



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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Kupang, 25 August 2023

Editors:

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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 assess 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
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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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