Assessment in Educational Context: The Case of Environmental Literacy, Digital Literacy, and its Relation to Mathematical Thinking Skill

Evaluación en el contexto educativo: el caso de la alfabetización ambiental, la alfabetización digital y su relación con la habilidad de pensamiento matemático

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Abstract
Digital literacy and environmental literacy are required skills at all educational levels and represent a crucial element for success in 21st century skills, especially mathematical reasoning ability. However, it is not a practical choice for educational contexts to lack simple assessment tools. The purpose of this project is to investigate the possibilities of assessing environmental literacy, digital literacy, and mathematical thinking skill, and to contribute to educational practices. Additionally, the relationship between environmental literacy, digital literacy, and mathematical thinking skill is explored. The sample of this study were all grade 7th – 9th secondary school students (N = 216). A questionnaire measuring environmental literacy and digital literacy as well as a test of mathematical thinking skills were used to collect data. Data were analyzed using JASP software, SPSS 26, Winstep, and Mplus8. Our evaluation proved to be a reliable and valid assessment. Digital literacy and environmental literacy can predict mathematical thinking skill. Concerning this topic in the twenty-first century, the meaning of this study is hugely important for educators and education researchers.
Key words: Environmental literacy, Digital literacy, Mathematical thinking skills

Resumen
La alfabetización digital y la alfabetización ambiental son habilidades requeridas en todos los niveles educativos y representan un elemento crucial para el éxito en las habilidades del siglo XXI, especialmente la capacidad de razonamiento matemático. Sin embargo, no es una opción práctica para los contextos educativos carecer de herramientas de evaluación simples. El propósito de este proyecto es investigar las posibilidades de evaluar la alfabetización ambiental, la alfabetización digital y la habilidad de pensamiento matemático, y contribuir a las prácticas educativas. Además, se explora la relación entre la alfabetización ambiental, la alfabetización digital y la habilidad de pensamiento matemático. La muestra de este estudio fueron todos los estudiantes de secundaria de 7º a 9º grado (N = 216). Se utilizó un cuestionario que mide la alfabetización ambiental y la alfabetización digital, así como una prueba de habilidades de pensamiento matemático para recopilar datos. Los datos se analizaron utilizando el software JASP, SPSS 26, Winstep y Mplus8. Nuestra evaluación resultó ser una evaluación confiable y válida. La alfabetización

digital y la alfabetización ambiental pueden predecir la habilidad de pensamiento matemático. En cuanto a este tema en el siglo XXI, el significado de este estudio es de gran importancia para los educadores e investigadores en educación.
Palabras clave: Alfabetización ambiental, Alfabetización digital, Habilidades de pensamiento matemático

1. Introduction

The covid-19 era has a significant impact on the development of education and the environment. Global issues such as the environment are something that is often heard regarding environmental damage caused by the excessive use of natural resources without sustainable conservation. CO2 concentration has significantly increased, from 0.7ppm/year in 1960 to 2.38ppm/year in 2014. On the other hand, Indonesia's role in the global CO2 emission rate increase has also increased from 0.6% in 1990 to 1.2% in 2005, then to 1.4% in 2015." (Martono & Komala, 2018). It can be seen that during the Covid-19 period, it had a significant impact on environmental quality, even though it only experienced a global decline of 4.2-7.5 percent".

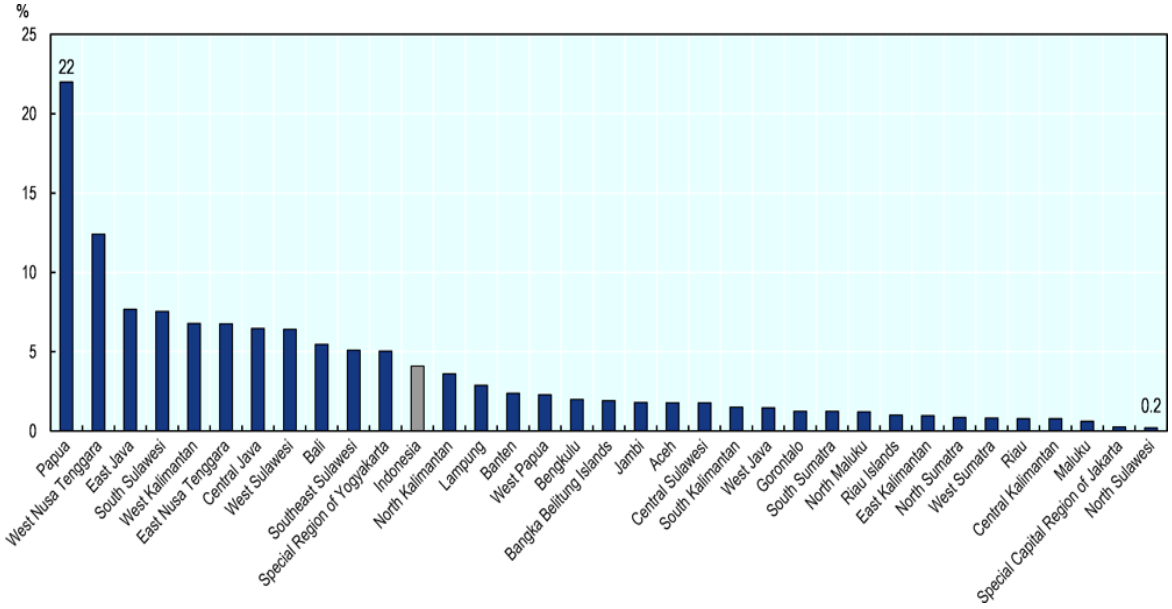
Developing a society with character and environmental care during Covid-19 is possible to run effectively with environmental education (Desfandi, 2015a). This is based on "the place of learning has a special role, in order to understand the impact of human behavior on this earth, and become a place where life is sustainable". Based on the results of previous research "students' environmental literacy is still stated to be low, one of the factors is the intention to know and learn about environmental issues (Nasution, 2016). Therefore, the importance of environmental literacy is as a basic capital of one's knowledge and attitude and overcome environmental problems arising from negative actions".

The integration of environmental literacy can be integrated with subjects in the school curriculum. In the revised 2013 Curriculum, it has been stipulated that "the development of attitude competencies, both spiritual and social attitudes, is carried out indirectly. In participating globally, students have participated in measuring reading literacy, math literacy, and science environmental literacy (Kusmana, 2017). The school learning environment is a good place (Wyndham, 2010), and a place to socialize (Fadlilah, 2018; Suherman et al., 2021; Wang et al., 2022). Learning outcomes are also one of the aspects influenced by the learning environment (Mawarsih & Hamidi, 2013; Ramdhani, 2017)". Learning is closely related to literacy. The literacy approach can provide knowledge and skills in analyzing, giving reasons and communicating them effectively, and interpreting problems in various everyday situations (Arsyad & Villia, 2022). Students are able to solve the problems they face if they can apply their knowledge to unfamiliar situations (Masjaya & Wardono, 2018). In addition, in the Covid-19 era, it is important in learning to utilize information technology to support students studying at home. Digital literacy plays an important role in this regard. Where students get very little information face-to-face at school, it is important to build digital literacy in the face of online learning for the continuity of the learning process.

Improving 4C skills in mathematics is important during Covid-19 so that learning can take place well. This is in line with the PISA framework that students' abilities in

reasoning, identifying, understanding, using the basics of mathematics are important in learning. PISA results in 2018, Indonesian students' abilities ranked 73 out of 79 countries with a score of 379 (Schleicher, 2019). TIMSS 2015 results, Indonesian students ranked 44 out of 49 countries with an international average score of 500. The average mathematics ability of junior high school students nationally is only 46.56 out of 100 (Kementerian Pendidikan dan Kebudayaan, 2019). On the other hand, we can see that the effect of the low of the results are expected to the education in the all province.

Figure 1
In Papua, around one-fifth of the Population is Illiterate, whereas North Sulawesi and Jakarta have Nearly Universal Literacy



People in rural and distant countries frequently lack a fundamental education. About one in five Papuans cannot read or write, making it the province with the nation's lowest literacy rate. West Nusa Tenggara has a significantly higher rate of illiteracy than the rest of Indonesia. In contrast, less than 1% of the population is illiterate in other provinces, including North Sulawesi and the Special Capital Region of Jakarta (see Figure 1 OECD (2020)).

Some previous studies that there is a relationship between cognitive and affective variables so that it has a good impact on the quality of learning outcomes. Among them are environmental literacy can improve learning achievement (Kresnawati, 2014), digital literacy can have a positive influence on learning outcomes (Prior et al., 2016), 4C is an important factor in learning mathematics (Supena et al., 2021).

Based on previous research, there are differences in this study, that this study will look at the ability to think 4C mathematics on environmental literacy and digital literacy. More spesifically, we aim to answer the following researh questions:

RQ1: What are the psychometric properties of an instrument for measuring mathematical thinking, digital iteracy, and environmental literacy in secondary school?

RQ2: What is the relationship between environmental literacy and digital literacy in mathematical thinking dimensions?

2. Literature Review

Mathematical Thinking Skills in 4Cs

Mathematical thinking is important in the 21st century. Indeed, learning is not only centered on cognitive abilities, but also on other social abilities. The 4Cs include critical thinking and problem solving, communication, collaboration, and creativity and innovation. Critical thinking is a 21st century high-level skill in the context of problem solving (Shaw, 2014). Meanwhile, communication is an interaction between people who provide information or ideas to each other (Berger, 2014). On the other hand, collaboration is a form of cooperation in achieving common goals and desired goals in groups (Hesse et al., 2015). These abilities are important in the 21st century, especially during the Covid-19 pandemic. It is owned to be able to connect between teachers and students and school elements in the future, to make changes, and develop learning innovations. Another perspective that critical thinking: using deductive or inductive reasoning, analyzing facts, making conclusions based on analysis results, solving problems with many ideas (Lee et al., 2016). Creative thinking: understand many solutions, change ideas in solving problems, create new solutions and ideas (Beghetto, 2017; Kozlowski et al., 2019). Communication: being able to express ideas or thoughts in writing or non-writing, being able to use them for various purposes/instructing, being able to use tools/media as communication materials (Greenwood et al., 2020; Suherman & Vidákovich, 2022). Collaboration: shows the ability to work together effectively in a group atmosphere, can accept the assignment of responsibility and contribute to the completion of tasks, show respect and provide input.

4C is a form of soft skill that is far more valuable in daily life than mastery of hard skills alone. It is essential to grasp the 4Cs as a means of achieving success, especially in the twenty-first century, when the world is evolving rapidly and dynamically. The teaching and learning process is a process that takes place in an instructive manner through a succession of instructor and student activities based on a reciprocal relationship. The process of learning mathematics in the third century is meant to educate pupils for a somewhat complex, static, and dynamic global environment (McClaren, 2019). Consequently, mathematics learning activities in schools must incorporate the 4 learning characteristics of the 3rd millenium, which are encapsulated in the 4Cs: communication, cooperation, critical thinking and problem solving, creativity and innovation.

Griffin & Care (2014) classify 21st century skills into four categories, namely: (1) Ways of thinking: includes metacognition, knowing how to make decisions, engaging in critical thinking, being innovative, and knowing how to solve problems; and (2) Creativity, innovation, and problem-solving; and (3) Collaboration and communication, (4) Utilizing the tools and having sufficient knowledge to function, as well as possessing information technology literacy. By engaging in government, a good citizen demonstrates social responsibility.

Previous research supports the importance of mathematical thinking skills. A study by the Maskur et al. (2022) found that mathematical thinking skills are crucial for success

in both the STEM fields and SSCS learning model were effective in improving the mathematical thinking skills (i.e., creative and critical thinking abilities). Another study by Farida et al. (2022) showed that the students who were taught using the STEM approach and computer science education exhibited a significant improvement in their metaphorical thinking skills, compared to the non-STEM group. In conclusion, the study highlights the potential of incorporating STEM and computer science education in the curriculum to enhance students' cognitive skills, particularly their mathematical thinking abilities. Moreover, a study by Hailikari et al. (2007) found that the pre-tests of content knowledge and mathematical skills were significantly related to each other and both significantly predicted students' final exam scores in the mathematics course. Overall, the importance of mathematical thinking skills in the 21st century cannot be overstated. The ability to think mathematically is essential for success in various fields and is a necessary life skill. Education systems must prioritize the development of mathematical thinking skills to ensure students are adequately prepared for the future.

Environmental Literacy

The definition of environmental literacy has been stated that a person who is environmentally literate is a person who has a basic skill, understanding and feeling about the human-environment relationship (Desfandi, 2015b). A person is said to be environmentally literate "must understand the interrelationship between natural and social systems, the unity of humans and nature, how technology affects decision making on environmental issues and learning about the environment is a lifelong endeavor". According to Liu et al. (2015), environmental literacy is knowledge related to the environment and individual attitudes in making effective decisions related to the environmental context The North American Association for Environmental Education defines the categories of environmental literacy as follows: affect, ecological knowledge, socio-political knowledge, environmental concerns knowledge, cognitive skills, and environmentally responsible conduct (Simmons, 1995).

Every human activity that utilizes natural resources without conservation and awareness of the necessity of environmental sustainability will have an adverse effect on the ecosystem harmful effects on the ecosystem, such as river and coastal water contamination caused by factors such as river and coastal marine pollution, increasing pollutants, and waste. If nothing is done to convince people of the importance of preserving the environment, the situation will continue to worsen. The continued preservation of the environment will result in human losses, notwithstanding the importance of the environment to humanity, but the importance of the environment for humans stems from the fact that it is an integral element of their life, integral component of his life Increasing awareness and regard for the environment is one of the measures that may be taken to reduce environmental damage. When attitudes and behaviors that care about the environment are implanted based on environmental knowledge, a good attitude toward the environment will develop. A person who has been educated about the environment will be aware of the need to protect the environment (Lloyd-Strovas et al., 2018), protecting the environment (Mullenbach & Green, 2018). In a number of countries, the government considers environmental problems to be the most difficult to solve (Johnson, 2016); however, in order to increase environmental awareness and a sense of affection for the planet in order to reduce environmental degradation, the government

seeks to integrate environmental education into every subject and lecture. Environmental issues must be addressed collaboratively (Levy et al., 2018; Lloyd-Strovas et al., 2018). It is that "the need for capable awareness, knowledge, skills and attitude funds to incorporate appropriate environmental considerations in making decisions for consumption, lifestyle, career, and citizenship both individually and in groups". Kelani states that “Environmental literacy is the ‘knowledge necessary tocomprehend relatedness, and an attitude of care or stewardship” (Graham, 2000). Furthermore “Environmental literacy is essentially the capacity to perceive and interpret the relative health of the environmental systems and to take appropriate action to maintain, restore or improve the health of those systems” (Lloyd-Strovas et al., 2018). It can be concluded based on this opinion that environmental literacy is the ability a person has with understanding and interpretation which is then applied by acting effectively in maintaining, overcoming, and improving the state of the environment.

Environmental literacy is the capacity for students to comprehend and interpret environmental issues and then act effectively in order to maintain, overcome, and improve environmental conditions (Rahmah et al., 2019). Environmental literacy components must meet the following criteria: knowledge, cognitive abilities, attitudes, and environmentally responsible behavior (behavior) in terms of organizing and implementing a behavior or decision-making action in response to environmental conditions (Ilhami, 2019; Supriyanto, 2020). In the context of the environment, it describes students' attitudes toward environmental stewardship in order to prepare humans who understand and can solve environmental problems, as well as environmental reform agents who have a caring attitude and take positive action toward the environment (Kusumaningrum, 2018).

Environmental literacy heightens one's awareness of the importance of preserving the environment's balance (Komariah et al., 2017). This awareness can also refer to environmental sensitivity, which includes not only knowledge of the environment but also a responsive attitude and the ability to provide solutions to environmental problems (Hekmah et al., 2019; Nugraha et al., 2021). Environmental literacy must be instilled in children at a young age through formal education, by incorporating it into the educational process (Pe’er et al., 2007). Along with environmental literacy, students must develop mathematical literacy as they study mathematics.

An individual's environmental literacy ability can be measured through indicators including (1) conceptualizing influence as hope. It is a conceptualization of hope that combines agency and pathway thinking, that is, believing that you can achieve goals (i.e. agency) and planning ways to meet those goals (i.e., pathways). These two components of hope can be analogized to self-efficacy (believing that you can influence desired outcomes). (2) Conceptualizing behavior, the extent to which students reported engaging in pro-environmental behaviors such as recycling or saving water (Szczytko et al., 2019).

Previous research, conducted by Clayton et al. (2019) found that overall environmental literacy scores were positively correlated with the frequency and diversity of nature experiences. In addition, environmental knowledge and behaviors were found to be strong predictors of environmental attitudes, while environmental attitudes were found to be strongly related to environmental behaviors. The study suggests that promoting nature experiences and increasing environmental knowledge can lead to more positive

environmental attitudes and behaviors, which can ultimately contribute to environmental sustainability. The study also highlights the importance of considering cultural and contextual factors in environmental education and outreach efforts. In addition, the environmental knowledge and values were positively related to environmental literacy, indicating that individuals with higher levels of environmental knowledge and stronger environmental values tend to have higher environmental literacy (Maurer & Bogner, 2020).

Digital Literacy

Digital literacy is a technical competence or basic mastery in the use of information and communication technology (Tejedor et al., 2020). On the other hand, digital literacy is a set of skills or competencies related to and needed in the digital era, so that it will develop and have knowledge of the digital world (Barrios-Rubio & Pedrero-Esteban, 2021). Based on this definition, there are three main things about the concept of digital literacy, namely: "The ability to formulate, apply, and interpret ideas digitally in various contexts which is hereinafter referred to as the process of digitizing ideas. The involvement of reasoning in digitization and the use of digital concepts, procedures, facts and tools to describe, explain and predict phenomena. The benefits of digital literacy skills are that it can help a person in applying ideas to everyday life as a form of constructive and reflective community involvement".

The term "digital literacy" is used in this study to encompass a wide range of skills and knowledge required to make effective use of digital tools. Hardware and software of this type are a subset of electronic technologies used by people for academic, social, and/or recreational purposes at home and in the classroom. Technology in the classroom includes computers, mobile devices (such as laptops, tablets, ultra mobiles, mobile phones, smartphones, PDAs, game consoles), interactive whiteboards, data logging equipment, digital recording devices (such as cameras, flip cams, voice, and video recorders), Web 2.0 technologies, and other resources on the Internet (such as information and multimedia resources, communication and collaborative resources like Skype, Moodle, Edmodo, Popplet, blogs, glogs, wikis, concept-map (Ng, 2012).

Digital literacy gives benefits and is crucial for participation in the modern world as it exists now. With digital technology, it is possible to engage and communicate with others. In the middle of the government's determination to introduce a new curriculum, called the autonomous curriculum, digital literacy plays a crucial role. With addition, in an autonomous curriculum geared toward independent learning, both teachers and students require engaging learning content delivered through various digital media.

Due to the prevalence of learning loss and widening learning gaps, curricular modifications have become necessary. The government's efforts to address these issues include the introduction of the Independent Curriculum, formerly known as the prototype curriculum. This curriculum for independent learning was designed as a curriculum framework that is more adaptable and focuses on content and character development as well as learner competencies. The purpose of this independent learning program is to give schools, teachers, and students the freedom to innovate and determine actions in the process of teaching and learning activities, so that teachers and schools are encouraged to avoid monotony and can accommodate the overall characteristics of students from diverse

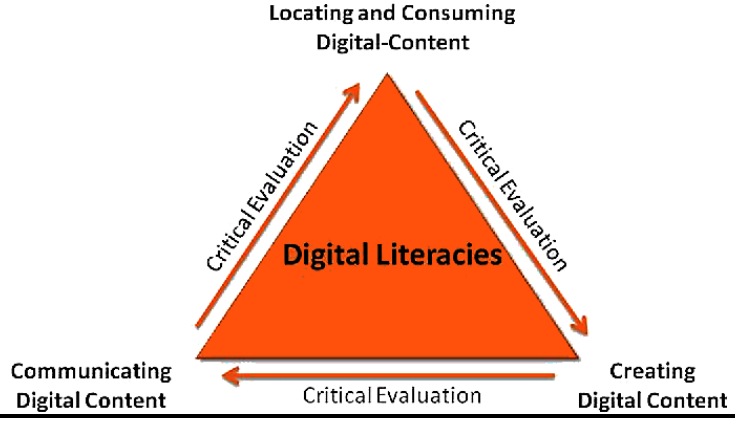
backgrounds (Maskur et al., 2022; Ministry of Education and Culture, 2014; Suherman & Vidákovich, 2022).

In an article, identifies five essential components of ICT literacy: 1) Access, understanding how to collect and retrieve information; 2) Manage, applying existing organization or classification schemes; 3) Integrate, interpret and represent information; 4) Evaluate, determining the quality, relevance, usefulness, or efficiency of information; and 5) Create, producing informatio (Nisbet & Shucksmith, 2017). Certain standards are used as measurements in evaluating learning in order to determine the impact of its implementation. Literacy benchmarks can be classified according to the aptitudes to define, access, manage, integrate, evaluate, create, and communicate. Information and Communication Technology literacy include not just knowledge of technical abilities, but also cognitive concepts. The purpose of integrating ICT into learning is, among other things, to increase the teaching ability of teachers and the learning quality of students. The inventive nature of ICT can improve what is currently being done as well as what is not currently being done but will be possible if ICT is implemented. When we begin leveraging information and communication technologies, we can accomplish more.

A person is said to have digital literacy skills, namely that "a good one will have a sensitivity to concepts or ideas that are relevant to the phenomenon or problem he is facing. From this sensitivity then proceed with problem solving through digital literacy" (Ojose, 2011). Digital literacy has the following dimensions or indicators: Professional engagement and collaboration, digital learning and suorces, direction in using digital by teachers in learning, supporting and empowering students in digital (Tejedor et al., 2020). Furthermore, the concepts of digital competence and digital literacy in education should focus on developing more comprehensive and coherent frameworks that can guide the assessment and development of digital competencies and literacies in higher education contexts (Spante et al., 2018; Tejedor et al., 2020).

The important of digital literacy in the 21st century are to be students independent, responsable for their knowladge. Digital literacy also provides new teaching and learning methods within the classroom. Digital literacy in the classroom helps students to access knowledge in new ways and then convey what they have learned to others, giving them a greater voice in the world around them. The framework of digital literacy in the 21st is ilustration in the figure bellow.

Figure 2
Digital Literacy in 21st Century (Spires et al., 2019)



3. Method

Participants

This research is quantitative research and is causal in nature which explains the causal relationship of the variables studied. The population of this study were all junior high school students in Indonesia. Sampling with random sampling. The sample demographic data are as follows.

Table 1.
Demographic Characteristics of Participants in the Study

Characteristics	Details	Frekuensi	Percentage (%)
Gender	Male	79	36.6
	Female	137	63.4
Age	Mean	13.58	
	SD	0.961	
School Type	Public	173	80.1
	Private	43	19.9
Grade	7th	91	42.1
	8th	91	42.1
	9th	34	15.7
Place Type	City	76	35.2
	District	140	64.8

Instruments

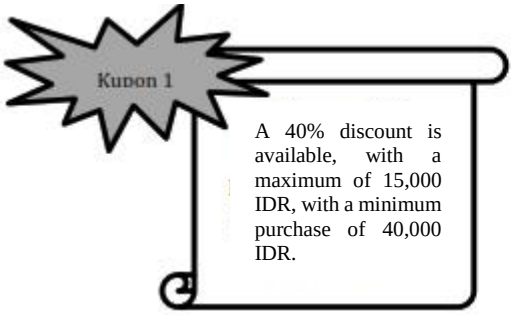
The research instruments used in this study are multiple choice test questions to measure 4C skills in mathematics which include critical thinking, creative thinking, communication, and collaboration. While the Environmental Literacy and Digital Literacy test instruments are in the form of a questionnaire with alternative answers using a Likert scale, 5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, and 1 = Strongly Disagree. Digital literacy adopts Lau & Yuen (2014) and Environmental Literacy adopts Szczytko et al. (2019), and the test refers to the Indonesian curriculum (Ministry of Education and Culture, 2014; Rahmawati et al., 2017). The instrument testing will be conducted on junior high school students in Lampung Province. The research instrument test used CFA testing, validity and reliability with SPSS 26, Winstep version 4.7.0 (Linacre, 2022), and Mplus 8. Winsteps was used to conduct data analysis using Rasch modeling. Winsteps performs Rasch analysis of simple rectangular datasets. Winsteps can be used to analyze multiple choice, dichotomous, and multiple rating scales and partial credit items. The software can be downloaded in trial and full versions on the Winsteps website (www.winsteps.com). The SPSS 26 version was used to analyze using statistical methods such as descriptive statistics. All samples in the data set were investigated as this preliminary study wanted to explore item and student interactions. An example items of the mathematical thinking skills in 4C is in Figure 3.

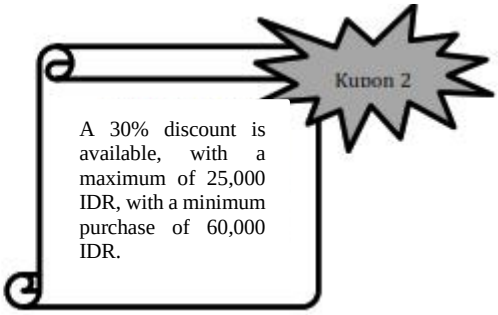
Figure 3
An Example of Mathematical Thinking Skill Task

One afternoon, Ani and her three friends were planning to buy their lunch menus through an online ordering application. To save on expenses, Ani wanted to use the discount coupons she had.

Fried noodles cost 15.000 IDR at "Mie Enak" shop.

Beef meatball soup costs 18.000 IDR at "Bakso Mantap"





With the condition that the coupon can only be used for one item, which type of food and which coupon should Ani and her friends choose?

a. Buying fried noodles by utilizing coupon 1
b. Buying fried noodles by utilizing coupon 2
c. Buying beef meatball soup by utilizing coupon 1
d. Buying beef meatball soup by utilizing coupon 2

Analysis Data

Test result data were tested using statistical tests. Before the hypothesis test was held, the prerequisite test was held first. For the analysis of test instruments using the Rash model assisted by Wisntep software, and questionnaire instruments with JASP software to see Kaiser-Meyer Olkin (KMO), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Bentler-Bonett Normed Fit Index (NFI), The Root Mean Square Error of Approximation (RMSEA), The Standardized Root Mean Residual (SRMR). Then analyze reliability with Cronbach Alpha's and McDonald Omega. Furthermore, validity with Average Variance Extracted (AVE) and Composite Reliability (CR).

Simple and multiple linear regression statistical tests using SPSS 26. However, before conducting the test, first conduct an analytical prerequisite test. These tests include the Kolmogorov Smirnov (K-S) method normality test, linearity test with the Test for

Linearity, multicollinearity test is carried out by looking at the tolerance value of the multicollinearity test is carried out by looking at the tolerance value or by using the variance inflation factors (VIF) from the analysis results using SPSS, Autocorrelation test with the Durbin Waston (DW) test approach, heteroscedasticity test. Then see the existence of a relationship or influence with the coefficient of determination.

4. Results

Mathematical thinking skill

There were 5 questions given in the reserch. The five items represent the 4Cs indicators. The results of the test analysis using the Rasch model are in the following table.

Table 2.
Summary of Test Analysis on Person and Item

Measured	Item	Person
Mean	0.00	1.49
SD	0.27	0.04
Mean Outfit MNSQ	1.18	0.96
Mean Infit MNSQ	0.99	0.94
Separation	6.87	0.41
Reliability	0.98	0.62
Cronbach Alpha	0.78	

Based on Table 2, it can be seen that the Cronbach Alpha of the items is 0.78. Furthermore, the reliability of the Rasch measurement instrument on item and person are 0.98 and 0.62, respectively. Although the statistics represent a reliability of more than 0.67 (Fisher, 2007). The distribution of item fit order is shown in Figure 4 and the items classified as difficult and easy in Figure 6.

Figure 4
Bubble Wrap for Item Fit

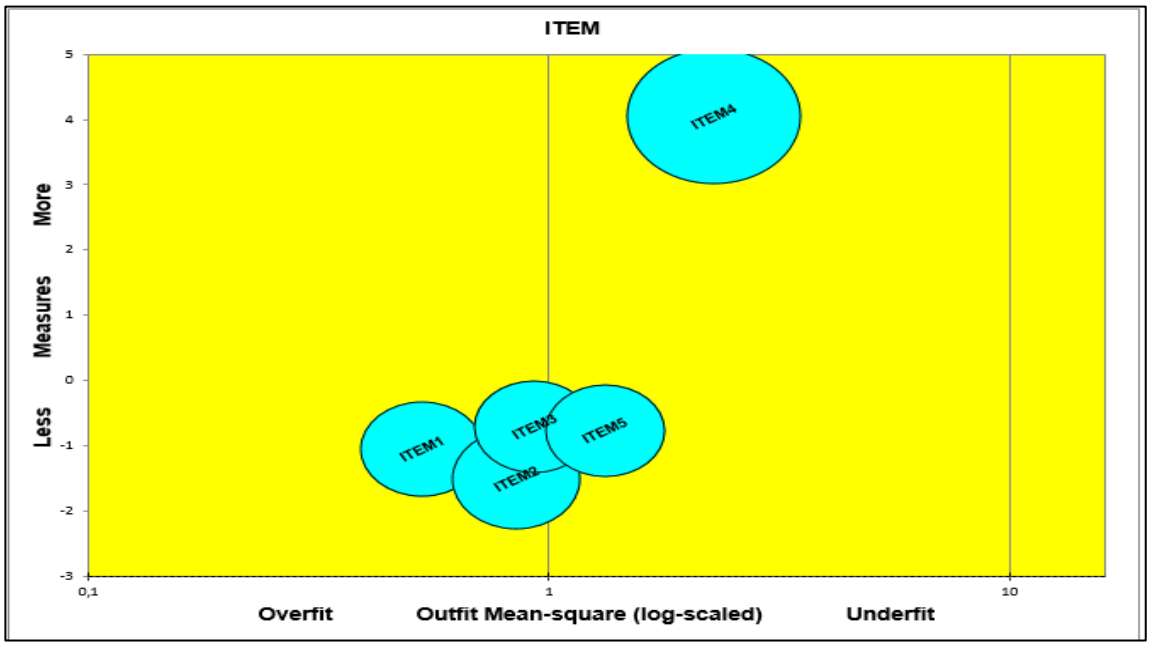


Figure 5
Classification of Difficult and Easy Questions on the 4C Mathematics Proficiency Test

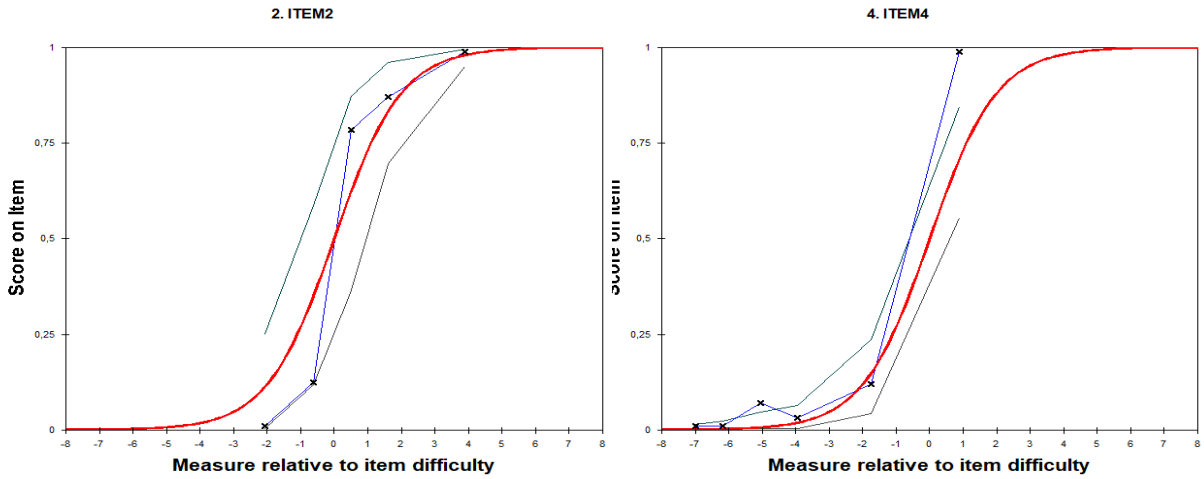
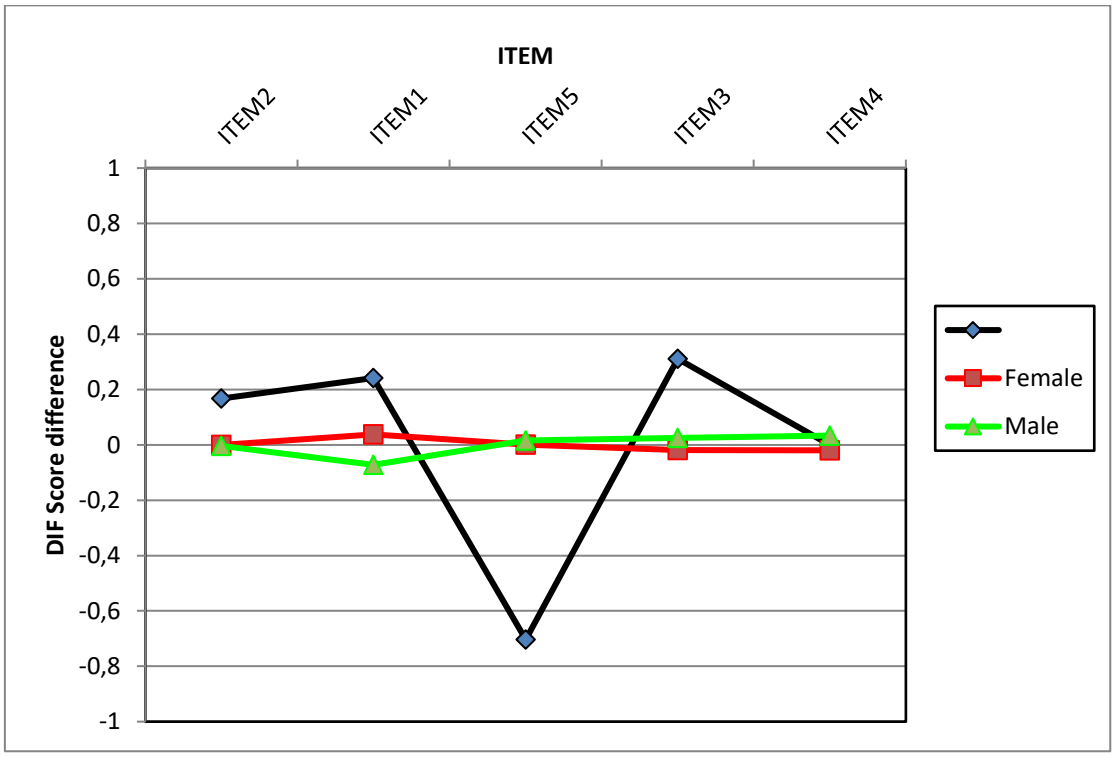


Figure 6
Wright Wrap for Difficult and Easy Items

Figure 4 shows that item number 4 belongs to the category of difficult items to measure 4C math skills, while item number 2 belongs to the easy category. This is reinforced by figure 6. Given the fact that all five questions are valid and reliable according to Rasch measurement. The facts about students' answers in the difficult and easy question categories can be seen in Figure 6. A diagram called the Wright map, depicted in Figure 6, was utilized to exhibit how items and students' abilities corresponded on the same logit scale (Bond & Fox, 2015). The Wright map positioned items on the right-hand side, and students' abilities on the left. A greater logit score indicates a more challenging item and a higher level of ability in students (Schwichow et al., 2016). The map highlights that item 2 is the least difficult, while item 4 is the most challenging one.

In regard to the Differential Item Funtioning (DIF), the aims of DIF is owing to gender. A DIF analysis was conducted to evaluate whether there were items with a gender bias. If the t-value was less than 2.0 or larger than 2.0, the DIF contrast value was less than 0.5 or greater than 0.5, and the p (probability) value was less than 0.05 or greater than 0.05, the item was acknowledged as having DIF (Bond & Fox, 2015; Boone et al., 2014). The analysis of DIF can be seen in the figure below.

Figure 7
DIF Owing Gender



We can see that on Figure 7 indicates that no DIF owing gender. The results of the Rasch model analysis show that the questions are valid and reliable. So that it is able to measure 4C math skills.

Environmental Literacy Questionnaire

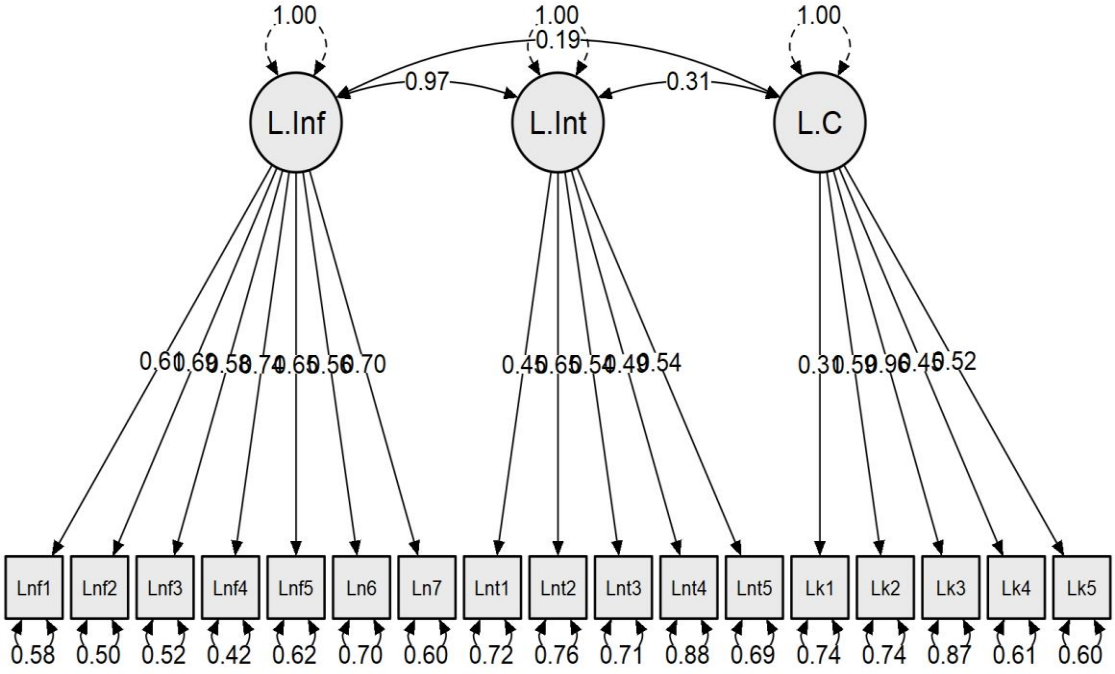
CFA

In EFA, the digital literacy questionnaire has 16 items. The results of the analysis using JASP 0.14.1.0 on KMO are 0.904. Then the CFA analysis was carried out with the aim of obtaining the most appropriate measurement model (Hermida, 2015). The results of the analysis of the fit model were obtained (Chi-square = 163.543; df = 116; p = 0.002), and the fit model factor index is in table 2. Figure 8 illustrates the CFA diagram after the modification index is applied, as well as information about the GoF values applied.

Table 3.
Model Fit of the Digital Literacy Questionnaire

Componens	Value
CFI	0.933
TLI	0.921
NFI	0.806
RMSEA	0.050
SRMR	0.060

Figure 8
Model Plot of Digital Literacy



Based on Table 3, it can be seen that all criteria of CFI, TLI, RMSEA, and SRMR are meet the fit standard. Figure 4 also shows the model plot of the questionnaire.

Reliability

The results of the analysis of reliability using Cronbach Alpha's and McDonald Omega. The results can be seen in the following table.

Table 4.
Reliability Results

Factors	Hope	Behavior	Total
Consistency Reliability (Crb$\boldsymbol{\alpha}$)	0.74	0.82	0.86
Composite Reliability ($\boldsymbol{\omega}$)	0.74	0.83	0.87

Based on table 4, two factors have a reliability of 0.86 and 0.87 with Crbα and ω analysis. While the Hope factor is 0.74 both Crbα and ω. Then the Behavior factor with a value range of 0.82 and 0.83. This illustrates that the data is sufficient for factor analysis.
Convergent Validity

The term convergent validity is used to describe the correlation factor between several variables in one construct in the measurement equipment. The reliability of the construct and the average variance extracted should be calculated (Ab Hamid et al., 2017). The following are the results of convergent validity data analysis using AVE and CR.

Table 5.
AVE and CR Results

Factors	CR	AVE
Information	0.84	0.43
Internet	0.65	0.28
Computer	0.67	0.30

Based on table 5, shows the data from the CR and AVE analysis results. The CR values for the three factors range from 0.64 to 0.84, while the AVE is in the range of 0.28 and 0.43. Even though the AVE value is smaller than 0.60, the CR value is more than 0.60, which means that the data is valid (Fornell & Larcker, 1981), and can be used.

Digital Literacy Questionnaire

CFA

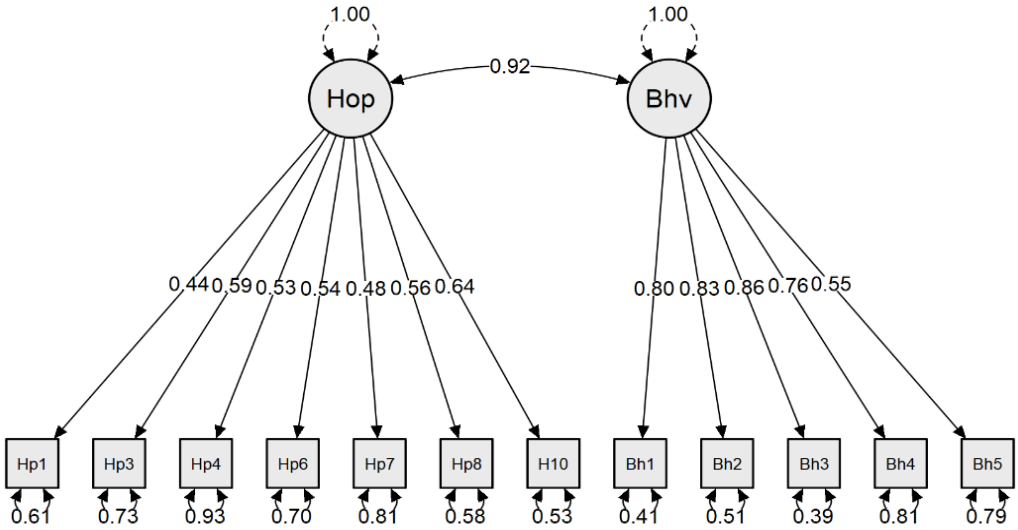
The digital literacy questionnaire has 16 items. The results of the analysis using JASP 0.14.1.0 on KMO are 0.837. Then the CFA analysis was carried out with the aim of obtaining the most appropriate measurement model (Hermida, 2015). The results of the analysis of the fit model are obtained (Chi-square = 78.114; df = 53; p = 0.014), and the fit model factor index is in table 5. Figure 5 illustrates the CFA diagram after the modification index is applied, as well as information about the GoF values applied.

Table 6.
Model Fit of the Digital Literacy Questionnaire

Componens	Value
CFI	0.960
TLI	0.950

Componens	Value
NFI	0.950
RMSEA	0.053
SRMR	0.051

Figure 9
Model Plot



The results of the analysis of modification indices, on the Hope factor with questions number 2, 5, 9, and 11 have an estimated value of less than 0.30 so that the question is deleted. While on the Behavior factor nothing was deleted. The deleted questions include "The actions I can take are too small to help solve most environmental problems", "Environmental problems are beyond my control", "Environmental problems are so complex, we will never be able to solve them", and "I feel powerless to solve environmental problems".

Reliability

The results of the analysis of reliability using Cronbach Alpha's and McDonald Omega. The results can be seen in the following Table 7.

Table 7.
Reliability Results

Factors	Hope	Behavior	Total
Consistency Reliability (Crbα)	0.74	0.82	0.86
Composite Reliability (ω)	0.74	0.83	0.87

Based on table 7, two factors have a reliability of 0.86 and 0.87 with Crbα and ω analysis. While the Hope factor is 0.74 both Crbα and ω. Then the Behavior factor with a value range of 0.82 and 0.83. This illustrates that the data is sufficient for factor analysis.

Convergent Validity

The term "convergent validity" is used to describe the correlation factor between several variables in one construct in the measurement equipment. The reliability of the construct and the average variance extracted should be calculated (Ab Hamid et al., 2017). The following are the results of convergent validity data analysis using AVE and CR.

Table 8.
AVE and CR Results

Factors	CR	AVE
Hope	0.83	0.41
Behavior	0.89	0.63

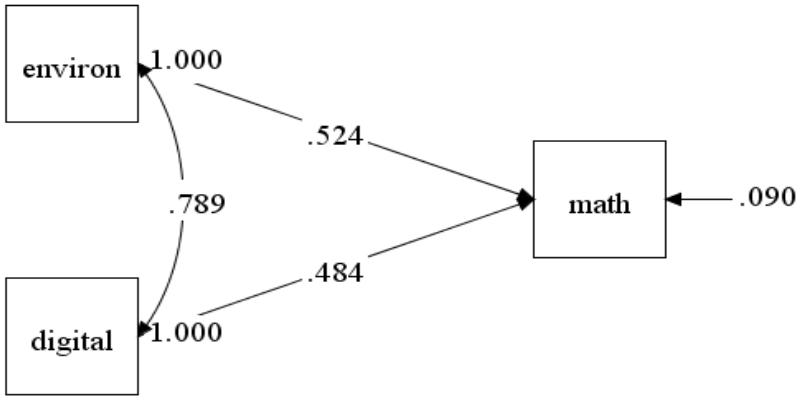
According to table 8, the CR and AVE values for the Hope factor are 0.83, although the AVE value is 0.41. The CR value for the Behavior factor is 0.89, while the AVE is 0.63. Even if the AVE value is less than 0.60, the CR value is greater than 0.60, indicating that the data can be used (Fornell & Larcker, 1981). The results of the three differents assessment were presented in Table 9.

Table 9.
Descriptive Statistics of the Variables

Variable	N	Min	Max	Mean	Std. Dev.	Skewness	Kurtosis
Environmental Literacy	216	8	55	2.99	8.716	.223	.034
Digital Literacy	216	13	77	3.56	9.331	.319	1.139
Math Thinking Skill	216	45	88	66.54	8.515	-.167	-.459

The math thinking which registered the highest scores were environmental literacy and digital litracy with mean values higher than 66.54 (2.99 and 3.56, respectively). In contrast, the digital literacy with the higest scores compare environmental literacy, which registered values around 3.56 and 2.99, respectively. The negative values regarding coefficients of skewness and kurtosis revealed asymmetrical distributions at the level of math thinking.

Figure 10
Relationship Between Environmental Litracy and Digital Literacy in Math Thinking Skill. Math: Mathematical Thinking Skills; digital: Digital Literacy; environ: Environmental Literacy.



It can be observed from Figure 10, standardized estimates indicate a significant relationship between environmental literacy and digital literacy in math thinking skill. There are several empirical views on the standardized estimate of the factor loadings. Generally, values of at least environmental literacy and math thinking was .524, indicating that environmental literacy positive influence in math thinking skill. Furthermore, digital literacy and math thinking to about .484, indicating positive influence.

Conduct multiple regression analyses based on the data. Thus, follow these results of the task.

Table 10.
Results of Multiple Regression Analysis for Math Skill Test Score as Dependent Variable

Independent variables	***r***	***ß***	***r·ß·*100**	***p***
School type	-.003	.009	0.000	0.877
Place	.034	.035	0.12	0.150
Gender	-.010	.049	-0.05	0.635
Environmental Literacy	.524	.906	47.44	< .001
Digital Literacy	.485	.898	43.56	< .001
Total variance explained			91.07	

Based on Table 10, we can see that the table describe the percentage of variance explained by the include independent variables. The statistics results have explained 91.10 % of variance in the dependent variable can be explained by the independent variables together and the total variance explained is 91.1% if we consider only the independent variables that make significant contribution to the regression model,, $R^2 = .91$, $p < .000$. That is can expected of matth thinking 4Cs test seems to exert the strongest influence, on the other hand may have an impact on the developmental level of math competencies. It is also influenced by students' environmental literacy and digital literacy skills which may possibly be explained by task characteristics. As for the environmental literacy, high explained variance was found by the grade point average which indicate that have influence of math 4C test. In accordance with the findings of Rosdiana et al. (2020), a person is regarded to have environmental knowledge if he has knowledge and attitudes regarding the environment and environmental concerns. He can contribute to society and aid in minimizing or resolving environmental problems using the gained abilities. Individuals are responsible for their behavior and attitudes towards environmental awareness, which are generally influenced by the knowledge factor. A person's environmental attitude and behavior will be influenced by their environmental knowledge.

Digital literacy have an influence, too. However, the school type, gender, and place does not influence to the dependent variable. Regarding the coeeficients analysis, the environmental literacy test score ($t = 15.60$, $p < .001$), the digital literacy test ($t = 14.44$, $p < .001$) are the significant explanatory variables, whereas gender, place, and school type does not have a significant contribution to the regression model. In the case of the math

4Cs test, the value of the standardized regression coefficient ($ß$ = .30) is the highest. The regression model containing all independent variables predict the dependent variable significantly well, $F(215) = 428.34$, $p < .001$.

5. Discussion

This study has two independent variables and one dependent variable, with the independent variable being environmental literacy and digital literacy and the dependent variable being 4C math skills. It can be seen that in this study, researchers gave a test related to questions and questionnaires. The question consists of 5 items, then analyzed using the Rasch model. The results can distinguish the quality of questions and student abilities. Meanwhile, the environmental literacy questionnaire has 12 items, and digital literacy has 17 items. The questionnaire was processed using JASP software.

In general, the needs for good education measurement guided the formulation of the tasks. This necessitated that they be associated with a well-defined construct. They were required to demonstrate a sense of developmental growth, supported by empirical and theoretical evidence. The draft developmental progression was supported by empirical evidence from clinical trials and cognitive laboratory investigations. According to Hattie (2012), proof was required for students' thought processes to be visible. Among the obstacles was the requirement to understand more about developmental progressions utilizing data on processes as opposed to data on goods, solutions, and outcomes. The process employed by the student was deemed to be at least as important as the problem solution. Developers were instructed to differentiate between the task's context and the cognitive component being evaluated. This is especially significant for generic types of skills, which are frequently contained within information that teachers and students are already familiar with. There was a need to develop means of assisting teachers to use assessment data in a formative manner to enhance both teaching and learning. Considering that the project's name was Assessment and Teaching of 21st Century Skills, formative assessment had to be an integral part of the project.

Our assessment instrument for environmental literacy, digital literacy, and math thinking provided to be reliable regarding the whole test and took based an online. Based on theoretical background, evidence for construct was informed. Advantages of online assessment, such as online test administration automatic can be calculation based on the score. With regards these characteristic, we took the first steps to make our instrument suitable for students' fill-in. The findings indicate that assessment may provide teachers an easy to use for evaluating the development of students environmental literacy and digital literacy may contribute to the development of mathematical thinking. Additionally, reported environmental behavior was found to be positively related to environmental knowledge, values, and environmental literacy, suggesting that individuals who engage in more environmentally friendly behaviors tend to have higher environmental literacy (Maurer & Bogner, 2020).

Examining the relationships with mathematical thinking showed that environmental literacy predicts mathematical thinking. The values are not high, and a significant amount of variance is unexplained; however, this finding supports the claim that environmental literacy thinking plays an important role in various aspects of mathematical performance. Regarding environmental literacy, we found a similar relationship to previous research

results (i.e., Christian et al., 1998; Goldman et al., 2018; Wei et al., 2020). In addition to these findings, we showed that digital literacy predicts mathematical thinking as well. The nature of possible connections between digital literacy and mathematical achievement is a connected with the previous research (e.g., Vodă et al., 2022; Ziya et al., 2010).

The research process was carried out to see each indicator of environmental literacy, digital literacy, and students' 4C math skills. Indicators of environmental literacy, digital literacy, and mathematical 4C skills are contained in the literature review. Referring to the results that have been obtained, there are still many students who have not mastered the ability of 4C mathematics and need to improve the environmental literacy skills and digital literacy of students. Through these results, educators are expected to provide the best solution in honing and improving students' environmental literacy, digital literacy, and 4C math skills. Given that this ability is important in the 21st century. Therefore, this problem gets serious attention considering the important role of mathematics. Mathematical 4C skills are important in learning. Given the 21st century makes a very important role. Then during the 19th pandemic, it requires students to be able to have digital literacy and environmental literacy. This ability contributes significantly to changes in literacy culture (Komalasari, 2021; Szczytko et al., 2019; Tejedor et al., 2020). With this ability, it can foster environmental literacy and digital literacy in mathematics learning. This is very good for taking into account the psychological problems of students, because positive psychological development is desirable to influence the formation of students' environmental literacy and digital literacy skills (Abdillah et al., 2021). In other words, students who have the 4Cs of mathematics can do a good job (Stiwne & Jungert, 2010).

6. Limitation and Further Research

This study has a significant impact on 4C math skills. Given the variables used such as environmental literacy and digital literacy. However, in this study there are some limitations, such as a small sample, so it is limited to research results in the Bandar Lampung area, Indonesia. Then, further research will be the latest topic for using the variables in this study as predictor variables in mathematics learning.

7. Conclusions

The digital literacy required in the contemporary context of widespread usage of information and communication technologies is gained in both formal and informal settings. In addition, environmental literacy may have a positive effect on daily performance. The formal and regulated environmental literacy and digital literacy significantly contribute to the improvement of mathematical thinking skills. This study addresses a significant scholarly gap in the areas of digital literacy and environmental literacy by emphasizing mathematical thinking and well-defined context.

Mathematical thinking skill is one of the most crucial parts of 21st century skills. Consequently, it is also fruitful to investigate the cognitive processes that underlie thinking skill and their interrelationships. Furthermore, it would be important to investigate the nature of their interrelationships in order to design new and effective programs that simultaneously teach 21st-century abilities. To achieve this objective, it is necessary and test these skills to track pupils' development (Suherman et al., 2021). In

addition, the significance of the research increases when it is conducted during a pandemic, a period of rapid technological advancement, and the implementation of unexpected changes.

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Competing Interests

There are no conflicts of interest to declare.

Author Contribution

All authors contributed to the study conception and design. Farida: Conceptualization, Formal analysis, and Editing; Suherman Suherman: Conceptualization, Writing - Original Draft, Formal analysis, Methodology, Editing, and Visualization; Yosep Aspat Alamsyah: Visualization, Review, and Editing.

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