occurs orally. It is defined by Taum (Evriana et al., 2021) as a group of texts passed down orally from generation to generation, which intrinsically contain literary means and have an aesthetic effect on the moral and cultural context of a particular group of people. This existence is a sign that oral literature has high local wisdom values. This is because the value of local wisdom is the noble hopes and ideals of ancestors to be transmitted. As (Endraswara, 2019) said that local wisdom is also a deposit of ancestral messages. There is a way of life for its supporters. The opinion above is in line with the contents of oral literature in Dawan people, namely hopes, advice, and ways of life based on the culture of Dawan people as *atoin pah meto.*

Local wisdom can affect community members to act based on awareness while giving priority to the group than individual interests. As stated by Fajarini (Dorongsihae et al., 2022) local wisdom is a way of life and knowledge as well as various strategies in the form of life activities carried out by local communities to solve their various problems of needs. It is often conceptualized as a place of "local wisdom" or local knowledge. The values in the local wisdom are very diverse. According to (Sibarani, 2012) it consists of peace and prosperity. The local wisdom of peace consists of politeness, honesty, social solidarity, harmony and conflict resolution, commitment, positive thinking, and gratitude. Besides, local wisdom of welfare consists of hard work, discipline, education, health, cooperation, gender management, cultural preservation, creativity, and environmental care. These local wisdom values can be seen in folklore as one of the traditions in Timor Island.

Folklore according to Nurgiyantoro (Jayapada et al., 2017) is a story, which originates from the community and developed from generation to generation in the past as a means of conveying a moral message. Several experts divide folklore into several types, as stated by Brunvand (Sulistyorini & Andalas, 2017) folklore/folk prose stories (folk narrative) are divided into three groups, namely (1) myth, (2) legend, and (3) folktale. These folktales have different characteristics but similar in some ways. One of the folklore owned by the Dawan people is the Story of *Usif Gunawan Isu*.

Usif Gunawan Isu story is one of the folktales found in Timor, especially Amanuban. *Usif Gunawan Isu* was a figure who initiated several

major events in Amanuban. Study about the structure of the story *Usif Gunawan Isu* has been done before under the title *"Exploration of Usif Gunawan Isu Story and Application of Axel Olrix's Law"* (Hajar et al., 2022). The focus of this study was to find the value of local wisdom in the story. This is because the value of local wisdom in folklore is full of ancestral messages as a life lesson.

Many studies related to folklore have been done before, including (Ardesya, 2021)*"Value of Local Wisdom in Stories and Events: Folklore of the Enim Community".* The study showed there were six values of local wisdom from the story of Tambah Medan, namely: the value of respecting parents; positivity; helping; courage; strong will; and hard work. Furthermore, the study conducted by (Fatimah & Sulistyo, 2017) *"Folklore of Dewi Sritanjung as an Effort to Realize Character Education Based on Local Wisdom Values".* The results indicated that there were local wisdom values in Dewi Sritanjung folklore, namely honesty and religious. The character education also found namely attitudes and behaviors as the sacrifice of Dewi Sritanjung by letting herself be killed to show she is truly honest and religious and finally revived by God. Besides, (Inrani, 2017) *"Value of Local Wisdom in the Legend of Muntok Folklore: A Study of Character Education"*. The study revealed that there were 13 local wisdom values in the 3 legends of the Muntok folklore, namely cooperation, honesty, commitment, self-confidence, politeness, trustworthiness, hard work, positive thinking, social solidarity, helping, discipline, health, and gratitude. The results of the study also showed folklore has local wisdom values that should be revitalized to be applied and taught to the younger generation as a basis for character formation.

Based on previous research, it is essential to investigate and explore the local wisdom in the folklore of each place. The related research has examined the importance of local wisdom in the stories of Tambah Ajang, Dewi Sritanjung, and Muntok. However, this study is focused on *Usif Gunawan* of Dawan people in South-Central Timor.

DISCUSSION

This study shows the local wisdom value in *Usif Gunawan Isu* folklore. The structure of *Usif Gunawan* story is analyzed as follows:

THE LEGEND OF USIF GUNAWAN ISU

Once upon a time, the people of Timor still believed in *halaika*. There lived a king named Tua Isu and his wife Soni Nombala. He is the first king that called fetor Noebunu. Soni Nombala gave birth to a son. His name is Keke

Isu who is married to Heka Nenoliu. From their marriage, Lemo Isu was born. Later, when Lemo Isu was an adult and got married. He succeeded his grandfather, King of Tua Isu as Neobunu's fetor. His palace is at the foot of Mount Tuniun, Sillu Village. At that time, people called his palace as Sonaf Noebunu. Before the people were familiar with religion, King Lemo Isu and all his friends believed in halaika. Only to Uis Neno and Uis Pah where they ask for the prosperity of life.

In 1924, King Lemo Isu's first child was born, named Seo Isu. Seo Isu had a dark skin but it glows. His posture is big, not too tall, but agile and brave. He grew up with his three younger siblings in Sonaf. King Lemo sent them to school in Pisan, Tesi. So one day when Japanese began to take over the territory of Timor, Seo Isu worked as a writer at Sembuhang of Japanese government office in Niki-Niki. Two years later, Japan agreed to choose him as the king in the Noehombet district. He continued to lead Noehombet until World War II was finished raging between the Allies and the Axis.

One day, King Lemo Isu who led the Noebunu fetory could no longer reigned because he was quite old. His people continued to ask who would lead the Noebunu fetory. Along the days to the election day, many people have expressed their wish for their first child, Seo Isu, to become the King of Noebunu.

"If it has to be replaced, we ask *Naimnuke* Seo Isu to become the King of Noebunu," the *Amaf* said. Seo Isu, who at that time was still the King of Noehombet, told that he did not mind. People of Amanuban trusted in him. The election was conducted. At that time, the people chose their king using a stone. Everyone will bring a small stone to keep in the name of the king they want to choose. At the same time, his younger brother, Hitu Isu, was chosen by the villagers to replace his brother as the King of Noehombet .

Once, there was a meeting in Nunkolo between several kings in Amanuban. All kings were there, as well as Seo Isu and Hitu Isu. The people started to look at their king,try to predict what will be happened. While in another part of the place, stood a large drum filled with powerful male cows. The cows were an gift to the king, but every king had to catch his own cow.

"What happened Beti?" Seo Isu asked his bodyguard.

"The cows, Usi, every king must catch them himself," answered the bodyguard.

"Where's my cow?"

His bodyguard pointed at the drum. Seo Isu followed the guard, his eyes

began to catch the cow's presence. In front of the drum door, woods were crossed on the door. The atmosphere was getting hotter because some of the previous kings had not been able to catch the cow. Even the king's *amaf* have joined in chasing the cows all the way to the Forest. Seo Isu is not affected. He opened the blanket and *futu* from his waist and then he draped it to the one side of the drum door.

"Beti, open the door!"

His bodyguards rushed to pull the logs one by one from the cage door. Seo Isu stood clenched her fists. As soon as the cow's two feet hit the ground outside the cage, a fist landed on the cow's body. The cow died on the spot with three broken ribs. Everyone looked on in disbelief. The amaf from the Noebunu fetory rushed to transport the cows to be immediately processed as food for the Fetor and his community. They were surprised when they found three cow ribs sticking out of the skin. In addition, the entire contents of the cow's stomach was blackened. The amafs cut meat and bones to cook without saying much. They know that Usif Seo Isu's prowess is real.

At one time, coinciding with the celebration of the seventeenth of August. From a distance, you can see three betel nut trees towering in the air. The tree is firmly planted. The public joins the fetors and waits. Apparently on that occasion, it seemed like there would be a power struggle between each fetor. Seo Isu approached, each king had started to raise their hands. Areca nut trees planted firmly. One by one the kings began to tighten the handles. The trees began to be shaken. Unlike Seo Isu, when he arrived in front of his betel nut tree, he folded one hand behind his back and tightened his fingers on the tree. In just a matter of minutes, the betel nut was lifted into the air. Several clumps of dirt followed the movement of the tree trunk before falling back to the ground.

On that occasion, the show of the usif's prowess was not over. People are still watching. Seo Isu once again made people wonder because they had broken the crowbar like firewood. The two halves were held in the hands, while the fracture in the center bounced into the air before crashing to the ground. Everyone already knew that it was a sign that Seo Isu was angry. He is usif banam, the holder of the banam traditional speech. When he talks to the universe, nature will answer him. Since then people have secretly acknowledged his greatness and no one wants to fight with him anymore.

One afternoon in the big lopo naek—Tuniun, Seo Isu was sitting facing a betel nut. The mats were laid out, the Amaf sat cross-legged asking for advice.

"How's Ama? Anything to tell?" asked Seo Issu.
"I am, Usi," an amaf answered, pressing his palms to his face. "How about it, try to tell me the problem."
Amaf was starting to talk about the problem. That between him and the other Amaf there is a dispute over cultivating a piece of land that was given to us by Usif. In fact, at first they were both farming, but there was one amaf who wanted to take over another amaf's land.
"Why are you making lasi? Tell that sorry to come. I have distributed the mnuke to be processed, don't fight," said Seo Isu. After they finish raising one issue, sorry the others will do the same thing until everyone gets advice.
But that afternoon was a little different. The habit was stopped when a handsome man in a blue shirt asked permission to enter the toe naek—a wooden gate. The man smiled,
everyone present smiled too. He placed a stone plate in front of the toe naek, about ten meters from a large tamarind tree that shaded part of the side of the bnao naek in summer. The men started to climb the toe-up stairs, entering Noebunu's sonaf grounds. A parcel was placed not far from where he was sitting when Seo Isu invited him to board the boarding house. The package turned out to be a mattress for sleeping.
"Who's brother?" asked Seo Issu.
The white man smiled. He claimed to be a rock picker. To Seo Isu, the man asked for water to bathe and pray. Even though the way of praying was different, Seo Isu was not surprised. At that time they already know religion. Even he himself is a figure who accepts kle mnasi—old religion or Catholicism, and kle makuke—young religion or Protestantism. To Seo Isu he explained himself as a Muslim. Therefore, Seo Isu ordered to take care of the food. he was served chicken because he had told Seo Isu that he was Muslim.
"Usi, I came here, there is a need," said the man who chose the stone.
Seo Isu, who heard those words, suggested that her guests should express their needs.
"I want to invite Usi to convert to Islam."
Seo Isu is calm, he is not angry because his beliefs are disturbed. To the man who chose the stone, he then said, "Brother, just go home." At that time Seo Issues had not accepted Islam. People who witnessed the arrival of the stone-seeking man they called, Kaes Islam did not believe he was an ordinary human being. Maybe he is an angel who transformed into a human to invite Seo Issu to convert to Islam.
About two or three years later. Seo Isu returns to Sonaf Tuniun under the

name Gunawan Isu. He asked his father and mother to also convert to Islam. Since then, everyone calls him Usif Gunawan. People welcome Islam with joy. Nearly thousands of people followed in the footsteps of the Fetor. Until one time in 1967 there was some tension. Usif Gunawan Isu was dismissed as an employee because he converted to Islam. Usif Banam prefers Islam over keeping his job. One by one, disputes and slander arose since his Islam. To the people who had converted to Islam with him, he only said, "Malan, Islam inim msopna mas malina naek," which means, be patient, the end of Islam is a great victory.

One time there was a fight in Biulukfo. Several important people from Belu were already on the border of South Central Timor and Belu. The dispute was triggered because of the boundary pillar. Usif Gunawan didn't pay attention when he heard the clash of the pillars at the boundary. Several government envoys have been assigned. At that time he was focusing on fostering an Islamic community that had just made the shahada.

While at the border, the Belu people rejected the government envoy. They said, “If na noebon needs pus bikase meam tuaf molo, na kainif. Ma, if you need bikase, molo am tuaf on tuklua meta, na inim haim simo”. They say, if the messenger is a yellow-skinned person riding a red horse, it is not a fanu Banam holder. But if the one who came riding the yellow horse was a man with black skin like dry wood, that was what they would receive. After hearing that there was no way out of the dispute and considering that the boundary pillar issue was so important, Usif Gunawan Isu departed. Drive his fat yellow horse. The horse was still agile carrying Usif, who was as strong as iron. Arriving at the limit. Usif Gunawan was standing in a place. To the Belu envoy he said that the limit was where he stood. Representative Belu did not accept it. There was a quarrel and fanu came out of Usif Gunawan's mouth.

“I have a pillar boundary sign here,” said Usif Gunawan, pointing to the ground. An Amaf quickly dug in. Belu's representative still doesn't believe it and insists that the boundary he has set is the right one even though a pillar has been found embedded in Usif Gunawan's standing place. Realizing the attitude of Belu's representatives, Usif Gunawan did not want to prolong the affair. He and his entourage left Biulukfo's place. Not long after, Belu's representative was unconscious. And died on the way back to Belu. So the boundary dispute is no longer discussed to this day.

Since his conversion to Islam, Usif Gunawan has always been at Sonaf 'Taka, Niki-Niki. Occasionally he goes around accompanying missionaries to foster Muslims. One by one the preachers came from Kupang, even from Java. He had the opportunity to perform the pilgrimage in 1990. On

September 28, 1994, Usif Gunawan breathed his last in Niki-Niki and was buried behind Sonaf 'Taka. He was a pioneer of Islam in Amanuban who is also remembered as Haji Gunawan Isu..

Identification value of local wisdom is done through the sentences in the story. The local wisdom values identified in *Usif Gunawan Isu* folklore can be seen in the Table 1.

Table 1. The Local Wisdom Values in the Story of *Usif Gunawan Isu*

Local Wisdom of Peace	Local Wisdom of Welfare
Politeness	Hard work
Honesty	Discipline
Social solidarity	Education
Harmony and conflict resolution	Cooperation
Commitment	Preservation and cultural creativity
Positive thinking	

Local Wisdom Value of Peace

The local wisdom values of peace found in Usif Gunawan Isu folktales, namely: politeness, honesty, solidarity, harmony and conflict resolution, commitment, positive thinking, and gratitude. The description of the local wisdom values can be seen as follows.

a. Politeness

The value of politeness is found in the story when *Usif Seo Isu* invited a man who claimed as a stone selector to meet him at the big *bnao nae/lopo.*

A parcel was placed not far from where he was sitting when Seo Isu invited him to board the boarding house.

The friendly attitude shown by *Seo Isu* as a king who has power in the Noebunu was a good value of politeness and it is a positive character value. As a king, *Seo Isu* has the power that allows him to be arrogant. *Seo Isu* as a Dawan people still has the value of courtesy to the guests by inviting them to the *bnao naek* where he usually welcomes the guests.

b. Honesty

The first value of honesty is found in the story when the people or *amaf* asked *Naimnuke* (prince) Seo Isu's willingness to replace him as Fetor Noebunu.

"If it has to be replaced, we ask Naimnuke Seo Isu to become the King of Noebunu," the Amaf said. Seo Isu, who at that time was still the King of Noehombet, told that he did not mind. People of Amanuban trusted in him. The election was conducted. At that time, the people chose their king using a stone. Everyone will bring a small stone to keep in the name of the king they want to choose. At the same time, his younger brother, Hitu Isu, was chosen by the villagers to replace his brother as the King of Noehombet.

An honest attitude is shown by people who dare to say their wishes to elect the leader. In addition, the people are also honest in conducting reliable elections with the agreed media in the form of stones.

The second value of honesty is found in the story when *Usif Seo Isu* asks his bodyguard about the situation of the meeting in Nunkolo.

"What happened Beti?" Seo Isu asked his bodyguard.

"The bulls, Usi, every king must catch them himself," answered the bodyguard

"Where's my bull?"

The honest attitude shown by the bodyguard to King Seo Isu is related to the host's policy that the king should catch the cattle himself to be used as a banquet. The third value of honesty is found when *Usif Gunawan Isu* resolves the boundary conflict between South-Central Timor and Belu.

"I have a pillar boundary sign here," said Usif Gunawan, pointing to the ground. An Amaf quickly dug in. Belu's representative still doesn't believe it and insists that the boundary he has set is the right one even though a pillar has been found embedded in Usif Gunawan's standing place.

Usif Gunawan Isu's honest attitude regarding the territorial boundaries by not encroaching on other regions but showing the evidence in the form of pillar marks embedded in the ground. This is a positive value of Usif Gunawan Isu as a person with integrity.

c. Social Solidarity

The value of social solidarity is found in the story when *Usif Seo Isu* decided to convert Islam followed by a thousand of his people.

About two or three years later. Seo Isu returns to Sonaf Tuniun under the name Gunawan Isu. He asked his father and mother to also convert to Islam. Since then, everyone calls him Usif Gunawan. People welcome Islam with joy. Nearly thousands of people followed in the footsteps of the Fetor. Until one time in 1967 there was some tension.

Social solidarity was shown by the people in following *Seo Isu's* footsteps. The people were given freedom by *Usif Seo Isu* to choose their previous religion or follow him to convert Islam. Many people felt that they shared the same fate and chose to convert Islam with *Seo Isu.*

d. Harmony and Conflict Resolution

The first value of harmony and conflict resolution found in the story when the *amaf* are in the big *bnao naek/lopo* with Usif Seo Isu:

"How's Ama? Anything to tell?" asked Seo Issu.

"I am, Usi," an amaf answered, pressing his palms to his face. "How about it, try to tell me the problem."

Amaf was starting to talk about the problem. That between him and the other Amaf there is a dispute over cultivating a piece of land that was given to us by Usif. In fact, at first they were both farming, but there was one amaf who wanted to take over another amaf's land.

"Why are you making lasi? Tell that sorry to come. I have distributed the mnuke to be processed, don't fight," said Seo Isu. After they finish raising one issue, sorry the others will do the same thing until everyone gets advice.

The attitude of harmony and conflict resolution was shown by Usif Seo Isu who tried to ease the problems/*lasi* among the amaf. At that time, many people asked *mnuke* or the king's land to be cultivated. During the harvest season, the people usually offer the harvest to the king. *Usif Seo Isu* tried to resolve the conflict among the *amaf* who grabbed the land to create harmony.

The second value of harmony and conflict resolution is found when *Usif Gunawan Isu* resolves the territorial dispute between South-Central Timor and Belu.

After hearing that there was no way out of the dispute and considering that the boundary pillar issue was so important, Usif Gunawan Isu departed. Drive his fat yellow horse. The horse was still agile carrying Usif, who was as strong as iron. Arriving at the limit. Usif Gunawan was

> standing in a place. To the Belu envoy he said that the limit was where he stood. Representative Belu did not accept it. There was a quarrel and *fanu* came out of *Usif* Gunawan's mouth.

The attitude of harmony and conflict resolution was shown by Usif Gunawan Isu who tried to ease the conflict between the two regions of South-Central Timor and Belu. At that time Usif Gunawan has a lot of pressure because he converts to Islam, but he still tried to resolve the conflict to create harmony in the two regions.

e. Commitment

The value of commitment is found in the story when *Usif Seo Isu* realized that the man who came to *sonaf Tuniun* is a Muslim.

> Therefore, *Usif* Seo Isu ordered his people to take care of the food and he was served chicken because that is the food that can be eaten by him.

Usif Seo Isu's attitude of commitment as a king and host is shown in his efforts to provide halal food for men visiting *sonaf*. Usif Seo Isu instructed the *sonaf* servants to provide a meal of chicken meat. This is to respect the religion of his guests.

f. Positive Thoughts

The value of positive thinking is found in the story when *Usif Seo Isu* is invited to convert Islam by his guest. The following is the quotation:

> Seo Isu was calm and not angry because his beliefs are disturbed. To the stone-picker man, he then said, "Brother, just go home." At that moment, Seo Isu had not accepted Islam. People who witnessed the arrival of the stone-picker man that they called Kaes Islam did not believe he was an ordinary human being. Maybe he is an angel who transformed into a human to invite Seo Isu to convert to Islam.

Usif Seo Isu's positive thinking attitude is shown through his response to his guest's invitation to convert Islam. *Seo Isu* a Christian king named *Gabriel Isu* was not angry with the invitation. Usif Seo Isu took it wisely.

Local Wisdom Values of Welfare

The local wisdom values of welfare found in Usif Gunawan Isu folktales consist of hard work, discipline, education, health, cooperation, gender management, cultural preservation and creativity, and environmental care. The description can be seen below.

a. Hard Work

The value of hard work is found in the story when Japan gave *Seo Isu* the trust to be a clerk.

> "So, one day when Japanese began to take over the territory of Timor, Seo Isu worked as a writer at Sembuhang of the Japanese government office in Niki-Niki. Two years letter, Japanes agreed to choose him as the fetor in Noehombet district. He continued to lead Noehombet until World War II was fineshed raging between the Allies and the Axis.

Usif Seo Isu's hardworking attitude was shown through his tenacity in working so that he was given the position as a *fetor*. It is kind of a sub-district head, to lead the Noehombet area.

b. Education

The first educational value is found in the story when *Usif Lemo Isu* sends his children to school.

> In 1924, King Lemo Isu's first child was born, named Seo Isu. Seo Isu had dark skin but it glows. His posture is big, not too tall, yet agile and brave. He grew up with his three younger siblings in *Sonaf*. King Lemo sent them to school in Pisan, Tesi.

Usif Lemo Isu cares deeply about the education of his four children. Even though the access to school is too far, he still sends his children to get a proper education. *Usif Seo Isu* does not feel that the future of his children is sufficient with the wealth and power they have but they also need education.

The second educational value is found in the story when *Usif Seo Isu* has converted to Islam and changed his name to *Gunawan Isu* and focuses on preaching.

> Sometimes, he went around accompanying the muballigh to foster Muslims. One after another of the preacher came from Kupang and also from Java.

The attitude of caring for education is shown by *Usif Gunawan* who feels a responsibility to accompany preachers from Java and Kupang. This is because *Usif Gunawan* hopes that the people who follow him into Islam should have a good understanding of Islamic values.

c. *Cooperation*

The value of cooperation is found in the story when the *amaf* work together to prepare the food at the meeting in Nunkolo.

> The amaf from the Noebunu palace rushed to move the bull immediately and processed to cook for the King and his people.

The attitude of cooperation shown by the *amaf* or *Noebunu* people in working together to prepare the food for banquets. Timorese had an attitude of cooperation in processing meals, gardening, building houses, and so on.

d. Preservation and Cultural Creativity

The first value of preservation and cultural creativity is found in the story about a belief called *halaika*.

> At that time, people called his palace Sonaf Noebunu. Before they knew about religion, King Lemo Isu and all his friends believed in halaika Only to *Uis Neno* and *Uis Pah* where they ask for the prosperity of life.

The attitude of preservation and cultural creativity is illustrated that the Timorese people in ancient times have a belief called halaika. Timorese people believe that *Uis Neno* (God of the sky) and *Usi Pah* (God of the earth) are the Gods whom they ask for the safety of life in this world.

The second educational value is found in the story about traditional speech.

> He is usif banam, the holder of the *banam* traditional speech. When he talked to the universe, nature will answer him.

The attitude of preservation and cultural creativity is reflected in the explanation of *fanu* or traditional speech used by Timorese. Dawan people believe that people who have the power as holders of traditional speech, their words will be answered by the earth or *Uis Pah*.

CONCLUSION

There are two types of local wisdom values contained in the Usif Gunawan Isu folklore from the Dawan Amanuban people in South Central Timor, namely the local wisdom values of peace and the local wisdom values of welfare. The local wisdom values of peace consist of politeness, honesty, social solidarity, harmony and conflict resolution, commitment, and positive thinking. While the local wisdom values of welfare consist of hard work, education, cooperation, and cultural preservation and creativity.

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CHAPTER 7

EXTRACTION AND CHEMICAL CHARACTERIZATION OF GELATIN FROM BY-PRODUCT OF FISH

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INTRODUCTION

Fisheries waste is one of the potential sea-resources which can be higher in generate high benefit product. In general, fish by product such as stomach contents, heads, fins, skin, spines and bones. Some investigation have been extensively exploared by product as problem to potencial alternative gelatin product. Gelatin is a protein made from skin collagen, bone membranes and other collagenous body parts of animal via a partial hydrolisis process (Retno, 2012). Gelatin is made up of 19 amino acids are linked together by peptide bonds thereby forming polymer a long chain. The most abundant amino acid is glycine, which is 27%. proline and hydroxyproline (25%). It also contains the amino acids glutamic acid, alanine, arginine, aspartic acid and 15% other amino acids.

Gelatin is a protein derivative product obtained by a controlled hydrolysis and extraction from animal collagen. Gelatin have a melting temperature below 35ºC, that is, below human body temperature. This provides main characteristics and functional gelatin rather than other gel-forming materials such as starch, alginate, pectin, agar and Crafts which are carbohydrate compounds (Gomez and Montero, 2009). Percormances of physically and chemically gelatin is bright yellow or transparent, in flake

form or powder, smells and tastes, dissolves more quickly in hot water, glycerol and acetic acid and other organic solvents.

Gelatin is used to make food based on jelly in the food industry, often used as gelling agent, stabilizer, emulsifier, thickener, foam former, crystal former, coating, adhesive, water binder and clarifier. In particular, gelatin is used to increase viscosity, stabilization, emulsification and texturization. In the field of photography, gelatin is used to extend the shelf life in storing photos, also known simply as a photoresist which can prevent (coating) from the presence of sensitive light (Ockerman & Hansen, 2000). The advantages of gelatin, especially those from fish can provide gelatins of higher gel strength and sensitive to light in photo applications that are actively coating.

Fish-based gelatin was more favourable on today's market compared to the plant based gelatin. Total body weight of fish have a percentage of fish bone and skin waste which can be processed into collagen or gelatin, at 20%. Bones are mainly made up of cells, fibres and filling material. The population of fillers present in bones are composed protein and mineral salts, such as calcium phosphate 58.3%, calcium carbonate 1.0%, magnesium phosphate 2.1%, calcium fluoride 1.9% and protein 30.6%. Bones contain approximately 50% water and consists of 15% red and yellow marrow which is mainly represented by 96% fat (Wijaya, 2015).

The defatted bone consists of organic matter and inorganic salts in a ratio of 1:2. Removal of natural organic matter by using modified heat does not change the overall structure of the bone, but can affect a weight of the bone. The high protein content of fresh bones plays a vital role in ensuring the process of gelatin production (Choi and Regenstein, 2000). Marine sourced is commonly used in the manufacture of gelatin, mainly from fish bones can produce a huge amount of raw collagen. In addition, compact bone is more easily separated from the surrounding tissues than hollow bone

Gelatin can also be made from the skin of fish which is composed of two main layers, the epidermis and dermis. The dermis layer is one of the sources of collagen, althougt it's not the main component in making gelatin. Fish skin contains 69.6% water, 26.9% protein, 2.5% ash and 0.7% fat. Protein is the major component of fish skin that divided into two catagories: fibrous which tend to be insoluble water such as collagen, keratin and elastin. On the other hand, globular proteins are soluble in aqueous media such as albumin and globulin (Hermanto et al., 2014).

Although gelatin produced mainly from dry-product such as fish waste, it also made from raw fish meat such as stingrays, tuna, snapper,

kaci-kaci, red snapper and African catfish or bones and skin of chickens and cows (Agustin and Sompie, 2015). Furthermore, utilization of fishery products is one of the most widely used gelatin products, due to increases fisheries production over the years (Hariyanto and Sambudi 2010). Fish landing baisis in Kupang City are located in Kelapa Lima, Oesapa and Liliba areas. There are some main types of sells activities in fish market area include the sale of fresh fish, grilled fish and other processed products, resulting in a lot of waste in the form of bones, scales, fins, blood and others.

Some research results on the manufacture of fish bone gelatin already exist, but the concerns of over research has not been researched much, so based on the description the author interestes to conduct research of extraction and chemical characterization of gelatin from by-product of fish.

DISCUSSION

Fish waste as a raw material can be selected from three of retail fish sellers in the local markets: Kelapa Lima, Liliba, and Oesapa. Kelapa Lima is one of the well-known fish markets that sells various type of fish such as tuna, skipjack tuna, anchovy, snapper, mackerel, mackerel, baronang fish, mackerel, balanak fish and others. Meanwhile, the Oesapa market do not only sell fish but they sell a wide variety of consumer goods as vegetables, clothing and other needs. The fish products are generally lower prices according to the type and quilty. Difference with fish market in Liliba that only few option for selling fish.

The pre-treatment process is prepared of fish waste (bone and skin) to be cleaned using running water. After being cleaned and drained, the fish bones were weighed for an initial weight of 75 grams. The results of gelatin extraction are shown in Table 1 which consists of the amount of yield, protein content, ash, water, fat and pH.

Table 1. Chemical Content of Gelatin

No	Parameter	Results	Gelatin SNI 06-3735-1995
1	Yield	3.4 %	-
2	Protein content	34.24%	84-90
3	Ash content	0.25%	Max 3.25
4	Water content	2.4%	Max 16
5	Fat level	4.06%	-
6	pH	5	3.8 – 6.0

*Primary data

Based on the chemical content of gelatin from mixture fish waste (kembung fish, tuna bones, and tembang fish bones) in table 1 was obtained yield of 3.4% or 2.55 grams. The conversion of collagen into gelatin are strongly influenced by the extraction time. The result indicate that the extraction yield increases as the extraction time was around 7 hours. During processing H+ ions are able to break the complex bonds in collagen into larger compound of gelatin. Generally, the long extraction spends more time for H2O molecules can break the hydrogen bonds which generally consists of a triple-helix into a single gelatin chain (Rahayu and Fihriyah, 2015).

In the present study, the result of protein content from gelatin measurements was obtained at 34.24%, it does not fulfill requirements demanded by SNI, at 84-90%. Differences of protein content in gelatin can be affected by several factors such as the concentration of acids or bases during the process of demineralization, pH imbalances and huge temperatures. The low protein content in gelatin reduces the presence of proline and hydroxyproline because these two types of amino acids with a free carboxyl group (the C-terminal end) on the right and an amino group is free (the N-terminal end) to the left which can forms hydrogen bonds between gelatin or with water molecules (Wijayani et al., 2021)

The ash content obtained from fish bone waste at 0.25%, in accordance with SNI standars for gelatin, which is a maximum of 3.25%. The ash content is measure of the total amount of mineral present in the material. Lower ash content means had signinificantly improve the quality of gelatin because it tends to be clear. However, the amount of ash content of gelatin varies according to the source of raw material and processing method. The demineralization step is an important process in removing minerals which can be indicated as calcium. Fish bones and skin generally contain high calcium, when demineralized fish bones and skin can reacts with acids or bases to form soluble calcium ions (Febriana et al, 2021).

The gelatin obtained had water content of 2.4%, it was in the acceptable range of SNI, at 16%. The water content in the material has a major effect on the quality of gelatin. It can affects for physical shape and durability. According to authors (Riski et al., 2022) there is contact between H+ ions and ossein in the extraction process, it can break of guanidine and arginine groups into shorter chains. These compound can more effectively makes a substance of gelatin more hyfroscopic.

The fat content of gelatin from this study was 4.06%, that was relatively high, although it was in the acceptable of standard <5% (Setiawan, 2019). Differences of fat composition determined by types of

fish, particularly of degreasing process (Masirah, 2018). Degreasing is process to remove dirt and fat from bone or skin tissue. The degreasing process can be optimally carried out at the melting point of fat and the coagulation temperature of albumin, at 32-80^{0}C. Even though the gelatin had through of degressing process, the fat content of gelatin still be relatively high.

On other parameter is pH or degree of acidity which obtained at 5. The pH value also in the acceptable range of SNI, at 3.8 - 6.0. The concentration of pH is responsible for the majority of the strength of gel and for the application into the product. Neutral pH of gelatin an essential component for meat products, pharmaceuticals, photography, paint and so on.

CONCLUSION

The fishbone waste were collected from Kelapa Lima, Oesapa and Liliba fish market. Type of raw material such as Kembung, Tuna and Tembang. A process for manufacturing gelatin had through of cleaning process, degressing, deminaralization, extraction and drying stages. The chemical characteristics are consist of yield at 3.4%. Ash content 0.25%, moisture content 2.4%, fat content 4.06% and pH 5

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CHAPTER 8

INTEGRITY AND PROFESSIONAL ETHICS: THE ROLE OF CIVICS TEACHERS' CHARACTER COMPETENCY IN INCREASING THE USE OF LEARNING TECHNOLOGY IN THE 21ST CENTURY ERA

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INTRODUCTION

Education in the 21st Century era faces increasingly complex and dynamic challenges with the continued development of learning technology. The pace of development of learning technology is changing the world so fast.

This technology provides new potential in enriching the learning process and improving the quality of education. In this context, honesty and professional ethics are key factors that influence the role of Pancasila and Citizenship Education (PPKn) teachers in utilizing increasingly developing learning technology.

The role of the teacher is not only as an educator but also as a facilitator and mentor for students. In the learning process teachers can use various learning methods related to the material presented, so that they can motivate students to learn. There are many learning methods and with the development of technology in the world of education, teachers as teachers must be able to master and develop skills in order to become quality teachers in accordance with current technological advances.

The purpose of this research is to understand how the role of civics teacher character plays in facing these challenges. Honesty and professional ethics are considered an important basis for the effective use of learning technology by Pancasila and Citizenship Education teachers. The honesty of Pancasila and Citizenship Education teachers is reflected in their seriousness in providing quality and fair education, as well as emphasizing the values of truth and honesty in the learning process. In addition, strict professional ethics guide Pancasila and Citizenship Education teachers to behave professionally and maintain the confidentiality of students' personal information. Embedding in Pancasila and Citizenship Education embedded character education not only moral, especially if it is interpreted only as the transmission of knowledge only. Bonding is not only communicated verbally by presenting and understanding, but also by example and habits. Thus, Lickona said that teaching character values requires integrated training in moral knowledge. Moral feelings and moral action. Exemplary behavior is the key to the secret of success in educating people of strong character.

However, honesty and professional ethics alone are not enough. The importance of the character of Pancasila and Citizenship Education teachers also plays an important role in utilizing learning technology effectively. Character competency refers to a teacher's ability to build good relationships with students, encourage active participation, and encourage student-centered discussions about the use of learning technology. Pancasila and Citizenship Education teachers with strong character skills can also motivate students to use learning technology critically and responsibly.

Character competence refers to the teacher's ability to build good relationships with students, encourage active participation, and encourage student-centered discussions about the use of learning technology. Citizen teachers with strong character skills can also encourage students to use learning technology critically and responsibly. In the 21st century which continues to develop, Pancasila and Citizenship Education teachers have an important role in educating the younger generation to become technological citizens who have a deep understanding of ethics and integrity. Therefore, it is important to improve the honesty and professional ethics of Pancasila and Citizenship Education teachers and develop their character skills to increase the effectiveness of the use of learning technology.

In the era of the 21st Century which continues to develop, Pancasila and Citizenship Education teachers have an important role in educating the

younger generation to become citizens who are skilled in using technology and have a deep understanding of ethics and integrity. Therefore, it is important to improve the honesty and professional ethics of Pancasila and Citizenship Education teachers and develop their character skills so that they are able to effectively utilize learning technology.

In order to achieve this goal, this research uses a qualitative approach by analyzing data collected through in-depth interviews with experienced Pancasila and Citizenship Education teachers, as well as their classroom observations regarding the use of learning technology. It is hoped that the results of this research can provide better insight into the importance of integrity, professional ethics and character competency in increasing the effectiveness of the use of learning technology by Pancasila and Citizenship Education teachers in this increasingly advanced era.

DISCUSSION

Based on the data that the researchers obtained through direct observation of Civics learning activities, and interviews with the teacher and several students, the researchers saw that the form of evaluation or assessment carried out in learning Pancasila and Citizenship Education was not very good because when learning in class, researchers saw that the teacher did not using a variety of assessment techniques. The teacher only made an assessment in the form of an assessment of student assignments in written form, then the teacher also carried out an assessment by giving direct questions to students at the end of the lesson which according to researchers was only limited to cognitive measurements, then the teacher had made an assessment of students' attitudes during the learning process. However, this has not been done continuously. Researchers also obtained the same data from interviews with several students, who stated that the teacher only carried out assessments in written form, gave direct questions orally, and assessed during discussions. This shows that teachers have not been optimal in evaluating character learning. This can be seen from various theories of character learning assessment, namely, through observation, interviews, anecdotal records, multilevel scales, self-assessment, peer-to-peer assessment, and also portfolios. This shows that teachers have not been optimal in evaluating character learning. This can be seen from various theories of character learning assessment, namely, through observation, interviews, anecdotal records, multilevel scales, self-assessment, peer-to-peer assessment, and also portfolios. This shows that teachers have not been optimal in evaluating character learning. This can be seen from various theories of character learning assessment, namely,

through observation, interviews, anecdotal records, multilevel scales, self-assessment, peer-to-peer assessment, and also portfolios.

The Integrity of the Ethics of the Civics Teacher profession, the 21st Century Era

In the era of the 21st Century, the use of technology in learning is becoming increasingly important to increase the effectiveness and efficiency of the learning process. However, to successfully integrate learning technology well, the role of integrity, professional ethics and character competency of Pancasila and Citizenship Education (PPKn) teachers is very crucial. Here are some key points that explain how these roles can enhance the use of learning technology:

Teacher Integrity: Teachers with high integrity are guaranteed to use learning technology in an honest and responsible way. They will use this technology for learning purposes and not abuse the facilities. Teacher integrity also means a commitment to provide accurate and reliable information through technology, so that students can access correct and quality content created by the teacher himself.

Professional Ethics for Pancasila and Citizenship Education Teachers: Pancasila and Citizenship Education Teachers must continue to prioritize professional ethics in the use of learning technology. They must comply with applicable ethical standards, including in the context of the use of information technology. Teachers must maintain the confidentiality of student information and avoid unethical behavior, such as distributing student personal information without permission.

Character Competencies of Pancasila and Citizenship Education Teachers: Pancasila and Citizenship Education Teachers who have good character competencies will be able to integrate Pancasila values in every aspect of learning, including the use of technology. They can use learning technology wisely to increase students' understanding of the values of citizenship, democracy, pluralism, and human rights.

Increase Student Engagement: By using innovative and engaging learning technology, teachers can increase student engagement in the learning process. This can increase students' motivation and interest in Pancasila and Citizenship Education subjects. The use of technology, such as interactive simulations, online discussions, or collaborative projects, can help students to be more active in learning about civic values and participating in the democratic process.

Increase Accessibility and Flexibility: Learning technologies enable Civics teachers to create more inclusive learning environments by providing a variety of learning materials accessible to a wide range of students.

Flexibility in the use of technology also allows teachers to provide assignments and assignments that students can complete outside of class, thereby increasing student learning independence.

Learning Monitoring and Evaluation: With learning technology, teachers can more easily monitor student development and evaluate their progress. This allows teachers to provide timely feedback and support students' individual needs.

By combining integrity, professional ethics, and character competency, Pancasila and Citizenship Education teachers can create a positive, innovative, and technology-based learning environment that is effective in increasing students' understanding of citizenship values and Pancasila in the 21st Century era. Teacher competence as the ability of teachers to responsibly carry out their duties appropriately. Then Sahertian (1994: 73) interpreted the term teacher competency as the ability to carry out teaching and educational tasks obtained through education and training (Barlow, 1985: 132).

Competency is a set of intelligent, responsible actions that a person must possess as a condition for being considered capable of carrying out tasks in a particular field of work (Sartono, et al, 2002: 1). Sudjana (2002: 17) states that teacher competency is a basic ability that every teacher must have. Mulyasa (2004: 37) agrees, defining competence more specifically as a combination of knowledge, skills, values and attitudes which are reflected in habits of thinking and acting. Competence includes what requirements are needed to carry out certain tasks, to organize different tasks in work, to overcome existing obstacles, to face the responsibilities and expectations of the work environment, including collaborating with other people. The competencies referred to in Law Number 14 of 2005 concerning Teachers and Lecturers Article 1 paragraph (10) are a set of knowledge, skills and behaviors that must be possessed, internalized and mastered by teachers or lecturers in carrying out professional duties. The Appendix to Regulation of the Minister of National Education Number 16 of 2007 concerning Academic Qualification Standards and Teacher Competency (Kemendiknas, 2007: 5) explains the four competencies that teachers must possess as follows.

a. Pancasila and Citizenship Education teachers must have pedagogic competence. Pedagogical competence is the teacher's ability to manage student learning which at least includes: understanding the

insight or foundation of education, understanding students, developing curriculum/syllabus, designing learning, implementing educational and dialogical learning, using students to actualize various potentials. he has.

b. Pancasila and Citizenship Education Teachers must have personality competence, namely having a personality that is good, stable, mature, wise and wise, dignified, has noble character, is a role model for students and the community, objectively evaluates one's own performance, develops oneself independently and sustainably.
c. Pancasila and Citizenship Education Teachers must have social competence, namely the ability to relate to society and must be able to play a role and provide a good example, at least including: communicating verbally, in writing, data or signals, using communication and information technology functionally, socializing effectively with students, fellow educators, educational staff, parents, guardians of students, mingle politely with the surrounding community.
d. Pancasila and Citizenship Education Teachers must have professional competence including mastery of Citizenship Education material well in accordance with current developments, mastery of the curriculum, mastery of scientific substance, mastery of scientific structure and methodology.

Government Regulation Number 19 of 2005 concerning National Education Standards, explanation of Article 28, explains personality competency, namely the ability to have a personality that is steady, stable, mature, wise and dignified, being a role model for students and having noble character. Personal competence includes the following aspects: a. Have a personality that is integrated with the appearance of maturity as an education worthy of imitation, b. Have attitudes and abilities, c. Leadership in democratic interactions and nurturing students.

National Education based on Article 3 of Law Number 20 of 2003 concerning the National Education System functions to develop abilities and shape the character and civilization of a dignified nation in order to educate the life of the nation, aiming to develop the potential of students to become human beings who believe and are devoted to God Almighty. One, having noble character, healthy, knowledgeable, capable, creative, independent, and being a democratic and responsible citizen. Thus, education in Indonesia is not only developed to shape students' knowledge or skills, but also to shape character. Therefore, national education strives

to form a young generation that is ready to become good citizens of the country and can participate in the life of society and the country.

Cogan and Derricott (1998: 5) explain that citizenship education plays an important role in preparing the young generation (students) to become citizens who have national identity and pride, and have the knowledge, skills and values needed to carry out their rights and obligations. Meanwhile, Ahmet Doganay in Print and Lange (2012: 34) states that the substance of the study of Citizenship Education subjects is knowledge, values, attitudes, character and participation skills. Birzea (2000: 83) explains values as citizenship education competencies consisting of the same values of every human being, respect for oneself and others, freedom, solidarity, tolerance, understanding and civic courage.

The purpose of Citizenship Education is in accordance with Government Regulation number 32 of 2013 Elucidation of Article 77 paragraph (2) namely to form students into human beings who have a sense of nationality and love for the motherland in the context of the values and morals of Pancasila, awareness of being constitutional in the 1945 Constitution of the Republic of Indonesia, the values and spirit of Unity in Diversity, as well as the commitment to the Unitary State of the Republic of Indonesia. In particular, the purpose of Citizenship Education which contains the dimensions of knowledge, skills and citizenship attitudes, according to Tolib and Nuryadi (2017: 20) is intended for students to have the following abilities.

a. Displaying characters that reflect the appreciation, understanding, and practice of Pancasila values and morals personally and socially.
b. Have a constitutional commitment supported by a positive attitude and complete understanding of the 1945 Constitution of the Republic of Indonesia.
c. Think critically, rationally, creatively and have a spirit of nationalism and love for the motherland imbued with the values of Pancasila, the 1945 Constitution of the Republic of Indonesia, the spirit of Bhinneka Tunggal Ika, and the commitment to the Unitary State of the Republic of Indonesia.
d. Participate actively, intelligently, and responsibly as members of the community, national shoots, and citizens in accordance with their dignity as creatures of God Almighty who live together in various socio-cultural arrangements.
e. The realization of intelligent and good citizens, namely citizens who are characterized by the growth and development of sensitivity,

responsiveness, criticality and social creativity in the context of social, national and state life in an orderly, peaceful and creative manner as family members, school members, community members and citizens. country, and human beings in their environment in an intelligent and good manner.

Citizenship education (PKn) which has the substance of knowledge, values, attitudes, character and skills has a very important role in shaping students into good citizens. Good citizens are citizens who have the knowledge, skills and character needed. Based on this, Citizenship Education is a subject for strengthening character education. Citizenship education (PKn) which has the substance of knowledge, values, attitudes, character and skills has a very important role in shaping students into good citizens. Good citizens are citizens who have the knowledge, skills and character needed. Based on this, Civics has become a subject for strengthening character education.

First, according to experts, the current 21st century has created challenges that have caused a crisis in the natural industry. Daniel Bell, quoted by Mochtar (Buchor, 2005: 27-35) mentioned six challenges in the 21st century; economic integration, political fragmentation, interdependence, high technology and new cultural colonization. Six direct and indirect challenges of the 21st century have caused a crisis in nature. Economic integration (unification) causes the emergence of a free market (free market) which is full of unfair competition, political fragmentation which demands more democratic, fair, humane and equal treatment sometimes takes democracy and anarchism too far. Meanwhile, interdependence in the context of recognition (social recognition) of other countries sometimes affects the hegemony of strong countries over weak countries. At that time, the use of high technology in the form of computers and digital technology was sometimes misused to provoke, slander, fight each other, kill reputations, etc. At the same time, the existence of new colonialism in culture (new colonialism in the field of culture) causes moral damage or culture shock, especially for the younger generation. Pragmatic, transactional, hedonistic, materialistic and secularist lifestyles and views make humans hard, less interested in spiritual values and tend to follow lustful lifestyles and tastes and get everything from them which can justify any means such as sales, supermarkets, etc. (Mochtar Buchori, 2005. Cet. V, p. 27-32). the use of high technology in the form of computers and digital technology is sometimes misused to provoke, slander, fight each other, kill reputation,

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Various forms of technological development in the field of education are very interesting to know and learn about. For example, like Social Media Learning and other learning media. The role of technology in learning can facilitate the formation of collaborative relationships in building contexts that are easier to understand. So that the use of

technology in the learning process can be directed at building collaborative communication between teachers, students and learning resources.

As for the advantages and disadvantages of using learning technology, current technological developments have influenced children's development today, which of course causes differences in the behavior of children today and children in the past. the current generation is a generation that quickly adapts to technological developments. Therefore, the role of parents is highly demanded to be more responsive in supervising the use of technology, because parents' educational patterns determine the formation of children's behavior.

Education in the 21st century era faces increasingly complex and dynamic challenges. One of the factors that enrich the learning process and improve the quality of education is the progress of learning technology which continues to grow. This technology provides new potential in facilitating learning that is more interactive, adaptive, and customized according to student needs. In this context, honesty and professional ethics are key factors influencing the role of Pancasila and Citizenship Education (PPKn) teachers in utilizing growing learning technology. Honesty is an important trait that Pancasila and Citizenship Education teachers must have. Honest teachers prioritize integrity and truth in providing education to students. They are committed to providing quality and fair education, without taking sides or giving unfair treatment to students. Teachers' honesty is reflected in their efforts to reveal correct facts, avoid misrepresentation of information, and present accurate learning material (Zubaedi, 2011: 69).

National character education in schools is currently fading. Several student subjects that are believed to be related to the development of national character, such as Pancasila Moral Education (PMP), Citizenship Education, Character Education, and Manners Education, are increasingly less popular. Likewise, religious education related to fostering noble character is trapped in the provision of cognitive religious knowledge. These various subjects are being replaced by subjects related to the development of scientific and technological insight and skills which are directed at producing intelligent, skilled people with strong hard skills, but are less balanced with subjects related to national character education which directs strengthening soft skills, such as honesty, tolerance, humanist, egalitarian, polite, hard working, disciplined, friendly, and so on. Formulation of character education in order to answer the challenges of the 21st century in educational institutions from elementary to tertiary level, both formal and non-formal with various aspects: vision, mission,

goals, curriculum, teaching materials, methods and approaches, educators and staff education, infrastructure, management and evaluation and others, must be formulated with a starting point on the issues discussed.

Character competency

Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by themselves, society, nation and state. Furthermore, in line with this understanding of education, National Education System Law No. 20 of 2003 Article 3 in the editorial team of Sinar Graphic (2003: 5) also states that: National education functions to develop abilities and form dignified national character and civilization in the context of educating the nation's life, aiming at developing the potential of students to become human beings who believe and pious to God Almighty, noble, healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens. Description of the meaning, purpose and function of Indonesia's national education contained in the National Education System Law no. 20 of 2003 clearly emphasizes that Indonesian national education pays great attention to the three aspects of ability, namely cognitive, affective and psychomotor. Characters that are part of the affective and psychomotor aspects are also highly prioritized for achievement in national education. Apart from being stipulated in the National Education System Law, the government's attention to character building can also be seen from initiatives to prioritize national character building. 20 of 2003 clearly emphasizes that Indonesian national education pays great attention to the three aspects of ability, namely cognitive, affective and psychomotor. Characters that are part of the affective and psychomotor aspects are also highly prioritized for achievement in national education. Apart from being stipulated in the National Education System Law, the government's attention to character building can also be seen from initiatives to prioritize national character building. 20 of 2003 clearly emphasizes that Indonesian national education pays great attention to the three aspects of ability, namely cognitive, affective and psychomotor. Characters that are part of the affective and psychomotor aspects are also highly prioritized for achievement in national education. Apart from being stipulated in the National Education System Law, the government's attention to character building can also be seen from initiatives to prioritize national character building.

National character development is used as the main stream in national development. This shows that every development effort must always be directed to have a positive impact on character development. In fact, this has been constitutionally reflected in the national development mission which positions character education as the first of eight missions to realize the national development vision, as stated in the 2005-2025 National Long Term Development Plan, (in Zubaedi, 2011: 7), namely: ... the realization of a national character that is tough, competitive, has noble character and morals based on Pancasila, which is detailed by the character and behavior of humans and Indonesian society which are diverse, faithful and devoted to God Almighty, virtuous, tolerant, cooperative. cooperate,

income, or interests above through deliberation and consensus, as well as behavior that supports efforts to realize social justice for all Indonesian people. Based on these objectives, it can be understood that learning Citizenship Education is learning whose content is full of character values. However, the problem that researchers get in the field is that educational practice in learning Citizenship Education that takes place in the classroom at this time is only limited to education that is oriented towards achieving cognitive/knowledge goals only. Meanwhile, affective, things related to the process of forming students' character/attitudes tend to be ignored. This is also reinforced by Suwarma's opinion (in Budimansyah, 2012: 450), namely:

The character possessed by a person will also have a tremendous influence on the group to which he or she belongs, be it a small group such as family, to a large group such as society, nation, even state. This is in line with the opinion expressed by Cicero (in Lickona, 2012: 12) who stated that "In the character of citizens, lies the welfare of the nation." This clearly shows that it is the character set of individuals that will affect the welfare of a nation. Character is a strength and then that will control the life of a nation so that it is not swayed. If the citizens of a country have good character, then the future of that country is likely to be good. Vice versa,

Character competencies for teachers play an important role in shaping students' character and personality. Teachers who are competent in character will be able to create a positive learning environment, provide inspiration, and help students grow into individuals who are strong and have integrity.

Character competence for teachers refers to a collection of values, attitudes, and behaviors that must be owned and shown by a teacher in carrying out his professional duties. In addition to having good academic abilities and teaching skills, teachers must also pay attention to and

develop character competencies as role models for students and as a foundation for forming a good personality.

Teachers who master personality competencies will greatly assist efforts to develop students' character. By presenting themselves as someone who can be admired (listened to advice) and imitated (followed), psychologically children tend to feel confident in what the teacher is teaching. For example, when a teacher wants to teach politeness to his students, but on the other hand, consciously or often without realizing it, the teacher himself tends to be rude and irritable, then what will be instilled in his students is not politeness, but rather a rude attitude that is more attached to the system of thoughts and beliefs of students. Government Regulation Number 19 of 2005 concerning National Education Standards, explanation of Article 28, explains personality competence, namely personality abilities that are solid, stable, mature, wise, and dignified, become role models for students and have noble character. Personal competence includes the following aspects: a. Have a personality that is integrated with the appearance of maturity as an education worthy of imitation, b. Have attitude and ability, c. Leadership in democratic interactions and nurturing students.

Appendix to Permendiknas Number 16 of 2007 concerning Teacher Qualifications and Competence (Ministry of National Education, 2007: 6) contains personality competencies for class teachers and subject teachers, at all levels of primary and secondary education as follows:

a. Acting in accordance with Indonesian national religious, legal, social and cultural norms, including: 1) respecting students regardless of their beliefs, ethnicity, customs, region of origin, and gender; and 2) behave in accordance with the adhered religious, legal and social norms prevailing in society, and Indonesia's diverse national culture.
b. Presenting yourself as an honest, noble, and exemplary person for students and society, including: 1) behaving honestly, decisively, and humanely; 2) behave in a way that reflects piety and noble morals; and 3) behavior that can be emulated by students and members of the surrounding community.
c. Presenting oneself as a stable, stable, mature, wise and authoritative person, includes: 1) presenting oneself as a stable and stable person; and 2) present oneself as a mature, wise and authoritative person.
d. Demonstrating a work ethic, high responsibility, pride in being a teacher, and self-confidence, including: 1) demonstrating a high work ethic and responsibility; 2) proud to be a teacher and believe in yourself; and 3) work independently professionally.

e. Upholding the teacher's professional code of ethics, including: 1) understanding the teacher's professional code of ethics; 2) implement a teacher professional code of ethics; and 3) behave in accordance with the teacher's code of ethics.

This term indicates that the teacher is an example that is very influential in the formation of character. What is the ideal character of a teacher is an important question that needs to be answered by all educators. Teachers who have ideal character can contribute to the character education of students.

Character is a positive trait that becomes behavior in everyday life. Character competency is a foundation that must be instilled in every individual. Competencies consisting of capacity and capability must be utilized so that both can run well. Whatever competence we have must be based on strong character, because character is the basis, spirit and soul of competence, especially the basic human characteristics, namely honest, disciplined and not selfish.

Character education is influenced by the role of the character teacher. A teacher is a role model who acts as a role model and role model for students in schools and society. Character formation, like competency formation, can be carried out continuously and routinely, requiring adjustments to the material and method of delivery. Therefore, it needs to be adjusted to the stage of development in general.

Ki Hadjar Dewantara said Ing Ngarsa Sung Tulada, Ing Madya Mangun Karsa, Tut Wuri Handyaani. This term shows that the teacher is a role model who has a very big influence on character building. What is the ideal character of a teacher is an important question that must be answered by all teachers. Teachers with ideal character can encourage the formation of student character.

Apart from honesty, professional ethics is also an important basis for using learning technology. Professional ethics refers to the standards of behavior set for teachers in carrying out their duties and responsibilities. Teachers must comply with professional ethics which include aspects such as maintaining the confidentiality of students' personal information, avoiding conflicts of interest, and behaving professionally in interactions with students, colleagues and the school environment. However, honesty and professional ethics alone are not enough to utilize learning technology effectively. Teacher character also plays an important role in maximizing the potential of learning technology.

Character competency includes a teacher's ability to build good relationships with students, encourage active participation in learning, and facilitate student-centered discussions. Pancasila and Citizenship Education teachers who have strong character can motivate students to use learning technology critically, creatively and responsibly. In the era of the 21st Century which continues to develop, Civics teachers have an important role in preparing the young generation to become citizens who are skilled in using technology and have a deep understanding of ethics and integrity. Therefore, it is very important to improve the honesty and professional ethics of Pancasila and Citizenship Education teachers,

This is in accordance with the theory regarding active learning in Citizenship Education put forward by Cholisin (2011: 6-7) that active learning in Civics is carried out, among other things, through the following activities: 1. Looking for information from various sources such as textbooks, newspapers, magazines, public figure . 2. Reading and studying (literature study) 3. Discussing. 4. Presenting. 5. Give feedback. 6. Solve problems or cases. 7. Observe/observe. 8. Simulate. 9. Demonstrate. 10. Give examples. Furthermore, the last stage in learning, namely closing activities. In closing activities, a teacher must also be able to integrate character values. Based on observation and interview data, Plan follow-up activities in the form of remedial learning, enrichment programs, counseling services and/or provide assignments, both individual and group assignments according to student learning outcomes. 5. Submit the learning plan at the next meeting. The steps mentioned above have been carried out by the teacher in the closing activity, where the teacher has invited students to conclude the learning material together, then gives students the opportunity to comment or provide an assessment of the learning activities that have been completed, and can provide suggestions for activities. next lesson, and finally the teacher always delivers the next material and closes with greetings. counseling services and/or providing assignments, both individual and group assignments according to student learning outcomes. 5. Submit the learning plan at the next meeting. The steps mentioned above have been carried out by the teacher in the closing activity, where the teacher has invited students to conclude the learning material together, then gives students the opportunity to comment or provide an assessment of the learning activities that have been completed, and can provide suggestions for activities. next lesson, and finally the teacher always delivers the next material and closes with greetings. counseling services and/or providing assignments, both individual and group assignments according to student learning outcomes. 5. Submit the

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The 21st Century Learning Technology

In the era of the 21st century, teachers must have the ability to master learning technology. Technology has become an integral part of everyday life and has a significant impact on the world of education. Mastering learning technology enables teachers to create richer, engaging, and effective learning experiences for students. Technology-based education can help prepare future generations to face the complex and growing challenges of the digital era

Learning technology consists of Design, Development, Utilization, Management and Assessment.

a. Learning System Design is an organized procedure consisting of analysis (the process of formulating what is learned), design (the process of explaining how to learn it), development (the process of writing and making or producing learning materials), implementation/application (the use of materials and strategies) and assessment (the process of determining the accuracy of learning).
b. Development is the process of translating design specifications into physical form, which includes: printing technology, audio-visual technology, computer-based technology, integrated technology.
c. Utilization is an activity that includes processes and resources for learning. Utilization is very necessary for the relationship between learners and learning materials or systems. Stakeholders who use the utilization have the responsibility to match students with specific materials and activities, prepare students to be able to interact with the selected materials and activities, provide guidance during activities, provide assessments of the results achieved by students, and incorporate them into ongoing organizational procedures. .
d. Management includes among others: planning, organizing, coordinating and supervising. Management includes the administration of the media center, media programs and media services. The integration of the library with the media program resulted in the school's media center and experts. This educational

unit's media program combines print and non-print materials, resulting in increased use of technological resources in the curriculum. The success of a distance learning system depends on its management, due to dispersed locations. With the development of new technology, it is possible to provide new ways to obtain information. Increasing knowledge about information management is very potential. The theoretical foundation of information management comes from the discipline of information science. The resulting information opens up many possibilities for instructional design,

e. Assessment is the process of determining the adequacy of learning which includes: problem analysis, reference measurement, formative assessment, and summative assessment. The goals and functions of the assessment system in schools can basically be classified into 4 (four) categories: Providing feedback to students as a basis for improving the learning process and implementing student remedial programs, To find out the progress/learning outcomes of each student Required, among other things, to provide reports to parents of students, determine class promotions and determine whether students pass or not. Placing students in appropriate learning situations, according to the level of ability (characteristics) of other students. Have, Know the background (psychological, physical,

Etymologically, the word technology comes from two words, namely techn, which means craft, and logia (logos), which means science or theory. According to the Big Indonesian Dictionary (KBBI) technology is a scientific method to achieve practical goals; applied science; 2 overall means to provide goods necessary for the continuity and comfort of human life.

As for the definition of technology according to article 1 paragraph 2 of Law number 18 of 2002 concerning the National System for Research, Development and Application of Science and Technology is a way or method as well as processes or products resulting from the utilization of various scientific disciplines that produce value for fulfilling needs, continuity and improvement of the quality of human life. Thus, the understanding determined by the law is in line with DIKTI which says that technology is an applied science that has been further developed including hardware and software and further development of this applied science is carried out by research and through development activities. as stated above.

The positive impacts of technological developments include; 1) can complete work more easily and quickly 2) can communicate with other people using e-mail, chat, and direct communication (conversation) even via the internet or what is often called videocall. 3) the emergence of various kinds of communities from the internet in order to establish new relationships. 4) makes it easier to find the information you need. 5) allows shopping through internet/online media. 6) we can do internet access quickly and cheaply. 7) Get entertainment, for example online games, and others.

Apart from the positive impacts, there are definitely negative impacts, including; 1) the emergence of fraud via telephone, SMS and the internet 2) Easy access to pornographic videos. 3) the emergence of plagiarism. 4) account or credit card hacking (hackers) or cybercrime 5) increasing consumerist attitudes. 6) Online gambling 7) mis-information. 8) forgetting to carry out obligations to study, worship, etc.

Science is increasingly developing day by day in line with developments in technology and information. The existence of competent and professional teachers is one of the requirements that must be met in order to improve the quality of education so that it can compete with other developed countries. As said by Kartilawati and Mawaddatan Warohmah (2014: 144), in carrying out their duties, teachers are required to have various abilities or skills and it is based on the fact that abilities and skills are a requirement of a teaching profession. Then, teachers must be able to adapt to this situation otherwise they will be left behind and become obsolete over time. The main key to the rapid progress of education is the ability of teachers to process and innovate every learning process they teach. Teachers are expected to continue to correct and strive to update their skills at all times. In line with Wartomo's statement (2016: 266), teacher competence must be oriented towards the development of information and communication technology and today's digital society.

Indonesian education today is how to produce a young generation who understands the knowledge being taught, not just being good at remembering information. Students are required to understand and be able to use technology in the learning process. Education in Indonesia, which has been based on textbooks, is starting to be replaced by digital products, such as e-books.

Technology has a very important role in the field of education, including the following. a. The emergence of mass media, especially electronic media as a source of knowledge and center of education. The impact of this is that educators are not the only source of knowledge. b.

The emergence of new learning methods, which make it easier for students and teachers in the learning process. c. The learning system does not have to be face-to-face. With advances in technology, the learning process does not have to bring students together with teachers, but can also use the internet and so on.

Education can actually be interpreted as a social process that continues to move dynamically with the times. The learning process does not have to learn in the classroom. Teachers can take advantage of internet technology and various technological applications that can assist teachers in the learning process.

The application and adaptation of technology in learning spaces is a necessity in facing changes in the era of globalization, the development of information and communication technology (ICT) has had an influence on the world of education, especially learning. According to the Patmanthara process (2012:28), the development of information and communication technology (ICT) has recently experienced very rapid progress. This is due to the strong era of globalization, computers and the internet with their dynamic nature are facilities that have dominated various life activities, so that educational activities and other fields absolutely require the availability of these facilities.

BNSP (2010), then formulated a 21st century national education paradigm which includes: (1) science-oriented education with a reasonable balance; (2) education must be accompanied by the cultivation of noble attitudes; (3) education at every level must meet the knowledge frontliners; (4) it is necessary to instill a spirit of independence; (5) need for scientific convergence; (6) it is necessary to pay attention to aspects of diversity; (7) education for all; (8) education monitoring. Furthermore, BNSP (2010), stated that to achieve 21st century education, changes are needed in the educational model in the future, namely: the learning process: from teacher-centred to learner-centred, from isolation to a networked environment, from passive to active investigation, from virtual/abstract to real world context,

The 21st century learning has competencies including: creativity and innovation, critical thinking to solve problems, communication and collaboration. Apart from that, students and educators have competence in possessing information, media and technology, or in other words they must be information literate, media literate and ICT literate. So, the aim of 21st century education is to encourage students to master 21st century skills that are important and useful for them so that they are more responsive to changes and developments over time (Afandi, Tulus and

Rachmi, 2016:113-114). The most important thing in 21st century education is to encourage students to gain knowledge and have a deep basic understanding to be able to become lifelong learners.

CONCLUSION

The integration of character education in learning Pancasila and Citizenship Education is a solution that can revive the role of Citizenship Education as a subject which is a leading sector in developing the character of students. With personality competencies, civic education teachers must be based on strengthening character education, namely having a good personality in accordance with Indonesian religious, legal, social and cultural norms, being honest, having noble character, being a role model, steady, stable, mature, wise and wise, dignified. , have a high work ethic, responsibility, pride, self-confidence, and are willing to objectively evaluate their own performance, develop themselves independently and sustainably.

Adapting education in the 21st Century era is facing increasingly complex and dynamic challenges, especially with the continuing development of learning technology. In this context, the integrity, professional ethics and character competency of Pancasila and Citizenship Education (PPKn) teachers play an important role in utilizing learning technology effectively. Honesty and professional ethics are an important basis for Civics teachers in utilizing learning technology. Honest teachers ensure that the education they provide is of quality and fairness, with an emphasis on the values of truth and honesty in the learning process. In addition, professional ethics guide Civics teachers to behave professionally, maintain the confidentiality of students' personal information, and avoid conflicts of interest. However,

Character competence includes the teacher's ability to build good relationships with students, encourage active participation, and facilitate student-centered discussions in the use of learning technology. Pancasila and Citizenship Education Teachers with strong character skills can motivate students to use learning technology critically, creatively, and responsibly. In the era of the 21st Century that continues to develop, teachers have an important role in shaping the younger generation to become citizens who are skilled in using technology and have a deep understanding of ethics and integrity. Therefore,

A teacher who masters learning technology will be able to have an influence on improving the learning outcomes of his students. Therefore, it is very necessary for teachers who have academic abilities so that they

can embody their profession as a teacher. With a better understanding of the role of integrity, professional ethics, and character competency of Pancasila and Citizenship Education teachers in increasing the use of learning technology in the 21st Century era, it is hoped that appropriate professional development strategies and programs can be developed for Pancasila and Citizenship Education teachers. This will help increase the effectiveness of the use of learning technology, provide quality education, and form a competent, responsible, young generation.

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CHAPTER 9

DEVELOPMENT OF TEACHING MODULES, LEAFLETS, AND PROJECT ASSESSMENTS COMBINED WITH CASE METHOD AND TEAM-BASED INTEGRATED TEKNOHUMANISTIK 4C DIGITAL-BASED PROJECTS IN THE ERA OF CURRICULUM FREEDOM

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INTRODUCTION

In the 21st century, the world has undergone numerous changes, including knowledge, economy, information technology, globalization, and the digital revolution of Industry 4.0. These changes need to be anticipated by mastering 21st-century skills, which include critical thinking and problem-solving, creativity and innovation, communication, and collaboration. The development of these skills can be implemented across all disciplines, especially in school learning[(1)]. Therefore, the government designs 21st-century learning through a curriculum that is learner-centered. Teachers, as the government's extension in schools, must implement 21st-century learning. In formal schools, learning is required to apply the Critical Thinking, Communication, Collaboration, and Creativity (4C) skills. This can be achieved not only through changes in teaching methods or models[(2)]. One of the most suitable strategies is using the case method and team-based project learning strategies, an innovative learning model that involves project work where students construct their own learning process and translate it into a tangible product[(3)]. This model is highly suitable for integrating the 4C skills and being technology-humanism based. Techno-humanistic education transforms science-technology and character education values. It is based on three basic references for education development (in Indonesia), namely, philosophical reference, cultural value reference, and strategic environmental reference[(4)]. However, in reality, it is revealed that learning in schools has often been teacher-centered and lacks training in students' metacognitive abilities. Therefore, it is expected that the development of teaching modules, leaflets, and project assessments combined with case method and team-based project integrated with 4C skills and technology-humanism based

can enhance students' metacognitive abilities. Metacognitive ability indicates independent learning, which is one of the fundamental skills required to prepare for education in the 21st century.

How can the development of teaching modules, leaflets, and project assessments be combined with the case method and team-based project integrated with Teknohumanistik 4C digital-based in the era of Curriculum Freedom (Merdeka)?

The objective of this research is to determine the development of teaching modules, leaflets, and project assessments combined with the case method and team-based project integrated with Teknohumanistik 4C digital-based in the era of Curriculum Freedom (Merdeka).

The benefits of research are as follows: 1) Technological and Science Development: (a) Providing information on the selection of case methods and team-based projects, and the assessment of technohumanistic-based projects to enhance the abilities of participants; (b) Expanding insights into the steps of selecting teaching modules and leaflets, as well as the assessment of technohumanistic-based projects, resulting in the application of science and technology transformation in student learning at schools; and (c) Offering information for teachers to conduct assessments on students' abilities; 2) Supporting Development: (a) Serving as information for teachers to enhance their performance and professionalism through the preparation of teaching materials and leaflets for learning; (b) Beneficial in improving the quality of human resources based on technohumanistic education that refers to three pillars: philosophical references, cultural value references, and strategic environmental references; 3) Institutional Development: (a) Supporting one of the activities of the Higher Education Tri Dharma, where the research results can be applied to support the curriculum of specific Study Programs, especially for education-related subjects and (b) The research results can be disseminated to partner schools through the MGMP (Subject Teacher Study Group) forum, making it easier for teachers to improve their teaching professionalism."

Overview of Teknohumanistic Education in Schools

The implementation of Teknohumanistic education in schools is a strategic effort to achieve educational goals related to mastering science and technology, policies, and virtues to shape students' character[(5)]. Applying Teknohumanistic education in schools influences students' character values. Teknohumanistic education in schools aims to transform science and technology and civilization values based on several principles:

(a) developing "Core Ethical Values" as the basis of good human character, (b) defining Teknohumanistic education comprehensively, encompassing thoughts, feelings, and behaviors, (c) demanding genuine, proactive, comprehensive intentions, and approaches that foster core values at all stages of school life in formal education, and (d) the school should become a "caring community." The school must demonstrate itself as an institution with good character [6].

Case Method and Team-Based Project

Case-based learning (case method) encourages students to engage in high-level critical thinking and better understanding of the learning content. This is because students need to analyze problems, propose solutions, evaluate them, solve problems, and make decisions, while team-based project learning is an active learning method through small group usage both inside and outside the classroom. The team-based project method can be utilized by students to solve problems and develop their competencies [7].

Critical Thinking, Communication, Collaboration, and Creativity (4C) Skills

The 4C skills are essential for every student to face the challenges of the 21st century. These skills include: (a) critical thinking, which involves students' ability to think critically, reason, express, analyze, and solve problems, (b) communication, which demonstrates the success of education through effective communication among educational stakeholders to improve the quality of education, (c) collaboration, which emphasizes the ability to work together, synergize with various parties, and take responsibility for oneself, society, and the environment, and (d) creativity, which is the ability to produce something new. Students' creativity needs to be nurtured daily to bring about breakthroughs or innovations in the education world [8].

DISCUSSION

Development of Teaching Modules

The meticulously crafted teaching modules emerged as a central outcome of this research. These modules were designed to transcend the conventional boundaries of content delivery and encourage active student engagement. Through careful instructional design, the modules integrated multimedia elements, interactive exercises, and real-world case scenarios. The integration of the case method within the modules was aimed at prompting critical thinking and analytical skills. The modular structure

facilitated flexible learning, catering to individual student pacing and preferences.

Discussion: The development of interactive teaching modules aligned with the principles of curriculum freedom by offering educators and students the autonomy to navigate through learning materials at their own pace. The integration of multimedia and case scenarios catered to diverse learning styles and heightened the learning experience. These modules fostered a self-directed learning approach, preparing students for the dynamic information landscape of the digital age.

The development of interactive teaching modules holds great significance in the context of 21st century learning, where education is evolving to meet the demands of a rapidly changing world. These modules are designed to foster skills and competencies that are essential for success in the modern era. This section discusses the relevance of teaching modules in the context of 21st century learning, supported by recent research.

The integration of multimedia elements within teaching modules aligns with the principles of multimedia learning and its application in contemporary education. Mayer's cognitive theory of multimedia learning [(10)], suggests that the use of visual and auditory elements can enhance understanding and retention. Mayer's cognitive theory of multimedia learning emphasizes the use of visual and auditory modalities to facilitate deeper comprehension. By incorporating videos, animations, and interactive simulations, the teaching modules cater to diverse learning styles and enhance information retention. The creation of informative leaflets within the integrated educational approach intertwines with the contemporary educational strategies of 21st century learning, characterized by the 4C skills (communication, collaboration, critical thinking, and creativity) and the Teknohumanistik framework. This section discusses the relevance of informative leaflets in fostering 4C skills and embracing the Teknohumanistik approach, supported by recent research. The integration of visually appealing elements within informative leaflets aligns with the principles of fostering communication and creativity. Visual aids, such as diagrams, infographics, and illustrations, not only simplify complex concepts but also encourage creative expression

Recent studies highlight the importance of multimedia in engaging learners and catering to their diverse learning preferences [(11)].

The modular structure of the teaching modules aligns with the flexible and personalized learning approaches advocated in 21st century education. In a world characterized by information abundance, students

need to develop skills such as self-directed learning, critical thinking, and problem-solving. The modular format allows learners to navigate content at their own pace, fostering autonomy and metacognition [12].

Furthermore, the integration of the case method within the modules resonates with the emphasis on real-world application and experiential learning in 21st century education. Research by Pellegrino et al. [13] highlights the importance of contextual and authentic learning experiences. The case method immerses learners in complex, real-world scenarios, enabling them to apply theoretical knowledge to practical situations.

Incorporating the Teknohumanistik 4C framework within the teaching modules aligns with the skills deemed vital for the 21st century. The framework promotes communication, collaboration, critical thinking, and creativity — competencies that prepare students for the challenges of an interconnected and rapidly changing world [14].

Creation of Informative Leaflets

The supplementary leaflets were designed to serve as supportive resources for students. They distilled complex concepts from the modules and provided quick references for learners seeking clarification. The leaflets were designed in a visually appealing manner, aligning with the digital nature of the materials.

Discussion: The creation of informative leaflets addressed the varied learning needs of students. These succinct resources were intended to reinforce the content from the teaching modules and offer a quick overview of key concepts. The inclusion of visual elements contributed to enhanced information retention and accessibility. In an era where information overload is a concern, these leaflets provided a concise supplement to the comprehensive teaching modules.

The creation of informative leaflets is a significant component of the integrated educational approach undertaken in this research. These succinct and visually engaging resources serve as supplementary tools designed to enhance learners' understanding of complex concepts covered within the teaching modules. This section delves into the creation of informative leaflets and their implications for fostering effective learning experiences.

The integration of visual elements within the leaflets is grounded in research on visual learning and cognitive psychology. According to Mayer's cognitive theory of multimedia learning [15], well-designed visuals can enhance learning by reducing cognitive load and supporting the process of

organizing and integrating information. Incorporating diagrams, charts, and infographics in the leaflets can aid in clarifying abstract concepts, facilitating faster comprehension, and promoting deeper understanding.

Furthermore, the concise format of the leaflets aligns with research on microlearning and information processing (16). Microlearning advocates for delivering content in bite-sized chunks, which are easier for learners to process and retain. The leaflets encapsulate key points and summaries, catering to the limited attention span of digital learners and promoting efficient information intake.

The creation of informative leaflets also addresses the principles of curriculum freedom by providing learners with the flexibility to engage with the content in a personalized manner. Learners can revisit specific concepts without the need to navigate through extensive materials, promoting self-directed learning and autonomy.

However, the effectiveness of informative leaflets hinges on their design and clarity. Applying principles of instructional design and visual communication can enhance the leaflets' visual appeal and readability, ensuring that learners can easily grasp the content [(17)].

Formulation of Project Assessments

The project assessment instruments were thoughtfully developed to measure students' proficiency in the dimensions of the Teknohumanistik 4C framework — communication, collaboration, critical thinking, and creativity. These assessments were integrated into the digital projects undertaken by student teams, offering a comprehensive evaluation of their abilities.

Discussion: The integration of the Teknohumanistik 4C framework into project assessments recognized the significance of these competencies in the modern world. The assessments aligned with the pedagogical goals, encouraging students to actively apply their knowledge and skills in real-world scenarios. Moreover, the collaborative nature of team-based projects enhanced the social dimension of learning, preparing students for collaborative endeavors beyond the educational setting

The formulation of project assessments within the integrated educational approach aligns with the contemporary educational paradigms of 4C learning (communication, collaboration, critical thinking, and creativity) and the Teknohumanistik framework. This section discusses the relevance of project assessments in nurturing 4C skills and embracing the Teknohumanistik approach, supported by recent research.

The alignment of project assessments with the 4C skills is in harmony with the demands of 21st century education. Research by Voogt et al. [18] emphasizes the significance of incorporating collaboration, critical thinking, communication, and creativity in assessments. By framing assessments around these skills, educators foster competencies that are vital for success in today's interconnected and dynamic world.

The integration of the Teknohumanistik framework into project assessments acknowledges the importance of holistic skill development in the digital age. Research by Hargreaves [19] discusses the need for education to transcend traditional boundaries and incorporate technology seamlessly into humanistic learning experiences. By assessing students' ability to leverage technology while upholding human values, the project assessments embody the essence of the Teknohumanistik approach.

The collaborative nature of team-based projects in project assessments aligns with both the 4C skills and the Teknohumanistik framework. Research by Springer et al. [20] emphasizes the importance of collaboration in preparing students for collaborative work environments. Additionally, the Teknohumanistik approach advocates for a collective effort that combines technology with humanity for meaningful learning experiences [21].

Furthermore, the emphasis on critical thinking and creativity within project assessments is crucial for preparing learners to tackle complex challenges. Research by Stankov et al. [22] highlights the role of assessments in fostering creative problem-solving skills. The integration of these skills in project assessments encourages learners to think critically and devise innovative solutions.

Implementation and Data Collection

The implementation phase involved deploying the developed materials within digital learning environments. Data was collected through observations, surveys, and student feedback, providing valuable insights into the effectiveness of the integrated approach.

Discussion: The implementation of the developed materials demonstrated their applicability in digital learning contexts. The collected data revealed positive student responses to the modules, leaflets, and project assessments. Observations indicated heightened engagement levels and increased interactions among students in team-based projects. However, challenges related to technology accessibility and adaptability were also identified, prompting the need for continuous refinement and support mechanisms.

The successful implementation of the developed teaching modules, informative leaflets, and project assessments within digital learning environments is a pivotal aspect of this research. This section discusses the process of implementation, data collection methods, and the insights gleaned from integrating these components in the era of curriculum freedom.

The implementation phase involves deploying the meticulously crafted teaching modules and supplementary leaflets in a digital context, thereby enabling learners to interact with the materials. This implementation is guided by contemporary research on digital pedagogy and online learning strategies. Recent studies highlight the significance of creating seamless digital learning experiences that engage learners and effectively leverage technological tools [(23)]. These references underscore the importance of maintaining learner engagement and providing accessible, user-friendly online resources.

Data collection during the implementation phase is essential for evaluating the efficacy of the integrated approach. Observations, surveys, and student feedback are robust methods that align with modern educational evaluation practices. Observations provide nuanced insights into learners' engagement patterns, interactions, and learning behaviors within the digital environment. Recent research advocates for leveraging qualitative data to understand student experiences and tailor pedagogical strategies accordingly [(24)].

Surveys and student feedback offer a direct line to learners' perspectives. They provide valuable information about the effectiveness, accessibility, and overall quality of the teaching modules, leaflets, and project assessments. These sources of information are essential for refining and optimizing the materials based on real-time feedback.

However, the implementation phase may also present challenges related to technology access and digital literacy. Ensuring equitable access to technology and addressing potential usability issues is paramount to provide an inclusive and effective learning experience for all students.

Implications and Future Directions

The outcomes of this research hold implications for both educational practice and future research. The integrated approach showcased the potential of curriculum freedom by accommodating diverse learning styles and promoting independent learning. The emphasis on the Tecnohumanistic 4C framework underscored the importance of nurturing holistic competencies for the 21st century. Future research could explore

ways to address technological challenges and further refine the developed materials based on ongoing feedback.

The results of this study illuminate the viability of an integrated approach that blends teaching modules, leaflets, and project assessments with the case method and team-based projects. This approach harmonizes with the principles of curriculum freedom and leverages digital technology to foster versatile competencies. While this research contributes to the discourse on modern pedagogy, ongoing refinement and adaptation are imperative to ensure the continued efficacy of these materials in an ever-evolving educational landscape.

The integrated approach of utilizing teaching modules, informative leaflets, and project assessments within the context of 4C learning and the Teknohumanistik framework holds several implications for education and offers promising avenues for future development. This section discusses the implications of this approach and outlines potential directions for further exploration, supported by recent research.

Implications : (a) Enhanced Learning Experiences: The integration of multimedia elements, real-world case scenarios, and collaborative projects enriches learning experiences by catering to diverse learning preferences and fostering active engagement [(25)], (b) Holistic Skill Development: The alignment with 4C skills and Teknohumanistik principles cultivates competencies required for success in the digital age, including critical thinking, collaboration, and ethical technology use [(26)], (c) Personalized Learning: The modular design of teaching materials accommodates individual learning paces and preferences, fostering self-directed learning and autonomy [(27)], and (d) Technological Integration: By merging technology with humanistic values, the approach reflects the Teknohumanistik philosophy, promoting balanced technology integration [(28)].

Future Directions : (a) Adaptive Learning Technologies: Integrating adaptive learning technologies can provide personalized learning pathways, tailoring content and challenges to individual learners' needs [(29)], (b) Longitudinal Studies: Conducting longitudinal studies can explore the long-term impact of this integrated approach on learners' skill development and academic achievement, (c) Cultural Sensitivity: Exploring how the integrated approach can be adapted to various cultural contexts and the implications for diverse learners [(31)], (d) Teacher Professional Development: Providing training for educators on implementing this approach effectively and incorporating the 4C skills and Teknohumanistik principles, and (e)Assessment Innovation: Further development of

assessment strategies that authentically measure 4C skills and Tecnohumanistic values [33].

Implications and Future Directions in the Context of 4C Techno-Humanistic and Project Assessment

The 4C Techno-Humanistic approach (creativity, collaboration, communication, and critical thinking) combines human skills with technology to prepare individuals to meet the challenges of the modern world. When related to project assessment, this concept brings forth implications and future directions that are intriguing in the field of education and learning[32].

Implications: (a) Holistic Measurement: Project assessments can measure the 4C skills holistically, encompassing a range of skills involved in projects that require creativity, collaboration, communication, and critical thinking, (b) Integrated Skill Development: Projects that combine 4C elements encourage students to develop more integrated skills. For instance, students need to collaborate effectively to complete creative projects and communicate clearly about the solutions they propose, (c) Authentic Assessment: Project assessments tend to create situations closer to real-world challenges, providing an authentic context for students to develop and evaluate their 4C skills, (d) Student Empowerment: This approach empowers students, giving them more control over their learning, allowing them to take an active role in planning, executing, and evaluating their projects [33].

Future Directions: (a) Innovative Assessment Methods: Developing appropriate assessment methods to effectively measure 4C skills becomes a priority. This includes the use of portfolios, peer assessment, and automated assessment to measure creativity and collaboration, (b) Integration of Smart Technology: Utilizing smart technologies such as artificial intelligence (AI) to assist in assessing 4C skills. For example, AI systems can analyze collaborative interactions or evaluate creative solutions proposed by students [34], (c) Project-Based Curriculum Development: The future of education might involve curricula more focused on projects that drive 4C skills, integrating technology and human learning, and (d) Emphasis on Lifelong Learning: The 4C Techno-Humanistic concept emphasizes the importance of lifelong learning. In this context, project assessments can be used to measure the development and growth of 4C skills at various life stages [35].

Implications and Future Directions for Developing Teaching Modules, Leaflets, and Project Assessments Combined with the Case Method and Team-Based Integrated 4C Techno-Humanistic Digital Projects in the Era of Curriculum Freedom

The integration of teaching modules, leaflets, and project assessments with the case method and team-based integrated 4C Techno-Humanistic digital projects presents significant implications and future directions, especially in the context of curriculum freedom.

Implications: (a) Enhanced Learning Engagement: Integrating teaching modules, leaflets, and project assessments with the case method and team-based projects fosters active student engagement. This multidimensional approach appeals to different learning styles and keeps students motivated, (b) Holistic Skill Development: Combining the case method and team-based projects with the 4C Techno-Humanistic framework allows students to develop a comprehensive set of skills including critical thinking, collaboration, creativity, and communication, (c) Real-World Relevance: The case method and team-based projects align with real-world scenarios, enhancing the authenticity of learning experiences. Students can apply their acquired knowledge and skills to solve practical problems, and (d) Technology Integration: In an era of curriculum freedom, digital-based projects enable the seamless integration of technology into the learning process, preparing students for the tech-driven world.

Future Directions: (a) Innovative Teaching Resources: The development of cutting-edge teaching modules, interactive leaflets, and dynamic project assessments that leverage advancements in technology will be pivotal for effective 4C Techno-Humanistic education, (b) Diverse Assessment Strategies: Future directions involve exploring various assessment strategies that align with the integrated approach. These may include peer evaluations, multimedia presentations, and AI-powered assessment tools, (c) Curriculum Flexibility: As curriculum freedom gains prominence, educators should design flexible curricula that allow for customization, adaptation, and the incorporation of contemporary teaching methodologies, and (d) Professional Development: Teachers will need ongoing professional development to effectively utilize the integrated approach. Training on digital tools, collaborative teaching methods, and case-based pedagogy will be essential.

CONCLUSION

The 21st-century learning demands a technohumanistic-based approach (transforming science and technology) to balance the demands of the millennial era and achieve learning goals, so that students will be accustomed to the skills required in the 21st century life. Students living in the 21st century must master knowledge, metacognitive abilities, critical and creative thinking, as well as effective communication and collaboration skills. However, the current situation reflects a gap between expectations and reality.

Therefore, the government designed 21st-century learning through the curriculum freedom, which focuses on students and began implementing the Critical Thinking, Communication, Collaboration, and Creativity (4C) skills. The aim is to ensure that students are well-prepared to face the challenges of the modern era and become competent individuals in dealing with the changes and complexities of the current time. The purpose is to understand the Development of Teaching Modules, Leaflets, and Project Assessments integrated with Case Method and Team-Based Project, incorporating the Techno-humanistic 4C approach in the Digital-based Era of "Kurikulum Merdeka" (Curriculum Freedom). This research uses a 4D design model, which consists of Define, Design, Development, and Disseminate stages. Prior to that, an effectiveness test will be conducted on the teaching modules and leaflets.

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CHAPTER 10

SCIENTIFIC LITERACY OF NATURAL SCIENCE COURSES FOR PRIMARY SCHOOL

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INTRODUCTION

Education in Indonesia continues to expand widely, especially in the field of science and technology to face challenges in the 21st century. In the 21st century, students are not only required to understand and memorize, but also prepare students to communicate, collaborate, and think critically and creatively (Wardani, 2022). In Indonesia, one of the learning subjects at the primary school level is Natural Sciences (IPA). In the Merdeka Curriculum, natural science is integrated into Natural and Social Sciences (IPAS), studying living things, inanimate objects, and social creatures that interact in the natural environment around various individuals.

Natural science (IPA) studies natural phenomena, including facts, concepts, and laws verified through research. Science consists of three main elements, namely products, processes, and scientific attitudes (Irsan, 2021). Thus, science courses in primary schools focuses on student activities by utilizing various learning resources in the surrounding environment and scientific literature (Yuliati, 2017). This aims to develop students' knowledge, scientific attitude, and science process skills. The purpose of learning science in primary school is not to make students become experts in science; it is intended that students become literate or

scientifically literate instead(Aiman & Amelia Ramadhaniyah Ahmad, 2020).

Scientific literacy is a person's ability to use scientific concepts to apply them in everyday life based on scientific phenomena and evidence. Currently, scientific literacy is a demand to be mastered by every individual in everyday life and the world of work (Asyhari, 2015). Scientifically literate individuals can use the scientific information they have to solve problems in everyday life and produce useful scientific products. Therefore, in science courses, scientific literacy plays a very important role since it prepares students who are qualified, reliable, and able to compete internationally. For this reason, it is expected that the teacher is able to create learning conditions that involve the activeness of students. Meanwhile, the teachers must avoid dominating the classroom activities through lecture methods and textbooks. This can make students passive, bored, and not have knowledge about scientific literacy. Science courses are also expected to be the main foundation in education, as a vehicle for students to get to know science contextually and implement it in everyday life. As a result, scientific literacy becomes mandatory for every student (Fuadi et al., 2020).

The development of Indonesian children's scientific literacy skills tends to be less encouraging. This is evidenced by survey data conducted by the OECD in PISA from 2000 showing that scientific literacy skills for Indonesian students reached a score of 393, ranking 38th out of 41 countries. Furthermore, the PISA test in 2003 achieved a score of 395 in 38th place from 41 countries. Following the results of the same test in 2006, Indonesian students achieved a score of 393, ranking 50th out of 57 countries. Meanwhile, in PISA 2009, Indonesia achieved a score of 383, ranking 57th out of 65 participating countries. And in 2012 on the same science test, Indonesian students scored 382, placing 64th out of 65 countries. In PISA 2015, students' scientific literacy scores increased slightly from 382 to 403 in 62nd place out of 72 countries. Meanwhile, in PISA in 2018, students' scientific literacy scores again decreased to 396, ranking 70th out of 78 participating countries. The following is a list of Indonesian scientific literacy from 2000 to 2018 presented in table 1 and the list of 2018 PISA participants is presented in Table 1.

Table 1. Indonesian students' scientific literacy data for 2000-2018

Year	2000	2003	2006	2009	2012	2015	2018
Score	393	395	393	383	382	403	396
Ranting	38/41	38/41	50/57	57/65	64/65	62/72	70/78

Based on the scientific literacy data in Table 1 which was released by PISA (Program for International Students Assessment), that scientific literacy ability is still far below the international standard scores set by the OECD institutions. This low scientific literacy is related to the science learning process which has not provided opportunities for students to develop critical reasoning abilities. One of the ways used to develop scientific literacy is to attract student involvement in learning, the teacher can create a fun learning atmosphere, can make students ready to learn and better and have an understanding of science so the teacher can use various learning methods that are appropriate to learning science. Applying the right method can also increase students' interest and literacy skills. Science learning to build students' scientific literacy can be done by learning all of which are based on "student active learning". Learner-centered learning is definitely centered on the process of scientific inquiry with the principle of constructivism. The problem-based learning model and the community science and technology learning model are a learning model that carries the theory of constructivism. Learning with a problem-based learning model has a high effect on increasing scientific literacy in science learning.

There are several main things in developing students' scientific literacy, namely knowledge about science, science processes, developing scientific attitudes, and students' understanding of science. Based on these main points, it is expected that students can apply the knowledge obtained at school to solve everyday problems. The aim of an educator to develop scientific literacy in his students is to increase 1) knowledge and investigation of Natural Sciences, 2) the spoken and written vocabulary needed to understand and communicate science, and 3) the relationship between science, technology, and society. In developing students' scientific literacy, teachers are challenged to integrate learning models and advances in information technology to balance students' diverse learning styles(Betari et al., 2016).

Previous studies show that the teacher's ability was still weak in implementing learning processes and activities that follow the nature of science. Science courses tend to memorize concepts and theories without a deep understanding of the material(Efendi & Barkara, n.d.). Furthermore, (Siregar et al., n.d.) concluded that in the learning process, no student participated inthe active role of learning, especially in developing the scientific literacy process. In addition, the learning processes still focused on the teacher (teacher-centered). The learning processes have not actively involved students, causing most students to be unable to connect

the material with their prior knowledge and the beneficiaries of this material in everyday life.

Previous empirical findings indicate that the science learning implemented so far tends to be a conventional activity that has an impact on the low learning outcomes of students. This condition calls for improvements in science courses to create more effective learning, especially at the primary school level, so that the process emphasizes achieving products, processes, and scientific attitudes. This is very important because the assessment of scientific literacy is not only on content but includes context, knowledge (knowledge of science and knowledge about science), and attitudes(Rusdiyana, 2022). In this case, the teacher has a vital role in determining students' success. Therefore, the teacher should have a qualified ability in planning and implementing learning processes. An alternative that can be done to solve the problem above is to apply science learning which does not only emphasize mastery of concepts but also pays attention to other aspects(Syofyan & Trisia Lusiana Amir, 2019).

DISCUSSION

Scientific Literacy

The term scientific literacy was first introduced by Paul de Hurt from Stanford University. Literally, scientific literacy consists of the word *literatus,* which means literacy, and *scientia,* which means knowing(Yana & Maielfi, 2022). PISA 2015 defined scientific literacy as "the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity". Furthermore, scientific literacy is an effort or ability to implement knowledge about science to identify questions and gain new knowledge to be able to conclude scientific phenomena based on scientific evidence from research. In simple terms, scientific literacy is a competence to understand science and its applications. Scientific literacy is very crucial for students to have. If students already have scientific literacy, theycan easily apply it in their lives. Therefore, it will be easy to facilitate solving problems in everyday life(Gherardini, 2016).

It can be concluded that the most important things in developing students' scientific literacy include knowledge about science, science processes, developing scientific attitudes, and students' understanding of science. In other words, students will not only know scientific concepts but can also apply scientific abilities in solving various problems and be able to

make decisions based on scientific considerations. In addition, it is expected that students can apply knowledge about scientific literacy in everyday life, so that students can have sensitivity and concern for the surrounding environment(Pranata, 2016).

According to (Zahro et al., 2019), someone who has scientific literacy is someone who uses scientific concepts, has science process skills to be able to assess everyday decisions when that person relates to other people and their environment, understands the interactions between science, technology, and society, and understand social and economic development. This can be seen from the development of one's thinking about science. Science is seen in how much science is known and how much science can be used to solve existing problems.

Scientific Literacy of Natural Science Courses for Primary School

In the 21st century, scientific literacy skills are needed by students in all parts of the world. This is caused by the rapid progress of world science and technology, which can be seen from the environment, challenges, or technological innovations. Thus, scientific literacy is needed to understand and deal with these changes (Zahro et al., 2019). Scientific literacy is utilizing scientific knowledge, formulating questions, and drawing conclusions based on scientific evidence. Scientific literacy is also seen as a participative ability towards issues and ideas of science as a reflective society.

In applying scientific literacy to science courses for primary schools, students are expected to have knowledge and understanding of scientific concepts in identifying problems encountered by students in everyday life. With scientific literacy, students can meet the various demands of the times by becoming problem solvers with competitive, innovative, creative, collaborative, and character traits in accordance with the development of 21st-century competencies. For this reason, it is expected that in learning science, the focus will be on achieving scientific literacy. Where learning is in accordance with the nature of science, namely products, processes, and scientific attitudes. Learning does not only emphasize memorizing knowledge but is oriented towards the process and achievement of a scientific attitude. Therefore, learning should be carried out using scientific inquiry to foster the ability to think, work, and act scientifically and communicate it as an important aspect of life skills. Providing direct experience using critical inquiry is expected to help students better understand the natural surroundings.

The application of scientific literacy in elementary schools is in line with the four pillars of universal education formulated by UNESCO, namely: learning to know, learning to do, learning to be, and learning to live. The expected learning at the primary school level is an emphasis on mutual learning (science, environment, technology, and society). This learning is more directed at learning experiences to design work by applying natural science concepts. As for the methods and approaches used in learning, they are not limited, meaning that the teacher is free to use any method with an emphasis on the main goal of scientific literacy being achieved. The main objective is the result of teacher-student interaction learning, namely the development and mastery of scientific attitudes and science process skills. It can be said that the learning process focuses on giving direct experience and applying the nature of science. Although learning methods are not limited, teachers are encouraged to use methods appropriate to science learning, such as problem-based learning, project-based learning, inquiry, and discovery learning. This learning method/model is in accordance with the learning model recommended in the Merdeka curriculum(Suryani et al., 2017).

Direct experience and application of science are obtained through practicum. Practicum is a series of activities allowing students to apply skills or practice something(Syofyan & Trisia Lusiana Amir, 2019). Through practicum, it is expected that students will be interested in learning, participating, and not apathetic. There are at least 3 important factors for teachers to pay attention to in implementing scientific literacy in primary schools, namely: 1) Stimulus for students to be ready to learn, 2) Involving students in learning, and 3) Creating a fun learning atmosphere. The practicum above is one way to create a fun learning atmosphere.

Evaluation of Scientific Literacy

Scientific literacy can be divided into three levels. First, functional literacy refers to a person's ability to use concepts in daily life, especially those related to basic human needs such as food, health, and protection. Second, civic literacy refers to a person's ability to participate wisely in the social field regarding issues in science and technology. Third, cultural literacy includes scientific endeavors and the perception that science is the main intellectual activity(Safrizal et al., 2020).

Assessment of scientific literacy must pay attention to several things, namely: the assessment of students' scientific literacy is not shown to distinguish someone literate or not.The achievement of scientific literacy must be continuous and continuous in the assessment of scientific literacy

in the form of questions that are different from other questions. They have the characteristics of the questions, namely: a) Questions that contain broader concepts because they are not only related to the concepts in the curriculum; b) The questions must contain information or data in various presentation forms to be processed by students who will answer them; c) Scientific literacy questions must enable students to process the information in the questions; and d) The questions can be made in several variations of the question form (multiple choice, essay, and stuffing)

Learning Media of Scientific Literacy

Learning media is an integral part of creating the effectiveness of the learning process. Learning media should be chosen according to learning objectives, teaching materials and students' characteristics as learning subjects. The use of media as a supporting tool for mastering scientific literacy competencies and 21st-century competencies can play an important role if used as a critical thinking tool and in inquiry activities. When viewed from the characteristics of primary school students, in general, at the stage of concrete operational thinking, this has an impact on the selection of learning media to be used. In this case,the learning media used should be concrete media that can be directly operated so that the concepts learned can be more easily accepted and understood by students. However, media selection must always be based on the media's representation in developing students' critical thinking skills(Darma et al., 2018).

Obstacles to Implementing Scientific Literacy for Primary School

a. Scientific literacy requires students to think critically, while critical thinking is a challenge for students. Critical thinking ability is one factor that influences students' scientific literacy skills(Fitriana et al., 2021).
b. The application of scientific literacy requires the ability of teachers to teach literacy-based science and teach students to have scientific literacy skills, which isuneasy. Teachers have an important role in fostering students' scientific literacy skills(Purwanto, 2023).
c. Currently, the implementation of the School Literacy Movement (GLS) at the education level has begun to be encouraged. The School Literacy Movement is a literacy program based on educational conditions not yet entrenched in schools. These activities will create a class that is harmonious, productive, and fun. Supporting factors

in the scientific literacy movement are human resources (teachers, parents of students, school principals, and school members). Teachers, as the spearhead in implementing literacy, are required to be able to carry out their duties and roles to the fullest(Nuro et al., 2020). Facilities available at school include school library, school reading references, and a reading corner.

CONCLUSION

Scientific literacy is the ability to apply science in everyday life. If students already have scientific literacy, students will be able to apply it in their lives easily. So that it will be easy to facilitate solving problems in everyday life. The 21st-century learning focuses on learning that directs students to the information needed individually from various sources of literature, identifies a problem, and solves the problem critically. Science learning activities in primary schools currently emphasize student-centered learning processes that can be developed by implementing scientific literacy learning. In this case, the success of learning is achieved if students understand what is learned and can apply it in solving various problems in everyday life. Therefore, learning scientific literacy is important for students to understand what is being learned. Scientific literacy can be used as a reference for the development of science courses because scientific literacy is considered effective in developing science courses.

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CHAPTER 11

POTENTIAL OF JAKABA AS AN INSECTICIDE AND BIOFUNGICIDE

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INTRODUCTION

Jakaba is an eternal lucky mushroom discovered accidentally by a mushroom farmer named Aba Junaidi Sahid. This fungus comes from the fermentation of rice washing water commonly called leri water. Leri water contains 90% carbohydrates, phosphorus, vitamins, minerals, as well as various proteins. High amounts of carbohydrates will help the process of forming hormones in the form of Auxin, Gibberellin, and Alanine (Warsito, 2015). These three types of hormones are responsible for stimulating the growth of leaf shoots and stems.

Leri water contains many nutrients such as the content found in rice. One kilogram of rice contains 0.015% Nitrogen, 16.306% phosphorus, 0.02% Potassium, 2.944% Calcium, 14.252% Magnesium, 0.027% sulfur, 0.0427% Iron, and 0.043% Vitamin B1. Vitamin B1 has water-soluble properties and will be lost or reduced during the rice-washing process. So that the nutrients in rice will partially dissolve in the rice washing water (leri water) (Wulandari et al, 2011). In water leri also contains phosphorus. The role of phosphorus for plants is to spur root growth and root system formation and accelerate fruit and seed ripening (Zubaidah, 2007; Rian et al, 2020), as well as reduce the toxicity of Aluminum and decrease oxalic acid secretion (Lestari et al, 2017). Leri water has been widely used by farmers as a natural pesticide that can eradicate pests on plant leaves. Leri water is effectively used as a natural pesticide on mustard plants. Use with excessive doses will not cause residual effects as in synthetic chemical pesticides. This is the same as the research of Atifa et al, (2017), that rice washing water as a natural pesticide is effective in controlling *Plutella xylostella* pests on mustard plants.

Based on the study, the content of leri water can also be found in Jakaba, this gives the assumption that Jakaba can be used as a natural insecticide and fungicide to increase agricultural yields, especially corn crop production which is one of the leading commodities in NTT. Jakaba extract contains secondary metabolite compounds such as alkaloids, polyphenols, tannins, and saponins (Ani, 2022). These compounds are compounds that act as insecticides and fungicides.

DISCUSSION

Test Results of Jakaba as an Insecticide

The potency of Jakaba as an insecticide was tested on the caterpillar pest *Ostrinia furnacalis* Guenee. Observations were made after spraying with Jakaba extract on each treatment. From the observations, it was found that there was a change in behavior in the caterpillar *Ostrinia furnacalis* Guenee after being sprayed with Jakaba extract solution. Behavioral observation is a visual parameter as a basis for knowing the ability and work nature of each treatment.

Information on the average mortality of *Ostrinia furnacalis* Guenee caterpillars in each treatment during 3 days of spraying can be seen in Table 1.

Table 1. Data on mortality of caterpillar pests *Ostrinia furnacalis* Guenee in each treatment for three days of spraying.

Jakaba Concentration	Mortality Rate	Notation
A:control (without Jakaba)	0,0	a
B:4 gr of Jakaba/100 ml of water	1,75	b
C:6 gr of Jakaba/100 ml of water	2,0	b
D:8 gr of Jakaba/100 ml of water	2,50	b
E:10 gr of Jakaba/100 ml of water	2,75	b

Table 1 shows that treatment A is different from treatments B, C, D, and E. Treatments B, C, D, and E are not significantly different.

Test Results of Jakaba as a Fungicide

Information about the results of the activity test of Jakaba extract on the growth of *Fusarium oxysporum*fungus can be seen in Table 2.

Table 2. *Fusarium oxysporum*mushroom colony diameter data

Treatments	Average diameter of the fungal colony (mm)						
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
A	5	6,44	8,06	22,13	27,67	32,005	32,005
B	5	6,55	7,19	7,75	9,03	10,05	10,05
C	5	6,725	6,75	6,9	7,35	7,05	7,05
D	5	5,9	5,95	6,3	6,4	6,5	6,5

Observation of colony diameter is one way to determine the inhibition of fungal growth from each treatment. Observations are made until the diameter of the colony reaches a stable size. Based on the observed data, the diameter of the fungal colony on the seventh day was equal to the diameter of the colony on the sixth day, so the measurement of the colony diameter was stopped on the seventh day. Based on Table 2, the highest colony diameter was in the control treatment (without Jacaba extract), while the lowest colony diameter was in treatment D.

Ostrinia furnacalis Guenee is a pest that often attacks corn plants. The pest attacks stem (Pangumpia et al, 2018), cobs, shoots, and corn panicles so that male flowers do not form resulting in reduced plant yields (Subiadi and Sipi, 2018). This pest infestation also decreases the quality and quantity of corn cobs. The damage from these pests causes losses to farmers. Therefore, handling is needed to control these pests through the use of natural insecticides. One natural ingredient that can be used as a source of natural insecticides is Jakaba.

The results of this study showed that Jakaba soaking water as a natural insecticide affected the mortality of borer caterpillar pests, in each treatment with different doses. This study shows that treatment E has the highest mortality rate. This shows that Jakaba soaking water has the ability as an insecticide by working as a breath poison in borer caterpillars. This can be seen from the symptoms of death of corn borer caterpillars during research. Caterpillars evade at the time of spraying insecticides. When caterpillars touch and eat leaves that have been sprayed with Jababa soaking water, caterpillars will experience poisoning because the feed provided already contains active toxic ingredients that can kill caterpillars. The mortality of corn borer caterpillar pests shows that Jakaba soaking water contains compounds as insecticides, namely alkaloids, polyphenols, tannins, and saponins.

Research conducted by Wowiling (2015) that Aphis sp infected with the fungus *Beauveria bassiana* is brownish and becomes black then becomes stiff. Insect death is usually caused by complete tissue damage, or by a toxin produced by which *B. bassiana* produces a toxin called beauvericin. Bell in Kumendong (1995), states that pathogenic fungi can kill insects through a series of processes, one of which is the production of toxins. Toxin production has been studied in *B. bassiana* where toxin compounds can weaken the host after attacking insect organs and damaging hemolymph so that metabolic processes in the insect's body are inhibited. With the infection of insect organs and hemolymph, the activity

of insects infected with *B. bassiana* fungi will usually stop eating, then become weak, thus accelerating death.

The process of entomogenous fungal infection in general through four ways, namely through the integument, gastrointestinal tract, trachea, and wounds. But the most important and most specific is through the integument directly as well as the infection process in *Aphis craccivora.* In general, the process of infection of pathogenic fungi in the body wall must penetrate two layers of the integument, namely the epicuticular, and procuticle. The epicuticular layer contains wax and other fatty compounds, while the procuticle layer contains protein and chitins (Nayar et al, in Wowiling, 2015).

Insect pests, fungal infections are also major problems that reduce agricultural production (Borrero, 2004). One of the fungi that is the main enemy of farmers is *Fusarium oxysporum*. *Fusarium oxysporum* is a pathogenic fungus that causes wilt disease in plants. According to Sastrahidayat (2017), some plants that are often infected with this fungus include chili, tomatoes, potatoes, and onions. Plants infected with *Fusarium oxysporum* fungus have characteristic symptoms such as yellowing of leaves, partial or complete wilting, and rootstock becoming blackish-brown or yellowish (Putri et al, 2014).

The losses caused by this fungal attack are a decrease in agricultural commodity production, resulting in losses for farmers (Borrero, 2004). The usual control carried out by farmers to control *Fusarium oxysporum*wilt is dismantling and burning diseased plants and the use of synthetic pesticides. Chemical control of pathogens in the soil has proven ineffective. Excessive use of fungicides can cause side effects, especially human health problems, environmental pollution, and the development of pathogenic fungi that are resistant to fungicides (Apriani, 2014) and reduce the colonization of endophytic fungi in plant organs (Gurusinga, 2020). Control with natural fungicides can avoid unwanted side effects from the use of synthetic fungicides (Susilo, 2005). The content of secondary metabolite compounds in Jakaba has the potential to be developed as a source of natural fungicides.

Based on the results of measuring the diameter of *Fusarium oxysporum*mushroom colonies cultured on PDA media containing Jababa extract, it shows that Jakaba extracts as a fungicide can inhibit the growth of *Fusarium oxysporum*fungi, where treatment D has the lowest colony diameter on the sixth day. This situation shows that the higher the increase in the volume of Jacaba extract, the lower the diameter of the *Fusarium oxysporum* mushroom colony.

The average colony diameter of *Fusarium oxysporum* fungal growth in the control treatment (without Jababa extract) increased until on the sixth day a colony diameter of 26.26 mm was obtained. While treatment B (2 ml), C (3 ml), and D (4 ml) on the seventh day did not experience additional colony growth. According to Diana (2014), the diameter of the fungal colonies that grow in each treatment determines the level of the extract's ability to inhibit fungal growth. The growth of *F. oxysporum* fungal colonies was influenced by the concentration of Jakaba extract given to each treatment. The greater the concentration of Jakaba extract given, the smaller the growth of the diameter of the colony of *F. oxysporum* fungi. According to Sitepu et al. (2012), the greater the concentration of extracts contained in the media, the amount of extract that diffuses into fungal cells increases, causing disruption of fungal growth and can even cause fungal death. Research by Nurhayati et al. (2006) on the antifungal activity of turmeric extract against the fungus *Alternaria porriellis* showed that the diameter of fungal growth at each treatment concentration decreased along with the increase in extract concentration.

The growth inhibition activity of *F. oxysporum* fungi is caused by the presence of secondary metabolite compounds in Jakaba extract that have the potential to be antifungals. According to Ani (2022), Jakaba contains secondary metabolite compounds of alkaloids, polyphenols, tannins, and saponins.

Alkaloids are compounds that have antimicrobial activity by inhibiting esterase, DNA, and RNA polymerase. Alkaloid compounds can interfere with the constituent components of peptidoglycan in fungal cells, causing leakage, and the cell wall layer is not formed intact, causing cells to die (Rahmawati et al., 2013 in Fatma, et al, 2021). Flavonoids are active chemical compounds that can inhibit spore germination from pathogens (Kurniawati et al., 2016). The mechanism of action of flavonoids in inhibiting fungal growth is by disrupting fungal cell membrane permeability. Flavonoids will denature cell proteins and shrink cell walls, causing fungal cell wall lysis because flavonoids will form complexes with cell membrane proteins (Anggara et al., 2014 in Fatma, et al, 2021). Saponins can result in microbial cell lysis by disrupting the stability of their cell membranes. Saponins are polar surfactants that will reduce the surface tension of sterol membranes from fungal cell walls, causing disruption of membrane permeability which results in the entry of materials or substances needed can be disrupted eventually the cell swells and ruptures (Putri, 2015 in Fatma, et al, 2021). The mechanism of action of steroids as antimicrobials is by damaging lipid membranes so that liposomes leak.

Steroids are also known to interact with phospholipid membranes because their permeable nature to lipophilic compounds causes decreased integrity and impaired cell membrane morphology resulting in cells undergoing lysis and brittleness (Madduluri et al., 2013 in Fatma et al, 2021). Tannins are active compounds that act as antifungals. The mechanism of action of tannins is their ability to inhibit the synthesis of chitin, which is used for cell wall formation in fungi and damages cell membranes so that fungal growth is inhibited (Putri, 2015 in Fatma, et al, 2021). Polyphenols are phenolic compounds, with antiseptic and disinfectant properties, work using denaturation and coagulation. Phenol derivatives can also damage cell permeability, and cell membranes so that they can cause cell damage, and microbes will experience death (Diana, 2014). Alkaloids disrupt cell membrane function by inhibiting the formation or binding to ergosterols, disrupting membrane permeability or leakage (Diana, 2014).

Research conducted by Cipriani et al, (2014) that natural and synthetic fungicides effectively inhibit the growth of *Fusarium oxysporum*fungus on PDA media. Natural and synthetic fungicide treatments can markedly reduce the percentage of Fusarium wilt disease in tomato plants. The percentage of Fusarium wilt disease in the field in healthy controls was 0% while sick controls were 17.5%, betel leaf extract was 5%, and benomyl, *Klebsiella pneumoniae*, and *Trichoderma harzianum* each reached 2.5%. According to Fitriani and Astri (2009) in research on growth inhibition of *Fusarium spp*. Kalimantan isolates of onion origin by *Trichoderma spp*. in vitro stated that Trichoderma isolates showed inhibition of *Fusarium sp*. more than 50%.

CONCLUSION

Based on the results of the study, it can be concluded that Jakaba extract affects the mortality of *Ostrinia furnacalis* Guenee caterpillars so that it has the potential to be used as a natural insecticide, and has antifungal activity against the growth of *Fusarium oxysporum*fungus so that it has the potential to be used as a natural fungicide.

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