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PROCEEDINGS OF THE 7th INTERNATIONAL CONFERENCE ON RESEARCH, IMPLEMENTATION AND EDUCATION OF MATHEMATICS AND SCIENCES (7th ICRIEMS)

Science, Technology, and Education in The Global Era for Virtuous and Competitive Generation

Yogyakarta, 25 – 26 September 2020

FMIPA UNIVERSITAS NEGERI YOGYAKARTA
INDONESIA

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Preface

This proceedings is the regular edition (non-Scopus-indexed) of the conference proceedings of the 7th International Conference on Research, Implementation, and Education of Mathematics and Sciences (ICRIEMS) held by the Faculty of Mathematics and Science, Yogyakarta State University, Indonesia on 25-26 September 2020 at Yogyakarta State Univesity . All papers in this proceeding were obtained from a selection process by a team of reviewers and had already been presented in the conference. Some selected papers from the conference were compiled under separate proceedings and published by Institute of Physics (IoP) which is Scopus-indexed. This proceedings comprises 9 fields, they are mathematics, mathematics education, physics, physics education, chemistry, chemistry education, biology, biology education, and science education.

The theme of this 7th ICRIEMS is '*Science, Technology, and Education in The Global Era for Virtuous and Competitive Generation*. This conference presented five keynote speakers, which were Martianus Frederic Ezerman, Ph. D (School of Physical and Mathematical, Sciences, NTU, Singapore), Prof. Dwikorita Karnawati, Ph.D (BMKG, Jakarta), Prof . Dr. Gultekin Cakmakci (Hacettepe University, Turkey), Prof. Wing Mui Winnie So (University of Hong Kong), and Dr. Insih Wilujeng (Universitas Negeri Yogyakarta). Besides the keynote speakers, there were also parallel articles that present the latest research results in the field of mathematics, sciences, and education. These parallel session speakers came from researchers from Indonesia and abroad.

Hopefully, this proceeding may contribute in disseminating research results and studies in the field of mathematics, sciences and education such that they are accessible by many people and useful for the development of our civilization.

Yogyakarta, October 2020

Editorial Team

Forewords From The Head of Committee 2020

Assalamu'alaikum warahmatullahi wabarakatuh
May peace and God's blessings be upon you all

Dear our respected speakers and participants on behalf of the 7th ICRIEMS 2020 Organizing Committee, we would like to extend our warmest welcome to the Yogyakarta.

The 6th International Conference on Research, Implementation, and Education of Mathematics and Science (ICRIEMS) which is organized by Faculty of Mathematics and Science, Universitas Negeri Yogyakarta, Indonesia held today on September, 25-26 2020. The theme of the 7th ICRIEMS is "Integrating Science, Technology, Engineering, & Mathematics (STEM) and Education for Disaster Risk Reduction and Mitigation". We certainly hope that the theme will covers the field of mathematics, chemistry, physics, biology, mathematics education, chemistry education, physics education, biology education, and science education to enhance society knowledge on natural phenomena and geographical position of countries in the ring of fire pathway that have the potential for natural disasters. The knowledge could help people and government agencies to reduce and prevent the emergence of a larger disaster impact.

The conference is an event where prominent practitioners, researchers, students and educators from all around the world are joining together to share their latest research and exchange their ideas. The conference will be a good place to promote or maintain not only national but also international collaboration and networking among academics, researchers and educators. The conference has accepted 210 papers from six countries, i.e. Turkey, Indonesia, Hongkong, Singapore, Malaysia, and Thailand. There are more or less 140 selected papers will be published by AIP Publisher under Scopus Index and Journal of Physics: Conference Series by IOP Publishing also under Scopus Index. The rest of the papers will be published on DOAJ Journals and Regular ICRIEMS Proceeding.

Last but not least, We address very big appreciation and many thanks to all presenters and participants who have been actively involved in this conference. We also wish to thank to our reviewers for invaluable comments and suggestions. We wish you a productive conference and hope you enjoy your time in Yogyakarta and at 6th ICRIEMS 2019!

Wassalamu'alaikum warahmatullahi wabarakatuh.

Yogyakarta, November 2020

Dr. Supardi, M.Si

Forewords From the Dean of Faculty of Mathematics and Sciences, Universitas Negeri Yogyakarta

May peace and God's blessings be upon you all.

On behalf of the Committee, first of all allow me to extend my warmest greeting and welcome to the 7th International Conference on Research, Implementation, and Education of Mathematics and Sciences (ICRIEMS) 2020, organized by Faculty of Mathematics and Natural Sciences (FMNS) Universitas Negeri Yogyakarta.

The readiness of human resources is required to face up the new era of industrial revolution which demands people to be actively involved in communication system, to think critically, and to have good skills including adaptability, social-emotional learning, growth mindset, and cultural awareness. The challenge for us is getting bigger with the Covid-19 pandemic around the world which changes the order of human life. Mastery and self-readiness are very important to face the world today. This condition could be achieved if it is supported by the empowerment of individuals and scientific and technological innovations in order to adapt to global change which encompasses technological, social, cultural, economic changes and natural events.

With the theme of "Science, Technology, and Education in The Global Era for Virtuous and Competitive Generation", this conference is aimed to pull together researchers, educators, policymakers, and practitioners to share their critical thinking and research outcomes. Therefore, we can understand and examine the development of fundamental principles, knowledge, and technology to adapt to global changes and to prepare the qualified generations. The scope of this conference covers all topics but is not limited to in the field of mathematics, chemistry, physics, biology, mathematics education, chemistry education, physics education, biology education, and science education.

Distinguished guest, ladies, and gentlemen,

This conference will be far from success and we could not accomplish what we do without the support from various parties. So let me extend my deepest gratitude and highest appreciation to all committee members. I would also like to thank each of participants for attending our virtual conference and bringing your expertise to our gathering. Should you find any inconveniences and shortcomings, please accept my sincere apologies.

To conclude, let me wish you a fruitful discussion and an impressive virtual conference.

Yogyakarta, September 2020

Prof. Dr. Ariswan

PROGRAM OUTLINE

VIRTUAL CONFERENCE PROGRAM
THE 7th INTERNATIONAL CONFERENCE ON RESEARCH, IMPLEMENTATION & EDUCATION OF MATHEMATICS AND SCIENCES (ICRIEMS) 2020
25-26 September 2020, DIGITAL LIBRARY, UNIVERSITAS NEGERI YOGYAKARTA, INDONESIA
Friday, Sept 25, 2020

No	Time	Programs
1	07.30 - 08.00	Registrasi
2	08.00 - 08.30	Pembukaan
		1. Menyanyikan Lagu Indonesia Raya
		2. Laporan oleh Ketua Panitia
		3. Sambutan dan Pembukaan oleh Rektor UNY
3	08.30 - 09.30	Keynote Speech #1 : Prof. Dr. Lee Ching Kuo (Taipei Medical University, Taiwan) Bidang Kimia
4	09.30 - 10.30	Keynote Speech #2 : Prof. Peter Charles Taylor (Murdorch University Australia, Australia) Bidang IPA
5	10.30 - 11.30	Keynote Speech #3 : Prof. Dr. Suriani Abu Bakar (UPSI, Malaysia) Bidang Fisika
6	11.30 - 13.00	Break
7	13.00 - 16.00	Sesi Paralel I
8	16.00 - 16.15	Penutup

VIRTUAL CONFERENCE PROGRAM
THE 7th INTERNATIONAL CONFERENCE ON RESEARCH, IMPLEMENTATION & EDUCATION
OF MATHEMATICS AND SCIENCES (ICRIEMS) 2020
25-26 September 2020, DIGITAL LIBRARY, UNIVERSITAS NEGERI YOGYAKARTA, INDONESIA
Saturday, Sept 26, 2020

No	Time	Programs
1	08.00 - 08.15	Pembukaan
2	08.15 - 09.15	Keynote Speech #4 Dr. Ariyadi Wijaya (Mathematic, Universitas Negeri Yogyakarta)
3	09.15 - 10.15	Keynote Speech #5: Assoc. Prof. Chatree Faikhamta (Kasetsart University, Thailand) Bidang Kimia/IPA
4	10.15 - 11.15	Keynote Speech #6 : Dr. Agus Purwanto (Institut Teknologi Indonesia) Bidang Fisika
5	11.15 - 12.00	Invited Speakers #1: Assoc. Prof. Vichit Rangpan (Yala Rajabhat University, Thailand) Bidang Biologi
6	12.00 - 12.15	Break
7	12.15 - 13.00	Invited Speakers #2 Dr. Retno Arianingrum (Chemistry, Universitas Negeri Yogyakarta)
8	13.00 - 16.00	Sesi Paralel I
9	16.00 - 16.15	Penutup

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REGULAR PAPERS

NATURAL SCIENCE EDUCATION (SE)

Analysis of scientific literacy instruments of natural science learning domain on vibrations, waves, and sound based on indigenous knowledge of Luwu South Sulawesi

I Ariska[1] and D Rosana[1]

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Abstract. Many things should be done in order to compete in the 21st century. One of them was by analysing students' scientific literacy abilities. This study aimed to determine the appropriateness of scientific literacy instruments on the themes of vibration, wave and sound based on the indigenous knowledge of Luwu, South Sulawesi. Subjects in this study were 226 class of IX junior high school students in Luwu Regency, Indonesia. Selected by purposive sampling technique. The sample criteria used are student who have studied the material on the instrument and choose students who have almost the same abilities. The method of this study used quantitative analysis and qualitative analysis. Data collection was carried out using qualitative test and study techniques by experts and practitioners. Quantitative data were obtained from the results of testing instrument tests on students. Aspects and indicators used to measure literacy abilities were adjusted to aspects and indicators of the OECD. The results of the validation analysis carried out by the scientific literacy instruments were declared eligible for measuring the scientific literacy abilities. While based on empirical trial results for multiple choice questions and essays had a reliability of 0.6 (fairly reliable); difficulty level 0.47 (moderate); distinguishing data is 0.36 (sufficient). As for the type of true and false indicated of reliability of 0.8 (reliable); difficulty level -0.18 (moderate); and the distinguishing power of 0.49 (good).

Keywords: *scientific literacy, indigenous knowledge of Luwu South Sulawesi, vibration, waves, and sound*

1. Introduction

In the 21st Century has required students to have knowledge, skills and abilities in using technology appropriately, media and information in learning [1]. In order to compete globally, everyone is required to have superior competence and skills [2]. Suma said that to be able to compete in the 21st century, one of the abilities needed was scientific literacy [3]. Because the ability of scientific literacy will make students understand the wider world by using scientific dimensions or by using technology [4].

Indonesian has participated in International Studies Trends in International Mathematics and Science Study (TIMMS) and Programmed for International Student Assessment (PISA) since 1999. Based on the results of the assessment conducted in 2018 Indonesian obtained an average score of 403 while the average score The OECD at that time was 493. These results proved that the ability of scientific literacy in Indonesia was still relatively low [5]. Low scientific literacy was also found in various studies that have been conducted [6] which has stated that all categories were under 50%.

Scientific literacy is the main goal of science education [7]. Because scientific literacy is used for an indicator to see the quality of education and human resources in a country [8]. Scientific literacy is not only the ability to read and understand the science, but more than that because scientific literacy is also the ability to understand and apply the fundamental principles in science [9] [10] [11]. By having the ability of scientific literacy is one can solve the problems with scientific consideration [12] [13]. This ability is used in decision making and action [14] [15]. At present students still have difficulty in using scientific knowledge in making decisions [16] [17] [18]. Introducing students with relevant scientific content in daily life is very important in helping to make a personal decisions that are needed in the job market [19] [20] [21]. Therefore, the ability of scientific literacy is very important at various levels of education.

PISA measures three components of scientific literacy based on logic, reasoning, and critical analysis. This component is used in knowing students' skills in identifying scientific problems, explaining scientific phenomena and using scientific evidence [22]. Thus, if students master scientific literacy, they will understand that modern society is very dependent on technological progress and the development of science [23].

Improving students' scientific literacy can be done by identifying and collecting interesting science topics and integrating topics on the curriculum; by involving students to read research and help explain relationships with concepts and social issues; and guide students in evaluating data such as where to collect data, how to collect data and whether the data obtained has represented the population [24].

Integrating the indigenous knowledge with scientific literacy instruments can help the students because Zuriah, Sunaryo & Yusuf stated that utilizing indigenous knowledge in learning will create meaningful learning [25]. Based on the results of a questionnaire 62.5% of students stated that teachers have not fully utilized indigenous knowledge in learning, even though the results obtained [26] stated that integrating indigenous knowledge proved effective in achieving learning objectives. Indigenous knowledge is proven to be able to develop students thinking and can increase students awareness about the local culture of what is learned in school [27]. Indigenous knowledge is also considered as an alternative to understanding [28]. There are many indigenous relationships in everyday life that will make learning more meaningful [29]. In addition, the integration of indigenous knowledge should be done done for its existence remains sturdy, so students need to be instilled a sense of love for the existing indigenous knowledge [30]. One way that can be taken is by integrating the indigenous knowledge in the area or the environment of students in the assessment process through an integrated instrument that is oriented towards indigenous knowledge. So the first thing to do is to analyse scientific literacy instrumens that have been integrated with local potentials that exist within students.

Scientific literacy assessment based on the 2015 PISA framework there are four interconnected scientific literacy domains as follows [5]:

a. Domain of Context, which includes personal, local / national and global
b. Domain of Competency, which consists of aspects of explaining phenomena scientifically, aspects of evaluating and designing scientific investigations, and aspects of interpreting scientific evidence and data
c. Domain of attitude, which consists of aspects of interest in science, aspects of respect for scientific inquiry and aspects of concern for environmental problems
d. Domain of knowledge which includes aspects of content knowledge, aspects of procedural knowledge, and aspects of epistemic knowledge.

The focus in this research is the analysis of scientific literacy instruments to determine the feasibility, reliability, different power and degree of difficulty of items in the domain of scientific literacy competency which consists of 3 aspects explaining scientific phenomena, identifying scientific issues and interpreting data and scientific evidence. For aspects of explaining scientific phenomena there are 2 indicators that will be used 1) Remembering and applying scientific knowledge in accordance with certain situations; 2) Identify, use and create simple picture models to explain

scientific phenomena encountered in everyday life. Aspects of identifying scientific issues with indicators 1) Propose a way to investigate certain issues scientifically and 2) Identify important elements in scientific inquiry. The last aspect is to interpret data and evidence scientifically with the indicators used 1) change the data from another form and 2) Analyze and interpret the data to make the right conclusions.

2. Research Method

This study aims to analyze the feasibility of a scientific literacy instrument on the theme of vibration, waves and sound integrated with the indigenous knowledge of Luwu, South Sulawesi, Indonesia. The research method used was descriptive research method that will describe qualitative and quantitative data. Qualitative data sources from the results of the question sheet that serves to determine the content validity of the scientific literacy instruments in terms of content, linguistic aspects, presentation techniques, answers and scientific literacy. To find out the quality of the scientific literacy instruments on the themes of vibration, wave and sound based on the indigenous knowledge of Luwu, South Sulawesi can be seen in table 1 [31].

Table 1. Quality of Instrument Scientific Literacy

Formula	Range	Category
$X \geq Xi + 1{,}8\ SBi$	X> 0,806	Very good
$Xi + 0{,}6\ SBi < X \leq Xi + 1{,}8\ Sbi$	$0{,}6 < \bar{X} \leq 0{,}806$	Good
$Xi - 1{,}8\ SBi < X \leq Xi + 0{,}6\ SBi$	$0{,}2 < \bar{X} \leq 0{,}6$	Less
$X \leq Xi - 1{,}8\ SBi$	$\bar{X} \leq 0{,}2$	Very Less

While quantitative data sources were obtained from students' answers that were analyzed using software Quests, the aspects that were analyzed quantitatively were differences in power, reliability and difficulty levels of items. The research subjects involved in the trial were 226 class IX students of SMP Negeri 1 Bua Ponrang and SMP Negeri 2 Bua Ponrang in the academic year 2019/2020. There are 13 items about scientific literacy that are tested in the form of multiple choice, fill the blank, and true false. Meanwhile, the aspect of scientific literacy is used to explain scientific phenomena, identify scientific issues and interpret data and scientific evidence. As for the categorization table of reliability, difficulty level of items and different power presented in tables 2 [32], 3 [33], and 4 [34].

Table 2. Interpretation of Reliability

Reliability	**Interpretation**
0.00-0.20	Very less reliable
0.20-0.40	Less reliable
0.40-0.60	Fairly reliable
0,60-0.80	Reliable
0.80-1.00	Very reliable

Table 3. Categorizing the level of difficulty item

Score	**Category**
b > 2	Very difficult
1< b ≤ 2	Difficult
-1 < b ≤ 1	Moderate
-1 > b ≥ 2	Easy
b > -2	Very easy

Table 4. Category of different power

Score	Category
< 0,00	Not good
0.00 – 0.20	Low
0.20 – 0.40	Enough
0.40 – 0.70	Good
0.70-1.00	Very good

3. Results and Discussion

The instrument of scientific simulation of vibration, wave and sound based on Luwu indigenous knowledge which is composed of 13 items in the form of multiple choice, essay, fill the blank and true false compiled based on aspects and indicators of the OECD. The aspect of explaining scientific phenomena consists of indicators remembering and applying scientific knowledge that are appropriate to a particular situation and identifying using and creating simple illustrative models to explain scientific phenomena encountered in daily life; the aspect of identifying scientific issues consisting of indicators suggests a way to investigate certain issues scientifically and recognize important elements in scientific inquiry; aspect of interpreting data and evidence scientifically with indicators changing data from another form and analyzing and interpreting data to draw conclusions. The results of the qualitative analysis conducted based on results of the study of the items from aspects of content, linguistic, presentation techniques, answers, and literacy conducted by 2 experts and 3 practitioners of Natural Sciences are presented in table 5.

Table 5. Evaluation result of validator lectureers and scince practitioners

Aspect	Rating result	Category
Content	0,96	Very good
Language	0,92	Very good
Presentation technique	1	Very good
Answer	1	Very good
Scientific Literacy	1	Very good

Based on table 5 shows that scientific literacy instruments were appropriate to be used in measuring students' scientific literacy abilities. In addition to assessing the experts also put forward suggestions for improvement of scientific literacy instruments which include 1) the use of sentences in item number 1was still difficult for students to understand, 2) for essay questions there were unclear answer rubrics, 3) complete units in all magnitude, 4) the numbers in the multiple choice answers should be sorted and 5) corrections for some inappropriate use of capital letters. After the scientific literacy instrument was revised, the instrument was tested on 226 class IX students of SMP Negeri in Luwu Regency, South Sulawesi, which were used to see the reliability, different power, and level of difficulty of the items analyzed using the software quest. The results were presented in table 6.

Table 6. Evaluation result of validator lectureers and scince practitioners

Type	Criteria	Result
Multiple choice, Essay	Reliability	0.6
	Average difficulty level	0.47
	Average power difference	0.36
Field, True false	Reliability	0.8
	Average difficulty level	-0.18
	Average power difference	0.49

Empirical data results obtained from 226 students in accordance with the results of a qualitative description of 2 experts and 3 practitioners stating that all items was in accordance with aspects and indicators of scientific literacy to be measured. Table 5 shows that the reliability of multiple choice questions and essays of 0.6 based on table 2 stated that the items are quite reliable while for fill the blank and true false questions have a reliability result of 0.8 which means the questions was very reliable. When viewed from the level of difficulty of the items for all multiple choice test instruments and essays included in the medium category as well as the type of fill the blank and true false questions. So the level of difficulty of the arranged test instruments included in the medium category. The results of the analysis of the difficulty level of items in detail of each aspects of scientific literacy instruments was presented in table 7.

Table 7. Level of difficulty item

Aspect	Number of item		
	Easy	**Moderate**	**Difficulty**
Explaning scientific phenomena	-	2, 7	1 , 4
Interpreting data and evidence scientifically	5	3, 6	13
Identifying scientific issues	8	9, 11, 12	10

Table 7 shows that the empirical test results data on students that the 2 items that was most easily found in the aspect of interpreting data and scientific evidence. Medium and difficult questions spread throughout all aspects of scientific literacy. So that all items were feasible to be used in subsequent experiment research based on the results of the analysis of the difficulty level of the problem. As for examples of items used in scientific literacy can be seen in table 8.

Table 8. The example of scientific literacy test items

Item Number	Question
2	Draw 4 patterns for the lute produced along with the similarities for each note!
5	If the lute being played has a string leghth of 5 m, a mass of 0.2 kg and the string is given a force of 100 N, then the wave propagates quickly….. a. 30 m/s b. 45 m/s c. 50 m/s d. 65 m/s
13	In order for sound waves to be heard, they must pass through the structures in the ear. Pay attention to the structure in the table and complete the blanks! Number — Ear structure 1. Auricle 2. Ear canal 3. 4. 5. Anvil bones 6. 7. cochlea 8.

The power of differentiation for all test instruments in the form of multiple choice and essay was 0.36 which was included in the sufficient category while the power of differentiation of the test instrument stuffing and correct is 0.49 in the good category. The results of the distinguishing power analysis for each test item was presented in table 9.

Table 9. Power difference of items

Category	Number of item
Not good (<0.00	-
Low (0.00 – 0.20)	-
Enough (0.20- 0.40)	1, 3, 6, 7, 9, 10
Good (0.40 – 0.80)	2, 4, 5, 8, 11, 12, 13
Very good (0.80 – 1.00)	-

The items were classified into five categories. Just The items that had enough, good, and very good categories were acceptable. If there were items that fall into the category of inadequate then it needed to be revised temporarily. for items that was not good category cannot be used or should be removed. Based on table 8 showed that 6 items included in the category enough and 7 items in the category very well. So based on empirical data there was no scientific literacy instrument based on the indigenous knowledge of Luwu, South Sulawesi, which needed to be revised and not used in further experiment research.

4. Conclusion

The Results of Analysis of scientific literacy instruments in natural science learning on the theme of vibration, waves, and sound based on indigenous knowledge was declared feasible in measuring students' scientific literacy abilities. While the results of empirical data analysis on 226 junior high school students all items were declared worthy to be used in measuring the ability of scientific literacy because the items had good reliability, distinguishing features and difficulty of items.

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TPACK level of teachers' inside and outside Yogyakarta in reading instruction for students with intellectual disabilities

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Abstract. This study aimed to explore the level of technological, pedagogical, and content knowledge (TPACK) of teachers in reading instruction for students with intellectual disabilities and to compare the TPACK level of teachers inside and outside Yogyakarta. This research used a quantitative approach with survey method. Respondents of the study were teachers of students with intellectual disabilities that showed lack in reading skills. The data collection method was through a survey using the TPACK instrument. The data analysis technique used was the descriptive statistical analysis technique and the comparative test using the independent sample t test. The results showed that all TPACK domain were in the good category. The t test calculation showed that there was no difference in the TPACK level between teachers inside and outside Yogyakarta. In conclusion, teachers' TPACK level is not differentiated by their location.

1. Introduction

The ability to read and understand written or printed text is part of social life. Reading ability is very important in school activities and daily life [1]. Individuals who have problems with reading will find it difficult to live independently [2]. In fact, limited reading ability can prevent students from having a normal standard of living, and it can be a big disadvantage for them in finding job opportunities [3, 4].

Intellectual disabilities (ID) is generally described as a condition of stunted intellectual function accompanied by deficits in adaptive behavior that reduces a person's ability to function independently [5]. Intellectual disabilities can be categorized into four levels, namely mild, moderate, severe, and profound. According to the American Psychiatric Association (APA) most of the individuals with ID (about 85%) have a mild type of condition [6]. Since most of them are included in the mild category and academic achievement is important for future success, it is important to determine how to overcome their specific academic needs in order to increase their success and their role in society [5].

There have been many changes in naming people with intellectual disabilities. The terms previously used such as idiot, mentally weak, mentally abnormal, stupid and mentally deficient are considered inappropriate and degrading [7]. The label currently suggested by The American Association on Intellectual and Development Disabilities (AAIDD) is intellectual disabilities (abbreviated as ID) [8]. Intellectual disabilities are characterized by significant limitations in intellectual function, adaptive behavior, and early age onset (before 18 years of age according to AAIDD; during the development period according to APA and WHO) [9].

Intellectual disabilities is also known as learning disabilities in general [10]. The impact of this intellectual disabilities can affect student performance in schools such as in reading, writing and

arithmetic [11]. In a study of adults with intellectual disabilities, all showed reading deficits, and 61% showed severe impairment of word identification [12]. For children with intellectual disabilities, reading is not easy when compared to children with normal development [13]. This is because they lack the ability of orthographic lexical representation, which is important to encourage reading speed [1].

Various ways have been made to help individuals with intellectual disabilities in learning how to read, including the use of technology. Technology can be integrated in learning through the Technological Pedagogical and Content Knowledge (TPACK) framework. TPACK is a combination of three knowledge domains, namely content, pedagogy, and technology in teaching. The TPACK framework is built on the PCK (pedagogical and content knowledge) description explained by [16] and how teachers' understanding of technology in education to produce effective teaching with technology [14]. Within this model, there are three main components of teacher knowledge: content, pedagogy, and technology. Equally important for this model, is the interaction between and among these domain of knowledge, represented as PCK, TCK (technology and content knowledge), TPK (technology pedagogical knowledge), and TPACK. The following is an explanation of each component [14, 15].

1. Content Knowledge (CK) is the teachers' knowledge of the subject matter to be studied or taught.
2. Pedagogical Knowledge (PK) is the teachers' in-depth knowledge of the processes and practices or methods of teaching and learning
3. Technological Knowledge (TK) refers to knowledge of various technologies, ranging from low technology and digital technologies such as the internet, digital video, and software programs.
4. Pedagogical and Content Knowledge (PCK) refers to content knowledge related to the teaching process [16]. This domain combines content and pedagogy to develop better teaching practices in the content area.
5. Technological and Content Knowledge (TCK) technology refers to knowledge of how technology can create new representations for certain content.
6. Technological Pedagogical Knowledge (TPK) refers to knowledge of how various technologies can be used in teaching
7. Technological Pedagogical and Content Knowledge (TPACK) is the knowledge needed by teachers to integrate technology into their teaching in any content area they teach.

Technology can be used to support the learning of students with intellectual disabilities [17]. Technology can also be used in learning to read. Research conducted by [18] on children with intellectual disabilities showed that learning with computers has the potential for classroom-based reading and increases motivation and enthusiasm for learning. This is because technology can interpret colors, sounds and computer images which can improve students' understanding of language in certain contexts [19]. The use of computers in teaching early reading in early childhood with intellectual disabilities also yielded positive results [20].

The use of technology seems very helpful for the implementation of reading instruction to students with intellectual disabilities. However, the use of technology in the learning process might bring up some arguments. Especially for educators who are not ready to use technology as a teaching media for students. Some evidence showed that teacher competence was still low based on the teacher competency test (Uji Kompetensi Guru/UKG) score. The quality of teachers in most parts of Indonesia based on the UKG results is still concerning, they are below the minimum competency standards set. Based on the UKG results, the national average achievement is only 53.02 or below the minimum competency standard set at 55.0 [21] Data from the Ministry of Education and Culture website [22] showed that Yogyakarta is the province with the highest average score (67.02) when compared to other provinces such as Central Java (63.30), East Java (60.75), Jakarta (62.58), Bali (60.12) and several provinces in Sumatra. This means that the level of teacher competence in the Yogyakarta region is arguably better than in other provinces. This difference in competence raises the question of whether there are also differences in the level of technology mastery of teacher inside and outside Yogyakarta in reading instruction for students with intellectual disabilities.

Observing the existing problems and the importance of reading skills for students with intellectual disabilities as well as the opportunity to use technology within the TPACK framework, it is necessary

to conduct a preliminary research. As a first step before implementing TPACK model, a preliminary study is needed to determine the TPACK level of teachers. Therefore, this study aimed to determine the level of TPACK teachers in reading instruction for students with intellectual disabilities. In addition, this study also intended to compare whether there are differences in the TPACK level of teachers inside and outside Yogyakarta.

2. Research Methods

2.1. Research Design

This study used a quantitative approach while the type of research was a survey research. Therefore, the data collection was done by using a survey method.

2.2. Respondents

Respondents of this study were teachers of students with intellectual disabilities who experienced problems in reading skills both in inclusive schools and in special schools with N = 31. The respondents were from Java, Bali, and Sumatera islands.

2.3. Research Instrument

The instrument used by researchers was the TPACK Survey which was developed and validated by [23] with total survey items amounted 37 items on a Likert scale with 4 levels (from 1-strongly disagree to 4-strongly agree). The calculations made by [23] showed that the reliability coefficient value for all instruments was 0.950 (very good).

2.4. Data Analysis

Data analysis was carried out with descriptive statistics and t test to compare the TPACK level of teachers inside and outside Yogyakarta. Descriptive analysis was carried out by representing and interpreting categories of data to see the TPACK level based on each domain using [24] categorization. First, the data is processed with the following formula:

$$P = \frac{f}{N} \; x \; 100$$

P = value
F = obtained value
N = maximum value

The values obtained were then entered into categorization according to [24] with the TPACK mastery criteria presented as follows:

Table 1. Teachers' TPACK Level

Value	Criteria
84- 100	Very good
68- 83	Good
52- 67	Enough
36- 51	Low
≤ 35	Very low

3. Result

3.1. Teachers' TPACK Level in Reading Instruction for Students with Intellectual Disabilities

The survey instrument was sent via the google form and then the respondents sent back their responses online. This survey was conducted within one week from 9 to 16 July 2020. Based on the results of data

collection from 31 respondents, the following table were obtained about the TPACK level of teachers in reading instruction for students with intellectual disabilities.

Table 2. Teacher TPACK Level

TPACK Domain	Mean	Standard deviation	Criteria
TK	72.17	10.80	Good
CK	72.07	8.14	Good
PK	77.72	8.35	Good
PCK	73.92	5.37	Good
TPK	72.98	7.46	Good
TCK	77.01	7.80	Good
TPACK	74.42	6.32	Good
Total Average	74.32	2.25	Good

In general, it can be seen that each domain is included in the good category with an average value above 72. The total average of all TPACK domain is also in the good category. This means that the teachers have a good level in TK, CK, PK, PCK, TPK, TCK, and TPACK. Comparing all domains, PK is seen to be the domain with the highest score with mean (77.72) followed by TCK (77.01). Teachers seem to have a high level of pedagogical knowledge. Meanwhile, CK and TK are the domains with the lowest scores, respectively (72.07 and 72.17).

3.2. Comparison of Teachers' TPACK Level in and outside Yogyakarta

The next analysis was carried out to determine whether there is a difference in the level TPACK of teachers based on location (inside and outside the city of Yogyakarta). TPACK data were compared with an independent sample t test. The results of TPACK level analysis based on location are presented in the following table.

Table 3. Comparison of Teachers' TPACK Level by Location

TPACK Domain	Inside Yogyakarta		Outside Yogyakarta		t	Conclusion
	Mean	SD	Mean	SD		
TK	72.91	8.57	71.15	13.63	0.52	Ho accepted
CK	69.96	6.95	75.00	9.02	-2.16	Ho accepted
PK	74.65	3.99	81.73	10.96	-2.71	Ho accepted
PCK	73.38	4.55	74.67	6.46	-0.78	Ho accepted
TPK	71.52	6.51	75.00	8.46	-1.58	Ho accepted
TCK	76.04	8.64	78.36	6.56	-1.16	Ho accepted
TPACK	73.01	5.90	76.94	6.60	-2.2	Ho accepted

Based on the results of calculations that have been done, it was known the t value in each domain. The t value in the t table with a significance level of 0.05 indicated the value of t = 2.04. Furthermore, the t value in the table was compared with the calculated t value. It can be seen that in each domain, the value of t table is greater than the value of t (t table> t counted) so that Ho is accepted and Ha is rejected. With Ho accepted in each domain, it can be concluded that there is no difference in the TPACK level between teachers inside and outside Yogyakarta. In other words, in the domain of TK, CK, PK, PCK, TPK, TCK and TPACK, there is no difference in the level of mastery. This means that teachers' TPACK level is not differentiated by location.

4. Discussion

This study aimed to explore the level of technological, pedagogical, and content knowledge (TPACK) of teachers in reading instruction for students with intellectual disabilities and to compare the level of TPACK of teachers inside and outside Yogyakarta. This study found that every domain of TPACK was included in the good category. This means that teachers have good confidence in their ability to integrate technology in the teaching and learning process of reading skills in children with intellectual disabilities. These findings are in line with the results of research conducted by other researchers [22, 26]. Comparing all domains, PK was the domain with the highest mean value. This is in accordance with the results of previous research [27]. CK and TK were the domains with the lowest scores, respectively. TK was only slightly ahead of CK. This finding confirms the findings of the previous opinion that the competencies related to technology are of lower value [26, 27]. However, there is a contradiction in the CK domain with previous findings. Another study found that special school teachers showed high CK levels [26,27].

The comparative t test in the study showed that there was no difference in the TPACK level between teachers inside and outside Yogyakarta. This is probably because almost all respondents are young teachers with an age range from 23-26 years so that they are more familiar with the use and integration of technology into reading instruction for students. This reason is reinforced by the opinion of [28] who reported that teachers with older age and more teaching experience tend to have less technological knowledge and ICT integration so that they can have moderate barriers to implementing technology in the learning environment. However, the results of other studies found that the level of TPACK was not influenced by age [25, 29, 30]. This shows that there is still no clarity regarding the TPACK level based on age. However, the abundance of information that can be accessed online about how to integrate technology in learning may also reduce the gap between regions. Nowadays, web-based professional development programs are increasingly popular so that teachers can learn independently to increase the knowledge of technology needed in reading instruction they might need [28]. So it is possible that regional disparities and differences in the level of technology mastery in various regions have begun to decrease.

Helping students with intellectual disabilities in reading instruction with technology integration seems to have positive results [18, 20]. This is because technology can interpret colours, sounds and images that can help students understand the lesson more easily [19]. Therefore, there is a need for good mastery of technology for teachers to be able to integrate it in reading instruction for students with intellectual disabilities. With TK mean value considerably lower than the average value of other domains, it is necessary to improve these competencies. Teachers who show a lack level of technological competence in the TPACK framework need support to improve their educational services [28]. Teacher professional development programs that were designed according to the TPACK framework have produced positive results in increasing teachers' TPACK competence among teachers [31, 32], so that teachers can propose a similar program to help teachers integrating technology into the learning process [28].

5. Conclusion

The results of this study found that all TPACK domains were included in good category. This means that the teachers have a good level in TK, CK, PK, PCK, TPK, TCK, and TPACK. In addition, the t test calculation showed that there was no difference in every TPACK domain between teachers inside and outside Yogyakarta. In other words, in the domain of TK, CK, PK, PCK, TPK, TCK and TPACK, there is no difference in the mastery level. This means that teachers' TPACK level is not differentiated by their location.

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Analysis of the Implementation of E Learning Strategies in Teaching at the Faculty of Mathematics and Natural Sciences, Universitas Negeri Gorontalo (UNG) During the Covid-19 Pandemic

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Abstract. Research has been carried out that aims to analyze e-learning strategies at the Faculty of Mathematics and Natural Sciences, UNG. The main question in research is how the teaching strategy carried out at the Faculty of Mathematics and Natural Sciences during the Covid-19 Pandemic. The research method used was mixed method through a sequential explanatory strategy. Data obtained through a survey on students of the Faculty of Mathematics and Natural Sciences UNG explained by interviews of students and lecturers of the Faculty of Mathematics and Natural Sciences, UNG. The results showed that most of the teaching at the Faculty of Mathematics and Natural Sciences UNG was carried out through E-learning teaching. Various E learning teaching strategies have been carried out during the Covid 19 pandemic, including through assignments and discussions, virtual face-to-face, video and audio uploads. Teaching E learning using several platforms including Learning Management System (LMS) such as the Google classroom Edmodo and the SIAT UNG application, teaching is also carried out with social media assistance. Some of the obstacles that have been found during the implementation of E-Learning teaching include: knowledge about the use of the E Learning platform / application, the availability of internet access quotas and internet networks that do not support the teaching process of E-learning. The general conclusion of the implementation of e-learning teaching at the Faculty of Mathematics and Natural Sciences, UNG, in general, students gave a positive response to teaching E Learning at the Faculty of Mathematics and Science, UNG in the emergency response to Covid-19.

Keywords: E Learning, Platforms, Learning strategies, The Covid-19 pandemic

1. Introduction

Online learning or better known as e-learning is learning that is recommended in the era of digitalization. This learning is recommended because almost all activities in the digitalization era or industrial era 4.0 have mostly been carried out through digital activities such as shopping activities which are mostly done through online shopping. Some online shopping platforms such as: Lazada, shoope, bukalapak and others. Meanwhile, the teaching and learning activities of several platforms are used, including google classroom, edmodo, and others.

The definition of e-Learning means learning through electronic media, such as radio, television, video, CD-ROM, computer networks. Now, e-learning means learning and teaching over the internet. Students and teachers, in this case teachers or lecturers, can learn using resources in the internet system

to learn and teach to be more effective [1]. E-learning is a transformation of the existing learning process at school or college into a digital form that is bridged by internet technology. The implementation of E-learning in education in particular has not been maximally implemented. This is indicated by the minimal use of the internet or applications for teaching activities such as use for E-learning activities [2] [3].

Since entering the Covid-19 pandemic that has hit around the world, all teachers are required to carry out learning and teaching activities from home. E-learning learning is one that is required in the world of education from elementary to university level. In general, universities already have an E-learning learning system created, but activities are very limited. Especially for UNG, it already has E-learning through SIAT. The Covid-19 emergency response requires teachers and students to study and carry out online learning. Teachers and students need adjustments in implementing online teaching.

Teachers and students who were initially reluctant to carry out learning and teaching E-learning, tried to learn and implement it. Basically, E-learning can support learning but during the Covid 19 pandemic it became a major teaching strategy. Teachers are expected to make optimal use of ICT to facilitate innovative teaching activities. A student-centered teaching strategy is very suitable to encourage the development of students' knowledge and skills. In this global world, students are not enough to just know information and remember facts, but they must be able to think critically, and solve problems, and have the skills to communicate and work together. In addition, students must be able to adapt, have initiative, be able to access and analyze information and have high curiosity. One way to increase motivation in using multimedia is by providing activities. Therefore, a multimedia learning must be interactive, so as to provide opportunities for students to move.

The delivery of material in E-learning can use an E-learning approach which consists of: synchronous and asynchronous. Synchronous is learning that occurs via real-time electronics, for example through video or audio conferencing activities, and chat. Asynchronous learning events that are free of time (self-paced learning). For example: learning via e-mail, discussion forums, Wiki, Blog, Webcasting, video and or audio files. Asynchronous can be categorized into 2, namely rapid E-learning and traditional E-learning. rapid E-learning is asynchronous learning which contains content / material that is updated regularly, while traditional E-learning contains content that lasts very long because it rarely changes [4].

Divides learning related to E learning and Blended Learning into two parts, namely: synchronous learning and asynchronous learning. Synchronous learning is a learning process that occurs simultaneously between students and teachers even though they are not in the same place. Asynchronous learning is the process of learning between students and teachers at different times and places. Some examples of synchronous activities include face-to-face or virtual face-to-face activities. Meanwhile, asynchronous learning activities where students and teachers may be at different times and places. Examples of asynchronous learning activities such as unscheduled discussion forums, work on assignments and others [5].

2. Method

The research method used is a mixed method. Mixed research combines two forms of research methods, namely quantitative and qualitative. Quantitative data is used to explain qualitative data or otherwise. The strategy chosen is a sequential explanatory strategy. Explanatory strategies are usually used to explain and interpret quantitative results based on the results of collecting and analyzing qualitative data [6]. The survey was conducted on 402 students from the Faculty of Mathematics and Natural Sciences UNG which were spread over 5 departments. After conducting the survey, it was continued with interviews conducted with several students and lecturers.

A survey questionnaire was prepared related to the E learning strategy at the Faculty of Mathematics and Natural Sciences, UNG. In some questionnaire items, students can choose more than one option provided, there are also questionnaires that are only given one choice per student. The interview was arranged in an unstructured manner but was related to the questions in the E Learning survey questionnaire.

3. Results and Discussion

The results of surveys and interviews related to teaching strategies at the Faculty of Mathematics and Natural Sciences show that teaching during the Covid-19 pandemic was carried out online, was postponed or had not been implemented, assignments, and assignments in the form of projects.

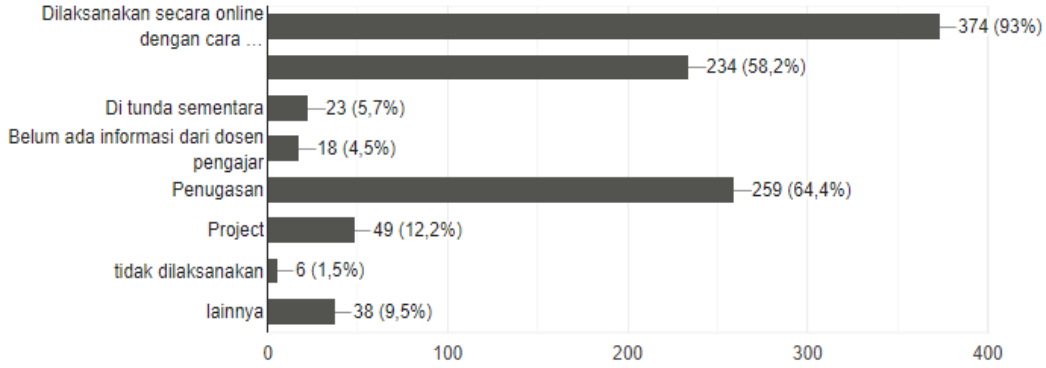

Figure 1. Teaching Implementation Strategy During the Covid-19 Pandemic at the Faculty of Mathematics and Natural Sciences, UNG

Figure 1 shows the highest percentage of teaching in a pandemic is done through online teaching, hereinafter referred to as E learning. There are several teachings that have been postponed or have not been implemented because they are related to the implementation of experiments carried out in the laboratory. Other teaching activities are carried out through assignments in various forms. E learning teaching at the Faculty of Mathematics and Natural Sciences UNG is implemented through various strategies. Several E learning teaching strategies at the Faculty of Mathematics and Natural Sciences UNG, as shown in Figure 2.

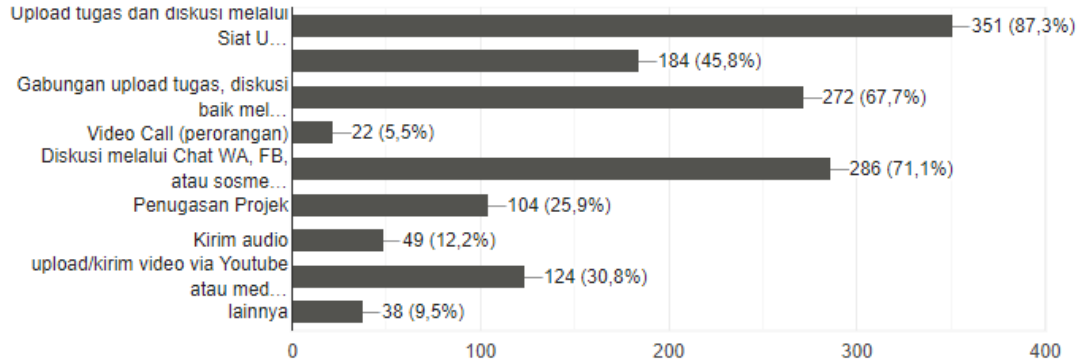

Figure 2. E Learning Teaching Strategy at the Faculty of Mathematics and Natural Sciences, UNG

The strategy with the highest percentage was uploading assignments on various E learning teaching platforms such as google classroom, Edmodo, SIAT UNG, and others (87.3%); chatting through various platforms such as social media and others (71%), virtual face-to-face learning or what is known as video conferencing (45%); video upload (30, 8%); project assignment (25.9%); upload audio (12, 2%), face to face virtual person (5.5%), others (9.5%).

The survey and interview results also show that from the implementation of E learning teaching at the Faculty of Mathematics and Natural Sciences, UNG, the strategy that most teachers respond to student questions or statements is the discussion strategy on all platforms. The second order percentage, the task upload strategy, the third order percentage via video conferencing and the last order percentage is video or audio uploads. The teacher gave the most responses during discussion activities on all E learning platforms. The interview from the teacher stated that discussion activities on E learning were

carried out after giving assignments to students related to the concepts or topics to be discussed. Discussion activities are scheduled and unscheduled (have a long duration). Real time (synchronous) discussion activities get a direct response by the teacher, but discussion activities that are not real time (asynchronous) often get a slow response or even not by the teacher. This is consistent with previous research by Rivalina (2017) who found several reasons for teachers not responding to E learning discussions, including: (1) most students took advantage of e-learning in the afternoon until evening after they returned from work; (2) the material provided during the E-learning will be discussed again at the face-to-face meeting [7].

In general, teaching E learning during the Covid-19 pandemic at the Faculty of Mathematics and Natural Sciences, UNG through two main parts, namely: synchronous and asynchronous teaching. Synchronous teaching strategies through virtual face-to-face either via video or audio and discussions via live scheduled chats on various platforms. Asynchronous teaching through unscheduled assignments and discussions. Synchronous E learning is mostly taught through face-to-face teaching virtually with students. The platforms used in virtual face-to-face teaching include: zoom meeting, google meet, Vicon E learning UNG and Jitse meet. As shown in Figure 2.

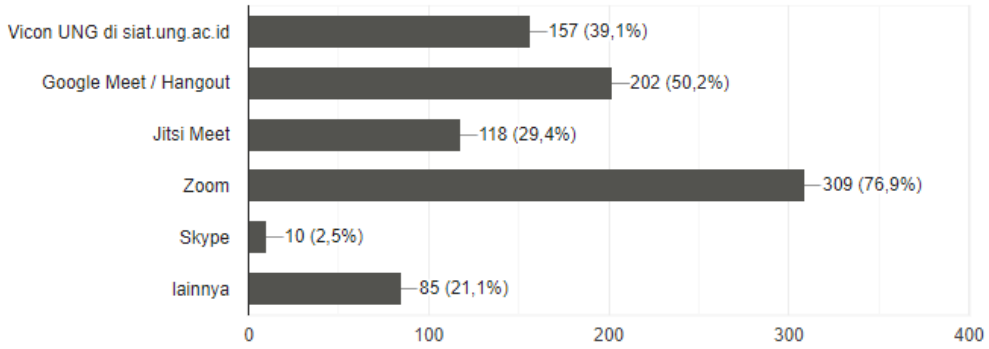

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Figure 3. E-learning teaching strategy is synchronous with face to face virtual in the Faculty of Mathematics and Natural Sciences, UNG

Figure 3.Shows the percentage of teaching using a virtual face-to-face platform with the highest percentage in order, is the use of zoom meetings (76.9%), google meetings (50.2%) and Vicon UNG (39, 1%), Jitsi meet (29, 4%) and Skype (2.5%). For virtual face-to-face use with other media, around 21%, other media are social media platforms that can conduct video conferencing.

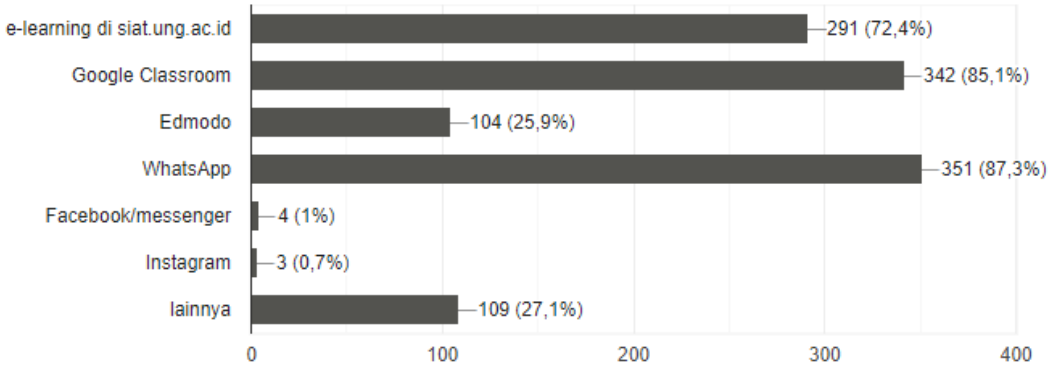


Figure 4. Platform in Teaching E Learning with methods other than face to face virtual

From Figure 4. It shows that teaching using platforms other than face-to-face virtual also varies with the highest percentages, respectively, using WhatssApp (87.3%), Google Classroom (85.1%), Siat UNG (72.4%), Edmodo (25 , 9%). The platform in teaching E Learning with a non-face-to-face strategy is synchronous and a synchronous because the platform can be used scheduled and unscheduled. For teaching that can be synchronous and asynchronous through the assistance of social media (WhatsApp),

google classrooms, E learning on UNG, other media. The E Learning platform is the most widely used as mentioned above with the largest order using WhatsApp, google classroom, e-learning on UNG, and other media. The advantage of the E learning platform is that it is not face-to-face virtual, it does not use large internet access quotas. While one drawback is the lack of direct interaction between students and teachers.

The results of teacher and student interviews about teaching using virtual face-to-face have advantages including students being able to interact directly with the teacher. Teachers can have direct discussions related to the concepts being learned. Teachers can also share material and discuss it sequentially. On some E learning platforms the teacher records teaching activities and can be shared again for learning. Weaknesses of using virtual face-to-face include: (1) internet access quotas of large data usage, so that not all students join teaching activities, (2) some students are on an internet access network that does not support for face-to-face virtual / video conference activities , (3) some students sometimes turn off the camera during video conferencing so that it is difficult to detect activities carried out in accordance with teaching or not in accordance with teaching activities.

One of the factors that causes the implementation of E learning to be less than optimal, both teachers and students lack knowledge in using platforms or applications related to E learning. Regarding training on the use of the E learning application as shown in Figure 6. Social media applications are widely used by teachers and students in learning E learning during the Covid-19 pandemic because it is easy to use and all students and teachers are familiar with social media platforms. Meanwhile, other learning applications that are Learning Management System (LMS) are underutilized by teachers and students because they require knowledge in their use. E learning at UNG has adequate E learning facilities for activities that carry out attendance according to the number of meetings, assignments, materials, even for video conferencing, as shown in Figure 5.

Teaching facilities at the Faculty of Mathematics and Natural Sciences UNG, either face-to-face virtual or not face-to-face, are available through E learning UNG, known as SIAT UNG. From Figure 3 and Figure 4, SIAT UNG E Learning teaching is not the main choice as a platform in teaching during the Covid-19 pandemic. E learning facilities at UNG are generally complete, both face-to-face virtual and non-face-to-face teaching. The E learning platform of UNG is shown in Figure 5

Figure 5. SIAT UNG E Learning Platform

Figure 5. shows that the E learning facility known as SIAT UNG has covered the entire learning process from attendance, material giving, assignments and even face-to-face virtual work which is also available through the UNG vicon. UNG has required the use of SIAT to perform attendance, input assignment scores, exams, and final grades. However, the use of E learning has not become an obligation for teaching. E learning SIAT UNG needs to get socialization through training for both students and teachers. The need for the introduction and training of E learning both related to the UNG SIAT platform or other platforms. Students state that training related to E learning is obtained from various sources and training places. Figure 6 shows the introduction and training of E learning obtained by students of the Faculty of Mathematics and Natural Sciences, UNG.

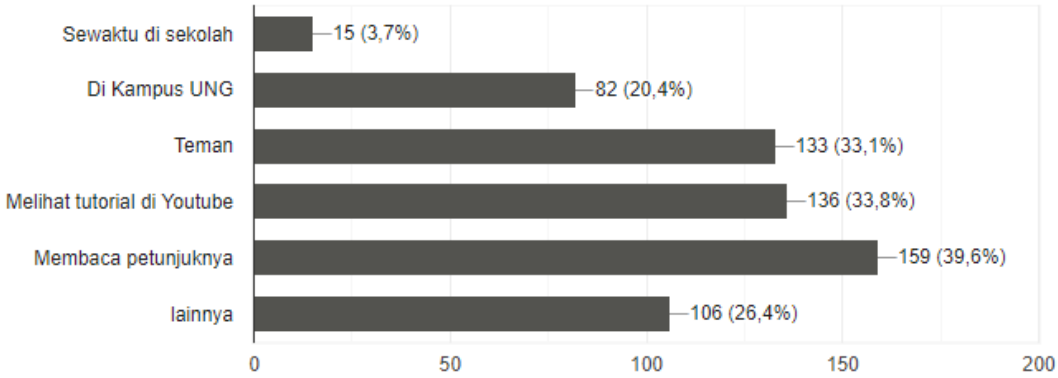
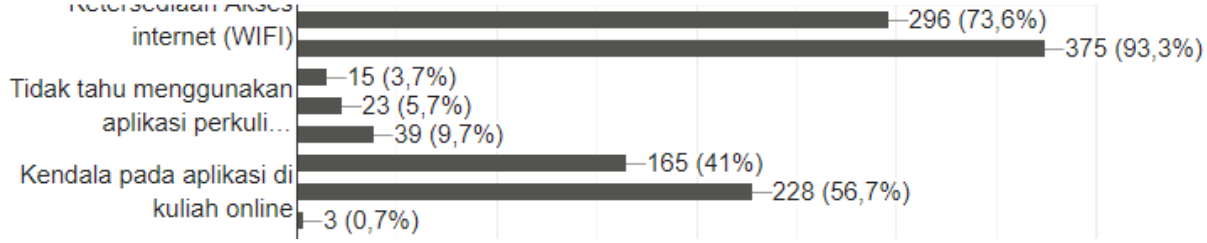


Figure 6. Places and Sources of Introduction to E Learning for Students of the Faculty of Mathematics and Natural Sciences, UNG

Figure 6 shows various sources and places to obtain information and an introduction to E learning for students of the Faculty of Mathematics and Natural Sciences, UNG. The percentage of all sources and places where it is absent reaches half. The highest to lowest percentage of sources and places of introduction to E learning for Mathematics and Natural Sciences Faculty students are reading instructions from books, tutorials on YouTube, friends. While the place for E learning identifiers for FMIPA UNG students is the highest percentage on the UNG campus and the lowest is at their home school. The percentage of obstacles related to the introduction of a learning platform or application as shown in Figure 7 shows a fairly high percentage, namely 56.7%.

The need for introducing E learning training in teaching and learning on campus has been revealed by previous research. The university should pay attention to the difficulties of students and teachers in implementing E learning [8]. This difficulty is related to the various abilities of students and teachers in implementing digital learning. The ability of students for digital activities is very high but for teaching it needs attention because students' knowledge is diverse about the application.

In addition to the constraints related to knowledge about the E learning platform / application, students of the Faculty of Mathematics and Natural Sciences UNG also experience several obstacles in teaching E learning, this is shown in Figure 7.



Gambar 7. Menunjukkan kendala terkait Pengajaran dengan E learning di Fakultas MIPA UNG

In implementing the e learning strategy in teaching students, there are various obstacles. The biggest obstacle is the availability of internet access quotas (93.3%) and the existence of internet network access according to 73.3%, knowledge of platforms / applications 56.7%. For facilities such as smartphones and laptops, it is very small, namely: 3.7%. Previous research also by Popovici & Mironov (2015) found that E learning-related facilities or hardware (smartphone or ipad) were mostly owned by students [8]. Related to the constraints on the availability of internet access quotas in the implementation of E learning teaching at UNG. Higher education leaders, in this case the Chancellor of UNG, provided internet access quotas to all UNG students including students of the Faculty of Mathematics and Natural Sciences [9]. This package assistance is highly expected by students, a survey of students of the Faculty of Mathematics and Natural Sciences showed 92.8% stated that internet access quotas assistance was very necessary, 5% said it was necessary, 1.5% was quite necessary and only 0.5% was not necessary. How necessary internet access quotas is in the implementation of E learning teaching.

In general, the implementation of teaching E Learning for the Covid-19 emergency response mass received a positive response by students of the Faculty of Mathematics and Natural Sciences, UNG. Students expressed very satisfied with 7.5% very satisfied, 46.5% satisfied responses, 37.6% quite satisfied, 7.2% dissatisfied and 1.2% very dissatisfied. E learning teaching is a teaching strategy that is one of the main options applied to situations that are not normal, such as during a pandemic. Research Omer (2015) teaching E learning that was applied to previous abnormal situations also showed a positive response shown by students in a post-conflict / war country. E learning reduces the effects of isolation or quarantine caused by various factors such as pandemics and conflicts. The empirical findings of this study require the promotion of the use and improvement of the experience of teaching E learning on campus in abnormal circumstances such as conflict [10].

Through E learning, it helps students of the Faculty of Mathematics and Natural Sciences, UNG, especially in learning independently. students must be more active in searching for various concepts that are learned not only from the teacher, which has been the main thing in campus teaching in normal situations. The results of research by Tubaishat & Lansari (2011) found that there was a high level of acceptance in adopting e-learning in educational institutions. High percentage of students who think that E-learning can contribute positively to student learning experiences; E-Learning can help students to build confidence in learning and become independent learners compared to previous learning that relied on face-to-face learning. Students are required to learn with less social interaction either with peers or with instructors [11] [12].

4. Conclusion

From the results of the survey and interview it was concluded that most of the teaching at the Faculty of Mathematics and Natural Sciences UNG during the Covid-19 emergency response was carried out through E learning. Various E learning teaching strategies have been implemented during the Covid-19 pandemic, including through virtual face-to-face (video conferencing), teaching using LMS such as google classroom, Edmodo and the SIAT UNG application, and social media assisted teaching. Various obstacles were encountered in the implementation of teaching E learning, especially the availability of an internet access network, internet access quotas for students teaching E learning and the introduction of the E learning platform to students and teachers. The general conclusion that the implementation of E learning teaching by Mathematics and Natural Sciences faculty students during the Covid 19 emergency response generally received a positive response with ratings above 90% expressed satisfaction.

5. Acknowledgments

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Analysis of Problem Solving Instruments in Science Learning Based on NGSS by Utilizing the Local Potential of PPLH Puntondo Takalar, South Sulawesi

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Abstract. This study aims to produce instruments that are feasible and meet the requirements to be tested in schools in natural science learning that are associated with NGSS learning standards for the interaction of living things with the environment by utilizing the local potential of PPLH Puntondo in Takalar Regency, South Sulawesi. This research uses descriptive qualitative and quantitative methods. The subjects in this study were students of VIII State Junior High School in Takalar Regency totaling 180 people in the even semester of the 2019/2020 academic year. Data collection techniques were carried out using product assessment instruments (expert lecturers, practitioners, and peer reviews), and student test instruments. The results of this study indicate that 80% of test items are accepted and declared to be fit for use, 10% of test items are declared to be revised before they are used in school, and 10% of test items that are declared rejected and are not suitable for use. Thus, the test instruments developed can be used in junior high schools to measure students' problem solving abilities in the material interaction of living things with the environment.

1. Introduction

The world is currently entering the 21st century which is marked by the development of science and technology that is progressing very rapidly. Every person is required to be able to compete globally and be able to develop themselves to follow world developments [1]. The development of the 21st century is very helpful and facilitates human life that is able to balance the development of science and technology that is happening. However, to realize this requires several abilities and skills, one of which is ways of thinking [2], [3]. This skill is a group of thinking skills that are divided into 1) creative and innovative, 2) critical thinking and problem solving, 3) learning how to learn and metacognition abilities [4]. This is in line with the challenges that exist in the world of education to improve the quality of superior human resources. Industry 4.0 revolution directs how students are able to change the way of learning, thinking patterns and how to develop innovation in various fields. Students are not only focused on achieving competence and knowledge, but also need to be trained to master a number of skills that support world competition [5].

Next Generation Science Standards (NGSS) are international education standards that must be achieved by students in the field of science by involving engineering, technology and application of science that can train students more actively in learning [6]. NGSS is integrated into three dimensions

of learning, science and engineering practices (SEPs), crosscutting concepts (CCs) and diciplinary core ideas (DCIs). Each dimension is divided into several choices that can be adjusted to the conditions that you want to measure. Dimension The integration of the reality of the NGSS dimension helps provide opportunities for students to develop the skills and abilities needed in the 21st century, namely problem solving, critical thinking and communication [7].

Preparation to face the challenges of the 21st century requires skills and problem solving skills so that students are able to compete globally in this century, students are able to find their own problem solutions in the life to come, and be able to think at a high level [8], [9], [10], [11]. Problem solving is the process of identifying, understanding a problem and asking important questions that can explain various points of view of a problem so that it can produce the right solution [12], [13]. Problem solving is the initial process in identifying problems, making considerations in solving problems and making decisions based on some information [14]. The problem solving process requires a variety of information, bringing up various perspectives that are combined to solve a problem [15].

Problem solving skills need to be measured by an appropriate test instrument. Profile of students' abilities is obtained from the preparation of good and appropriate instruments. The students' problem solving abilities can be identified by the existence of measurable problem solving indicators. The initial step in the design of test instruments is the analysis of literature related to the ability and indicators of problem solving. The design of the problem solving test instrument refers to the problem solving indicator by Bagno & Eylon in 1997 which put forward 5 indicators namely problem solving, reflecting, conceptualizing, applying, and connecting [16]. Other indicators are also explained by Ohlsson which include problem perception, retrieval action, decision making, outcome evaluation, and problem finding [17]. Another opinion was also put forward by Carlgren that indicators of problem solving are managing problem solving strategies, making a list of possibilities, exploring strategies, and evaluating strategies [18].

There are 5 indicators of problem solving that can be used based on the analysis of indicators of several opinions, namely 1) identifying the components of the problem, 2) understanding the causal relationship of the problem, 3) designing the solution to the problem, 4) implementing the planned solution, 5) evaluating the suitability of the solution in solving [16], [17], [18]. Achievement in measuring problem solving abilities can be supported by the inclusion of NGSS learning standards in the form of SEPs analyzing and interpreting data skills, the dimensions of CCs understanding in the form of cause and effect and the DCIs dimension related to learning material, namely the interaction of living things with the environment [19].

Problem solving learning can help students in understanding the concept of science. One of the targets in science learning is that students can apply science concepts in daily life by linking them to local culture. Law N0. 32 of 2013 concerning the National Education System states "learning for each education unit must contain content and learning processes related to local potential and uniqueness in accordance with their respective regions" [20].

Integrating local potential in subject matter can help students understand concepts correctly and contextually [21]. In accordance with the DCIs NGSS dimensions, the material used in the test instrument is the interaction of living things with the environment that can be linked to the local potential of PPLH Puntondo in Takalar District, South Sulawesi. PPLH Puntondo is a natural tourist spot that offers environmental education programs that help students learn firsthand about things related to the environment. Science learning that is associated with local potential can train students in making a direct observation, finding various problems and finally being able to find a solution [22]. To find out the problem solving abilities of students who will support in facing the challenges of the 21st century, it is necessary to have a problem solving instrument that is feasible and can be used in schools as an instrument to measure students' problem solving abilities. This is the urgency that is the basis for conducting research into the analysis of problem solving instruments in NGSS-based science learning by utilizing the local potential of PPLH Puntondo. The target to be achieved in this research is the existence of problem solving instruments that are considered feasible and suitable to be tested in schools, especially in South Sulawesi in measuring students' problem solving abilities.

2. Research Method

This research aims to produce a problem solving instrument that is feasible and can be used in school trials in NGSS-based science learning by utilizing the local potential of PPLH Puntondo. This study uses descriptive qualitative and quantitative methods [23]. Retrieval of qualitative data is done through non-test techniques in the form of validation sheets of assessment instruments and validation sheets of problem solving items by expert lecturers, practitioners and peer reviews. While taking quantitative data through test techniques provided to students. The test sample consisted of 180 grade VIII students from SMPN 2 Takalar, SMPN 4 Takalar, SMPN 2 Mangarabombang, and SMPN 4 Mangarabombang in Takalar Regency, South Sulawesi in the academic year 2019/2020. Students are chosen through a random sampling method.

Problem-solving test instrument consisting of 10 essay items. The problem solving test instrument is designed based on the Next Generation Science Standards (NGSS) which shows the dimensions of Analyzing and Interpreting Data and Cause and Effect. The item items are made by characterizing the local potential of PPLH Puntondo so that it is more specific. The selection of test forms in the form of essays is based on the theory that the form of essay tests is useful for measuring complex achievement indicators [24].

Data were analyzed using qualitative and quantitative techniques. Qualitative analysis is carried out through the results of the validation assessment that is used to analyze and describe the results in terms of aspects of the instrument components of the questions, items, language and appearance. Qualitative analysis was also carried out on the validation result sheet for each item arranged based on 5 problem solving indicators consisting of identifying problem components, understanding the causal relationship of problems, designing problem solving, implementing solutions to a problem, and evaluating the suitability of solutions in solving problems. While quantitative analysis is used to determine the level of validity and reliability of each item from the results of the students' problem solving test answers. The quality of students' answers is judged based on the scoring guidelines of 0-3 scale problem solving which are then analyzed with the help of QUEST. The acquisition of qualitative and quantitative analysis is then used as material to revise problem solving problems. The following tables categorizes the results of data analysis:

Table 1. Ideal evaluation criteria

Range of Scores (y)	Values	Category
$X \geq Xi + 1{,}8.SBi$	A	Very decent
$Xi + 0.6\,SBi < X \leq Xi + 1{,}8\,SBi$	B	Worthy
$Xi - 0.6\,SBi < X \leq Xi + 0{,}6\,SBi$	C	Decent enough
$Xi - 1{,}8\,SBi < X \leq Xi - 0{,}6\,SBi$	D	Inadequate
$X \leq Xi - 1{,}8\,SBi$	E	Very Inadequate

[25]

Table 2. Interpretation of reliability values

Value of Reliability	Interpretation
0,00 – 0,20	Very less reliable
0,20 – 0,40	Not Reliable
0,40 – 0,60	Reliable
0,60 – 0,80	Reliable
0,80 – 1,00	Very reliable

[26]

Table 3. Difficulty level criteria

Value of Threshold	Category
$b > 2$	Very difficult
$1 < b \leq 2$	Hard
$-1 \leq b \leq 1$	Medium
$-1 \leq b \geq -2$	Easy
$b < 2$	Very easy

[27]

Table 4. Differential Power Criteria

Value	Category
Negative Signed	Very bad
0,00 – 0,20	Bad
0,21 – 0,40	Enough
0,41 – 0,70	Well
0,71 – 1,00	Very well

[28]

3. Result and Discussion

3.1. Characteristics of Test Instruments Problem Solving Capabilities

This research was conducted to produce an instrument for solving NGSS-based science learning problems by utilizing the potential of a local PPLH Puntondo that is feasible and can be tested in schools. The problem solving test instrument was designed with 10 items of essays which were formulated based on five indicators of problem solving ability using the material interaction of living things with the environment that was integrated with the local potential of PPLH Puntondo in Takalar District.

The design of the test instrument is based on 5 indicators namely first identifying the problem components, which shows how the students' ability to identify the components contained in a given problem. The second indicator understands the cause and effect relationship, where students are expected to be able to build knowledge by trying to show the cause and effect relationship between a problem. The third indicator is designing problem solving, how students make a strategy or design in solving a problem. The fourth indicator applies the planned solution, students are able to choose a logical and relevant solution to solve the problem. The fifth indicator evaluates the suitability of the solution in solving problems, students check and analyze the effect of the solution that has been applied whether or not according to [16], [17], [18].

1. Indicators: Identify the components of the problem
   Read the discourse below!
   PPLH Puntondo natural tourism location is built based on the local community's sense of concern for the preservation of an environment. PPLH Puntondo as clear evidence of the various environmental damage that occurs along the coast that threatens coastal vegetation and marine ecosystems such as mangroves, destruction of coral reefs and bombing of fish. Local people who are predominantly fishermen have made the Marine Ecosystem of PPLH Puntondo a source of income by fishing through sea bombing. From this discourse, what problems are going on and what will happen to the conditions of the living beings affected by the bombing?
2. Indicators: Evaluating the suitability of solutions in solving problems
   Rabita and her friends are carrying out field research assignments in the tourist area of PPLH Puntondo. The research resulted in the discovery of interactions in the form of weaver ants making nests on mango trees. According to Rabita, the interaction formed is a symbiosis of mutualism. Tell in your opinion, is the opinion of the Rabita correct or not?

Figure 1. The example of problem solving items

The developed test instrument also characterizes the NGSS skill dimension in the form of analyzing and interpreting data, where the questions show that students need to analyze data to be able to answer a problem [19], [29]. The dimension of understanding of NGSS is also raised in the form of

cause and effect, which is the problem that shows the ability of students to link information related to a causal relationship in explaining a problem [29]. The third dimension is the knowledge that is raised in the test instrument related to matter matter, namely the interaction of living things with the environment described in the material section of the ecosystem [19]. The third dimension of NGSS is integrated with local potential in Takalar District, namely PPLH Puntondo or Puntondo Environmental Training Center which presents 3 types of ecosystems in the form of mangrove forest ecosystems, seagrass ecosystems, and coral reef ecosystems which can be used as material for making test instruments [30]. Science learning that is linked to local local potential can help in the achievement of Nature of Science [31].

3.2. Test Instrument Feasibility Test Process

3.2.1. Feasibility Test Assessment Instrument and Problem Solving Instrument

Qualitative analysis is done to review the questions from several aspects of assessment. The process of the feasibility test on the problem solving test instrument that was designed using the instrument validation assessment sheet questions that are composed of 4 aspects and 43 assessment indicators. Validation sheets were given to 2 expert lecturers, 2 science educators, and 2 peer reviewers. The results of each indicator are converted into scores which are then averaged. The following are the results of the validation of the question assessment by expert lecturers:

Table 5. Scores for each aspect of expert lecturer assessment

Aspect Criteria	**Score**	**Value**	**Category**
Instrument Components Problem	4	A	Very decent
Item Question	15	A	Very decent
Linguistic	15	A	Very decent
Display	9	A	Very decent
total	43	A	Very decent
Average	**10,75**	**A**	**Very decent**

Experts also provide some suggestions for perfecting the designed problem solving test instrument, the suggestions given include 1) editorial or narrative sentence questions need to be fixed on indicators identifying problem components and indicators of designing problem solving so that the problems raised can be understood by students, 2) the word structure of the invalid question needs to be improved where there is the word "bombing should be bombing", 3) the whole question designed must be based on the local potential of PPLH Puntondo, 4) pay attention to the suitability of the indicator with the question, 5) check the command sentence on the question, and 6) image needs to be clarified.

Table 6. Quality of test instruments

Range of Scores (y)	**Criteria**	**Values**	**Category**
$X \geq Xi + 1{,}8.SBi$	X ≥ 8,59	A	Very decent
$Xi + 0.6\,SBi < X \leq Xi + 1{,}8\,SBi$	6,44 < X ≤ 8,59	B	Worthy
$Xi - 0.6\,SBi < X \leq Xi + 0{,}6\,SBi$	4,29 < X 6,44	C	Decent enough
$Xi - 1{,}8\,SBi < X \leq Xi - 0{,}6\,SBi$	2,14 < X ≤ 4,29	D	Inadequate
$X \leq Xi - 1{,}8\,SBi$	X ≤ 2,14	E	Very Inadequate

The assessment of the test instrument was also carried out by science educators and peer reviewers, the results are as follows:

Table 7. Scores for each aspect of the assessment of science educators and peer reviewers

Aspect Criteria	**Score**	**Value**	**Category**
Content / Material Eligibility	6	A	Very decent
Presentation of Material	8	A	Very decent
Evaluation Tool	4	A	Very decent
Linguistic	9	A	Very decent
Display	14	A	Very decent

Aspect Criteria	Score	Value	Category
total	41	A	Very decent
Average	**8,2**	**A**	**Very decent**

Table 8. Quality of test instruments

Range of Scores (y)	Criteria	Values	Category
$X \geq Xi + 1{,}8.SBi$	X ≥ 6,54	A	Very decent
$Xi + 0.6\,SBi < X \leq Xi + 1{,}8\,SBi$	4,91 < X ≤ 6,54	B	Worthy
$Xi - 0.6\,SBi < X \leq Xi + 0{,}6\,SBi$	3,28 < X 4,91	C	Decent enough
$Xi - 1{,}8\,SBi < X \leq Xi - 0{,}6\,SBi$	1,65 < X ≤ 3,28	D	Inadequate
$X \leq Xi - 1{,}8\,SBi$	X ≤ 1,65	E	Very Inadequate

Test instrument criteria Table 6 [25], assessments conducted by expert lecturers, science educators, and peer reviewers show that the test instruments are very feasible. The feasibility test is not only carried out on the assessment sheet but also on the feasibility of solving problems done with the help of 2 expert lecturers. Item validation sheets are different from item assessment validation sheets. The item validation sheet evaluates the overall problem solving problem while the item item validation sheet assesses each item item with a valid or invalid assessment choice. Of the 10 problems of problem solving ability, there were 9 questions that were declared valid by expert lecturer 1 while the second expert lecturer stated that all questions were valid. 1 question that is declared invalid is because there is an unclear question structure so it needs to be done before it is given to the students. The results of the overall percentage of item items indicate that the problem solving problem is at a percentage of 95%. Based on the results of the validation criteria assessment instruments that are in the category of very feasible and the results of the validation of the items show the acquisition of a percentage of 95%, then the test instrument is worthy of being used in the next feasibility test to students after the revision according to the experts' recommendations.

3.2.2. Empirical Feasibility Test and Reliability of Problem Solving Ability Problems

The feasibility test was then carried out with a sample of 180 SMPN students in Takalar District with 10 question items.

Table 9. Results of trial analysis of problem solving test instruments

Criteria	Results
Lowest score	0
Highest Scores	20
Average score	11,66
Test Reliability Coefficient	0.69
Average Difficulty Rate	1.96
Average Difference Power	0.33

Table 9 shows the reliability coefficient of the test according to the classical theory calculated according to the Kuder-Richardson Reliability Index, which is 0.69 that meets the Reliability category in the range 0.60 - 0.80 according to the interpretation of the reliability value in Table 2 [26]. Furthermore, in terms of the difficulty level of the problem solving test instrument items with an average value of 1.96 included in the difficult category. The detailed difficulty level analysis results are as follows:

Table 10. Difficulty levels of trial test items

Problem Solving Indicators	Item Number / Difficulty Level				
	Very Difficult	Hard	Medium	Easy	Very Easy
Identifying problem components			2	1	
Understand the causal relations of	7, 8				

problems		
Designing problem solving	3	9
Implement the planned solution	4, 5	
Evaluate the suitability of the solution in solving problems		6, 20

Based on Table 10 can be seen as a whole the level of difficulty item items on each item problem solving indicators. Questions on indicators identifying problem components are more easily answered by students. While the difficulty encountered by students lies in the problem with indicators understanding the causal relations of the problem and implementing the solutions that have been designed. Furthermore, an analysis of the distinguishing power of test items is carried out, where the power of difference is a process of measuring the extent to which an item is designed to be able to distinguish ideal participants who have not or have adjusted competencies based on certain criteria [32]. The higher the coefficient of distinguishing power of a question, the more able the question is to categorize the ability of students [33]. The results of the difference in problem solving problems that have been analyzed are as follows:

Table 11. Distinguishing power of test item items

Category	Item Question
Very Bad (Signed -)	8
Poor (0.00 - 0.20)	1
Sufficient (0.21 - 0.40)	3, 4, 6, 7, 10
Good (0.41 - 0.70)	2, 5, 9
Very good (0.71 - 1.00)	

Table 11 shows the categorization of the different powers of each problem solving test item into 5 categories. Item items that are in the very different power category are bad items that are rejected or cannot be used, while item items that are in the poor power different categories need to be revised, and different power problems are very good, good and sufficient are items that are acceptable . Therefore the results of the analysis showed that there were 8 item items received, 1 item item that needed to be revised and 1 item item that was rejected.

The results of the feasibility test instrument of qualitative and quantitative problem solving tests, the results obtained that the questions have met the requirements as a good instrument seen from the suitability of problem solving indicators and questions according to experts, and also seen from the results of the analysis of the level of difficulty, and different items. In order to obtain the conclusion of acceptance of problem solving test items as follows:

Table 12. Conclusions on the acceptance of test instruments

Category	Item Question	Total (%)
Received	2, 3, 4, 5, 6, 7, 9, 10	8 (80%)
Revised	1	1 (10%)
Rejected	8	1 (10%)

Based on Table 12, it can be said that the 9 items in the test instruments prepared can be used as test instruments to measure the problem solving ability of junior high school students on the material interaction of living things with the environment and 1 item in the compiled test instruments cannot be used.

4. Conclusion

Problem solving test instruments have been compiled as many as 10 questions developed from 5 indicators of problem solving in the interaction material of living things with the integrated environment of local potential PPLH Puntondo based on Next Generation Science Standards. The results of the qualitative and quantitative analysis of the test can be concluded that 80% of the test

items were received and declared worthy of use, 10% of the test items stated need to be revised before being used at school, and 10% of the test items that were declared rejected and unfit for use.

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DEVELOPMENT OF PISA MODEL ASSESSMENT INSTRUMENTS TO MEASURE SCIENCE LITERATION ABILITIES OF JUNIOR HIGH SCHOOL STUDENTS

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Abstract. The research aims to develop an assessment instrument for the PISA model to measure scientific literacy skills and to determine the scientific literacy abilities of students at SMP N 6 Yogyakarta. This is Research and Development (R & D). The development model that uses is 4-D (Four D) which has been modified by the researcher based on the needs of the field conditions during the study. The data analysis was carried out quantitatively to see the quality of the items from the aspect of fulfilling the assumption test in the item response theory and item compatibility with the Rasch model using the SPSS Version 25 application. The results of the study included: (a) the PISA model of science assessment instrument to measure students' scientific literacy skills SMP and (b) the scientific literacy skills of students at SMP N 6 Yogyakarta.

1. Introduction

Scientific literacy is developed through science education. The concept of scientific literacy refers to science-based knowledge and technology. Scientific literacy also requires not only knowledge of scientific concepts and theories but also knowledge of general procedures and skills related to scientific inquiry and how to progress. PISA literacy problems are dominated by higher-order thinking skills in the form of interpretation, reflection, and evaluation skills. The reading ability tested is to re-reveal information, develop interpretations and integrate, and reflect and evaluate texts. Questions tend to use long discourse (135-630 words) and sentence questions tend to be complex [1]. The context for the 2018 PISA assessment assesses scientific knowledge using contexts that address related issues that are often relevant to science education curricula in participant countries, but assessment items are not limited to the school science context. Items in PISA 2018 can relate to self, family and peer groups (personal), community (local and national) or life around the world (global). The context can involve technology or, in some cases, historical elements for assessing students' understanding of the processes and practices involved in advancing scientific knowledge. The context for the items in the PISA science assessment is categorized into five things namely a) science and technology, b) health and disease, c) natural resources, d) environmental quality, hazards, and e) boundaries of science and technology. The types of tests used include multiple choice, complex multiple choice, short answer, closed essays, and open essays. The characteristics of the context are classified into four categories, namely education, work, personal, and society. The contents of quotes on the theme of personal safety, social security, how to complete education and science and technology, personal stories contain moral values to improve the quality of life[1]. PISA questions really demand reasoning and problem solving skills. In PISA questions, there are eight characteristics of cognitive abilities, namely: Thinking and reasoning; Argumentation; Communication; Modeling; Problem posing and solving; Representation, using symbolic; Formal and technical language and operations and Use of aids and tools. The eight cognitive abilities are in accordance with the science learning objectives contained in the curriculum. PISA problems not only require the ability to apply concepts, but more on how a concept can be applied in various situations, and the ability to reason and argue about how a case in a problem can be solved. The PISA assessment emphasizes how students use or apply scientific concepts that have been

learned in the application of everyday life [2]. PISA assessment does not only measure student knowledge, but also measures science process skills and scientific attitudes carried out by students. [3] state that the assessment framework developed should see the up-to-date side that assessments that emphasize students' ability to think at higher levels have a larger portion. The PISA assessment pattern emphasizes the student's ability to analyze, predict the symptoms of science in everyday life. [4] in the Unesco Science Report 2008 forum stated that there are eleven important issues in science / science education policy. One of them is the issue of scientific literacy, namely the main goal of science education is to create a science literate young generation. *Organization of Economic Development* [5] express an opinion about scientific literacy as follows ,"*scientific literacy is the ability to engaged with science-related issues, and with the ideas of science, as a reflective citizen*". The OECD statement implies that scientific literacy is a person's ability to engage with science issues and science ideas as part of society. [5] explains that someone with a scientific literacy is willing to engage in critical discussions about issues involving science and technology that require the following competencies: 1) Explain phenomena scientifically, 2) Evaluate and design scientific investigations, 3) Interpret data and scientific evidence. The three competencies above are then categorized as competencies needed for someone to have scientific literacy or in the [5] it is called Scientific Competencies. PISA assessment emphasizes how students use or apply scientific concepts that have been learned in the application of everyday life [6]. Science literacy skills can significantly increase student engagement with ideas and issues regarding science, then teachers in schools have a good understanding of science so that they are able to support and accommodate student aspirations during their involvement in ideas and issues. science during the learning process. This definition of scientific literacy shows that scientific literacy skills do not only require students to understand science knowledge, but students must also be able to understand various aspects of the scientific process and the ability to apply science knowledge in real life. The demands of science learning are not only related to understanding concepts, principles, laws and theories in science, but also must improve student competencies so that they are able to meet their needs and be able to follow the development of education in society which is currently influenced by developments in science and technology. The four aspects of the 2006 PISA concept illustrate the 2006 PISA Assessment Framework[7] PISA divides scientific literacy into 3 dimensions [8]: *"First, scientific concepts, which are needed to understand certain phenomena of the natural world and the changes made to it through human activity..... The main content of the assessment is selected from within three broad areas of application: science in life and health; science of the earth and the environment and science in technology. ...Second, scientific processes, which are centered on the ability to acquire, interpret and act upon evidence. ... Third, scientific situations, selected mainly from people's everyday lives rather than from the practice of science in a school classroom or laboratory, or the work of professional scientists. As with mathematics, science figures in people's lives in contexts ranging from personal or private situations to wider public, sometimes global issues." In general, the above passage provides an explanation that scientific literacy is divided into 3 dimensions, namely scientific concepts, scientific situations and scientific processes. The scientific concepts dimension is needed to understand natural phenomena and natural changes due to human activities. The assessment of scientific concepts is selected from within three application areas, namely life and health sciences, earth and environmental sciences and technological sciences. Then scientific processes, centered on the ability to obtain, interpret and act on evidence. Meanwhile, scientific situations emphasize the daily life of people and not from the practice of science in school or laboratory classes, or the work of professional scientists. PISA 2018 in the Assessment and Analytical Framework contains 3 interconnected domains [5]*

2. Research Method

Research development or Research and Development (R & D). The development model that uses is 4-D (Four D) which has been modified by the researcher based on the needs of the field conditions during the

study. The 4-D (Four D) development model consists of four main stages, namely define (restriction), design (design), develop (development), and disseminate (deployment) [7]

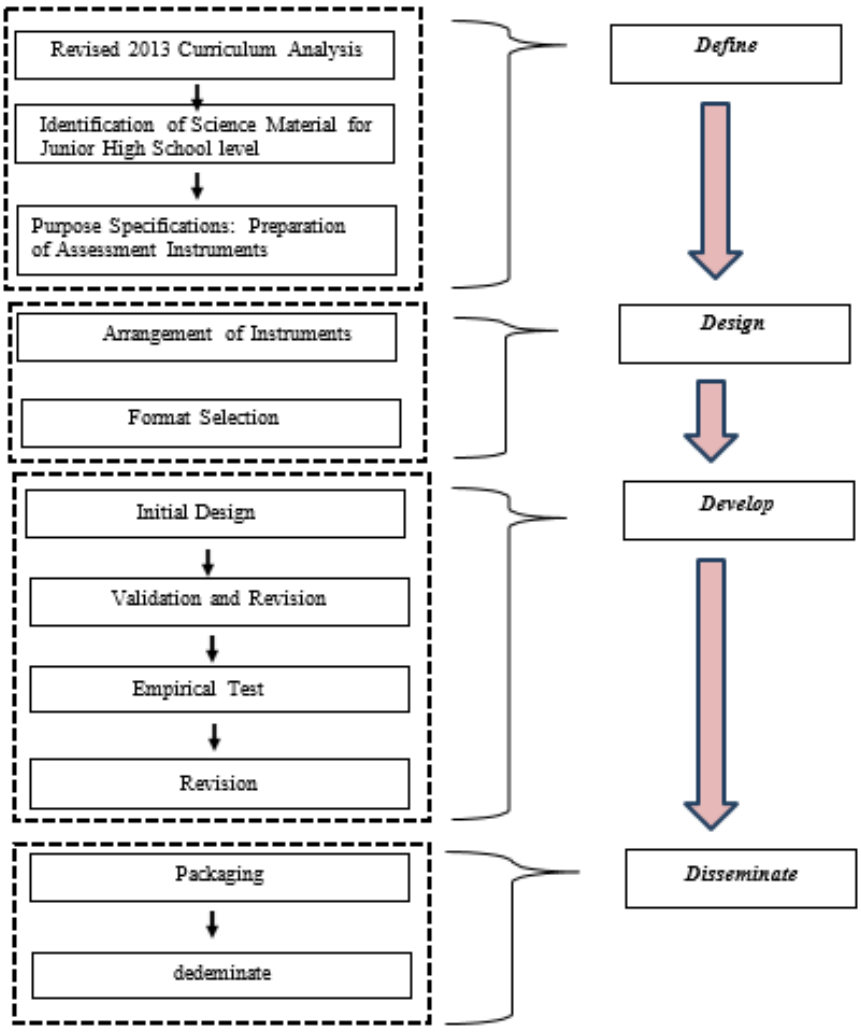

Figure 1.Research Flowchart

3. Result and Discussion

The results of the validity test of the 33 items of the PISA model for scientific literacy, problem solving, and scientific attitudes through four science education experts with an assessment of four categories, namely very suitable (SS), appropriate (S), less suitable (KS), and unsuitable (TS) using the Aiken formula as follows.

Table 1. The results of the validity test with the Aiken formula

No	Aspect	Skor	Information	Result
1	Content	0,93	> 0,92	Valid
2	Contruction	0,95	> 0,92	Valid
3	Language	0,94	> 0,92	Valid
	Average	0,94	> 0,92	Valid

The determination of valid or invalid is based on the Aiken table for 5% or p value <0.05 is 0.92.

Analysis of the quantitative to qualitative scale conversion from the results of expert assessments related to the feasibility of the PISA model of science assessment instrument which has been developed from the aspects of content, construct, and language provided that the criteria are with the lowest score of one and the highest is four. The average ideal score of the three aspects of the set (Xi) = ½ (ideal maximum score + ideal minimum score) = 7.5. Standard deviation of ideal scores from these three aspects (SBi) = ⅙ (maximum ideal score-minimum ideal score) = 1.5 as shown in.

Table 2. Scales to Convert Scores to Criteria

Score	Criteria
X >10,2	Very Good
8,4 < X ≤ 10,2	Good
6,6 < X ≤ 8,4	Enough
4,8 < X ≤ 6,6	Less
X ≤ 4,8	Very less

Table 3. Expert assessment results

Total Eligibility Score (X)	Result	Information
11,28	X >10,2	Very Good

a. Test assumptions in the item response theory include unidimensional, local independence, and subgroup invariance. The assumption test is carried out using the SPSS version 25 for Windows application.

The unidimensional assumption can be understood that the ability or ability measured using a set of questions is single, namely the aspect of PISA ability. The items are said to meet unidimensional assumptions if the test items that are made only measure one of the [9] abilities of the test taker, in this case the PISA ability. Unidimensional tests in instrument development can be seen from the results of the KMO and Bartlett's Test, Total Variance Explained, and Scree Plot, and the Rotated Component Matrix as follows. Unidimensional assumptions can be understood that the ability or ability as

measured by using a set of questions is a single aspect of the ability of PISA. The items are said to meet unidimensional assumptions if the test items that are made only measure one of the test taker's abilities, in this case the PISA ability. Unidimensional tests in instrument development can be seen from the results of KMO and Bartlett's Test, Total Variance Explained, and Scree Plot, and Rotated Component Matrix.

Table 4. KMO and Bartlett's Test Results

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.631
Bartlett's Test of Sphericity	Approx. Chi-Square	1054.265
	df	528
	Sig.	.000

KMO and Bartlett's Test are used to see whether the sample used in the test is sufficient or not. Based on the results of the factor analysis in the KMO and Bartlett's Test table, it is known that the Chi-Square value in the Bartlett test is 1054.265 with a p value <0.01 or a significance of less than 5%. Based on these results it can be stated that the sample size used in testing on factor analysis is sufficient for the needs of the test sample. In addition, it is also strengthened by the results of the KMO (Kaiser-Meyer-Olkin Measure of Sampling Adequacy) test, which is 0.631 where the value is> 0.5. If the KMO value is more than 0.5, the variables and samples used allow for further analysis. So it can be concluded that the test sample is sufficient to use the assumption test.

Total Variance Explained is used to see the dominant factors that exist in the item set. Based on the Total Variance Explained Table in the Initial Eigenvalues column, the highest eigenvalues can be determined, so that the factor component of the item set can be determined. The number of factors in the grain set can be seen from the eigenvalues> 1, which means that these factors are used as indicators. Based on the eigenvalues on the item set measuring the PISA ability in the aspects of scientific literacy, problem solving, and attitude, it can be seen that there are 12 components that have a value of more than 1.Thus, it can be seen that out of 33 items, 12 factors are formed. Furthermore, it is known that there is 1 dominant factor where this factor has the most dominant eigenvalues, namely 14,420. Based on the dominant factor of the measurement eigenvalues, it can be concluded that the PISA model items that have been compiled are unidimensional. It is further strengthened by the cumulative percentage value of 12 measurement factors. The cumulative percentage of eight factors obtained a value of 66.751%, which means that 673% can be explained by 12 factors. The minimum criterion for the cumulative percentage is 50% so that a number of factors can be determined accordingly. Thus it is evident that the unidimensional assumption on the instrument can be proven.

4. Conclusion

The results of the study are: (a) the PISA model of science assessment instrument to measure students' scientific literacy skills SMP and (b) the scientific literacy skills of students at SMP N 6 Yogyakarta is 11,28 in critera very good

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Qualitative and Quantitative Analysis of Critical Thinking Ability for Student in Science Learning Material Interaction of Living Things with Environment Based on Local Potentials of Kampung Adat Kuta Ciamis

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Abstract. The purpose of this study is to analyze students' critical thinking instruments on the material interaction of living things with their environment based on local potential of Kampung Adat Kuta. The research method used is descriptive qualitative quantitative to determine the quality of instruments developed. Using the quest application. The instrument developed was in the form of critical thinking test questions in the form of description. The instrument was analyzed qualitatively by expert lecturers, science teachers and colleagues to find out the quality of the instrument, besides the test questions were analyzed quantitatively through trials to 85 students to determine the quality of the questions. The results of the analysis showed that the question instruments that had been designed were declared valid by expert lecturers, teachers and colleagues. The results of empirical trials of critical thinking test questions show that all questions are valid. Judging from the level of difficulty, there are 8.4% of the very difficult category questions, 41.7% of the difficult categories, 33.3% of the easy categories and 16.6% of the very easy categories. The reliability value of item estimate is 0.64 with the weak category and the reliability value of the case estimate is 0.75 with enough category. Based on the results of the Passed Item Estimation (Fit) test all the questions are said to have passed which means that all questions can be used.

1. Introduction

Education is one of the most important things that must be built by humans to survive in the current global era. The teacher is one who has an important role to create quality education. The teacher does not only deliver the material to students but must do learning planning, learning implementation and assessment to see the competencies of students. Not only teachers, students should know the benefits of assessment for themselves because it can arouse students' learning enthusiasm. If more and more students find benefits in assessment, then they increasingly invest their own efforts when they prepare for assessment [1].

As for the technical reforms of valuation, it must promote transparency regarding the validity and reliability of assessments. Final learning in students, assessment must provide evidence of how competent students are from learning outcomes in the form of knowledge, skills and dispositions in life outside the academy [2]. The teacher must examine all components of the assessment plan in a rational, specific general framework, determine the overall plan for compatibility and make sense [3].

Currently we are in the 21st century, we are required to master the abilities needed by students. Teachers need to prepare learning instruments that support, and practice the abilities of students in the current century. Critical Thinking Ability is one that is needed in 21st century learning [4]. Critical thinking is very important as a tool of inquiry. Critical thinking is not a negative activity but rather an activity of asking questions, challenging assumptions, examining claims and identifying alternatives [5]. Critical thinking is analytical and involves original thinking. Critical thinking processes knowledge to identify cross-disciplinary relationships and find potential creative solutions to problems. People who think critically have a desire to seek the truth even when the truth may be contrary to old beliefs [6].

In learning activities, teachers must also be guided by the existing curriculum. In the curriculum of learning activities there are regulations that contain developing local potential. Utilization of local potential in science learning supports learning in the 21st century [7]. Students not only instill theoretical concepts, but the application of concepts in real-life everyday such as local potential [8]. Local potential is the potential of resources contained in an area, including natural, human, technological, and cultural resources that can be developed to build national self-sufficiency [9]. One of the local potentials of the Ciamis Region is the Kampung Adat Kuta. Kampung Adat Kuta has a hilly nature that affects the weather and soil fertility. Kampung Adat Kuta wholeness and sustainability is maintained, because there are guards. Kampung Adat Kuta has Kramat forests, yards, rice fields, plantations, ancepan land, rivers and lakes [10]. The people of Kampung Adat Kuta conduct sugar palm planting activities as their economy. But many students still do not know the Kampung Adat Kuta [11].

Reliability is to obtain instrument results that are always the same and do not change (consistent) every time the instrument is used. Validity aims to refer to how accurate the question is. If the researcher gets good reliability and validity, it is said that the instrument is good and can be used for research and both are needed to build research credibility. [12]

This research is motivated by the conditions in schools in developing question instruments that are still not good. In making questions about science teachers still use questions from the internet or from textbooks, so the teacher does not pay attention to the quality of good questions to use to see students' abilities. There are still teachers who have not applied much local potential in learning.

This research was conducted to answer the problem of how the quality of critical thinking skills in the material interaction of living things and their environment by utilizing the local potential of Kuta Indigenous Village developed?

2. Methods

The research method used in this study is quantitative descriptive qualitative method. Using the quest application. Descriptive method is a research method that discusses the character of the subject or object of research that emphasizes the actual facts. The quantitative descriptive method in this study was used to assess the quality of the designed critical thinking questions instrument. Critical thinking test questions for empirical exams amounted to 12 questions in the form of descriptive questions. This research was conducted in several schools in Ciamis, namely junior high school 3 Ciamis, and Madrasah Tsanawiyah 1 Ciamis. There are 85 students who have studied the material interaction of living things and their environment.

2.1. Non Test Data Collection Techniques

Non-test technique is the data about the quality of the critical thinking questions instrument that has been validated by a device expert lecturer, material expert lecturer, 2 science teachers and 2 colleagues. Syllabus, RPP, LKPD, and Handout validation questionnaires were analyzed by looking for an average rating. The formula for obtaining an average score from each aspect of the assessment is:

$\overline{X} = (\sum X)/n$

Information:

$\overline{X}$ = Average score

$\sum X$ = Total score obtained

n = Maximum number of scores

All data obtained on each item is then analyzed and referred to as the actual score (X). The actual score is quantitative, then it is converted into a qualitative value based on the conversion of scores to a scale of five. The five scale assessment criteria can be seen in the Table 1.

Table 1. Five Scale Assessment Criteria

Range of Scores	Value	Category
$X \geq \bar{X}i + 1{,}8$ SBi	A	Verry Good
$\bar{X}i + 0{,}6$ SBi $< X \leq \bar{X}i + 1{,}8$ SBi	B	Good
$\bar{X}i - 0{,}6$ SBi $< X \leq \bar{X}i + 0{,}6$ SBi	C	Enough
$\bar{X}i - 1{,}8$ SBi $< X \leq \bar{X}i - 0{,}6$ SBi	D	Less
$X \leq \bar{X}i - 1{,}8$ SBi	E	Very Less

[13]

Tabel 2 . Assessment Criteria for MNSQ INFIT Value

MNSQ INFIT Value	Information
>1.33	Does not fit the model
0.77-1.33	Fits the model
<0.77	Does not fit the model

[14]

Tabel 3. Difficulty Level Criteria

Value	Information
< -1	Very Easy
-1 - 0	Easy
0 - 1	Difficult
>1	Very Difficult

Tabel 4. Assessment Criteria Reliability Value of the Rasch model

Value	Information
<0,67	Weak
0.67-0,80	Enough
0,81-0,90	Well
0,91-0,94	Very well
>0,94	Perfect

[15]

2.2. Test Data Collection Techniques

The test technique used to determine the quality of the test items that have been tested on 85 students in grade 8 and class 9. Quantitative analysis of the instrument includes empirical validity, instrument reliability, difficulty level dan question estimation. Empirical test results were analyzed using the QUEST application.

3. Results and Discussion

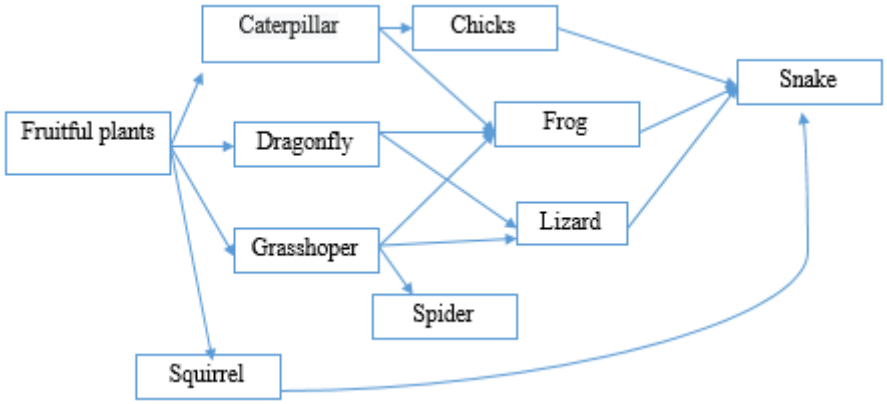
Analysis of critical thinking instruments include:

3.1. Qualitative Analysis

The assessment in the critical thinking instrument consists of three aspects of the twenty criteria. The first aspect is the appropriateness of the contents, namely the items in accordance with KD (Basic Competence) and learning indicators on critical thinking ability, the items able to develop abilities, the completeness of the scoring guidelines, the accuracy of the preparation of the scoring guidelines, the

items in accordance with the material and learning objectives, the corresponding items with the local potential of Kampung Adat Kuta, and the items in accordance with the level of students. The second aspect is the language used in accordance with PUEBI guidelines, the use of language does not lead to multiple interpretations, the use of common language, and the use of language in accordance with the stages of student development. The third aspect is the presentation technique that is designed to consist of clearly formulated items, availability of places to write answers, availability of places to write answers, availability of time to answer questions, the components of the questions are arranged in clear and understandable detail, graphical tables are presented clearly readable and function, the limits of the questions and answers expected are clear, the items are in accordance with the school level, the items use question words that guide the answers unraveled, and use clear instructions the procedures for working on the questions.

Tabel 5. Sample Questions

Indicator	Question
Defining Terms	Rice plants, mice, birds, chickens, and insects are biotic components found in rice fields, which need water, sunlight and others to live. Based on the information above, what is meant by the biotic component?
Make Questions and Answers	 Based on food webs found in the garden ecosystem of the Kampung Adat Kuta Make 1 question and answer from the picture of the food web!

Tabel 6. Results of Validation of Questions by Validator

No	Rated Aspect	Expert lecturer	Teachers	Peers	Category
1	Content Feasibility	102.5	105	105	Very Decent
2	Language	55.5	57.5	58	Very Decent
3	Presentation Techniques	136.5	139.5	139	Very Decent
Average Number			299,46		Very Decent

The results of the analysis show that the developed critical thinking questions have a greater number of 299.46 X≥256 and are categorized as very feasible with a maximum score of 320 and a minimum score of 0. Some of the suggestions of expert lecturers, teachers and colleagues from the designed critical thinking questions are more appropriate writing procedures that have been determined based on PUEBI guidelines, clear scoring guidelines, and the availability of more answers.

3.2. Quntitative Analysis

Quantitative analysis is carried out on the instrument in the form of critical thinking test questions that were previously tested on students of class 8 and class 9 who have studied the Interaction of Living Things with their Environment. Analysis of validity, reliability, difficulty level and questions passed through testing on test questions.

3.2.1 Validity Results of Empirical Tests
The results of the analysis of the validity of the empirical test are shown in the Table.7

Tabel 7. Validity Results of Empirical Tests of Critical Thinking Indicator

Indicator	Item Number	*Infit MNSQ*	Indicator	Item Number	*Infit MNSQ*
	1	0,92	Describe as much	5	1,18
Defining Terms	2	1,03	as possible	6	1,00
	9	1,11		11	0,76
Make Questions	3	1,22	Conclude	7	1,06
and Answers	4	0,83		8	1,13
	10	0,90		12	0,89

Based on the results of the analysis of the instrument validity data, it is known that 12 questions of critical thinking tests of 4 indicators were designed. Indicators of critical thinking include defining terms, making questions and answers, explaining as much as possible, and concluding. Each question is said to be valid if it has an MNSQ Infit value of 0.77-1.33. The indicator defines the terms in item number 1 has a score of 0.92, number 2 has a score of 1.03 and number 9 has a value of 1.11. The three questions from the indicators define the problem including valid problems. The indicator makes the questions and answers on item number 3 has a score of 1.22, 4 has a score of 0.83 and number 10 has a score of 0.90. The three questions from the indicators of making questions and answers are including valid questions. The indicator explains as much as possible at number 5 having a score of 1.18, number 6 has a score of 1.00, and number 11 earns a score of 0.76. Of the three indicator questions explained as much as possible, only two questions were said to be valid, because question number 11 only got 0.76. The indicators concluded on point number 7 obtained a value of 1.06, number 8 obtained a value of 1.13, and number 12 obtained a value of 0.89. All three problem indicators conclude that they have valid questions.

3.2.2 Empirical Test Reliability Results
Reliability is the main characteristic that indicates a good instrument. The higher the level of reliability the smaller the inconsistency of the measurement results of the instrument. It can also be said that instruments that have higher reliability will get the same answer even if given to the same respondent at different times.

Table 8. Results of Empirical Test Reliability

Type of Reliability	Value	Information
Reliability item estimate	0,64	Weak
Reliability of case estimate	0,75	Enough

The results of the item reliability estimate of critical thinking questions from the empirical test obtained a value of 0.64 which was categorized as weak so it had less effect on the model. The results of the reliability value of the case estimate with enough categories then, the test participants' answers showed consistency. This shows there is a consistency of students or filling out questions with no carelessness.

3.2.3 Item Difficulty Items

Table 9. Difficulty Level Results

Question number	Value	Information	Question number	Value	Information
1	0.5	Difficult	7	-0.62	Easy
2	-.33	Easy	8	0.59	Difficult
3	0.42	Difficult	9	2.44	Very Difficult
4	-0.82	Easy	10	-0.12	Easy
5	-1.90	Very Easy	11	0.81	Difficult
6	0.53	Difficult	12	-1.05	Very Easy

Table 10. Difficulty Results for Each Indicator

Indicator of critical thinking	Very Easy	Easy	Difficult	VeryDifficult
Defining Terms	-	2	1	9
Make Questions and Answers	-	4,10	3	-
Explain as much as possible	5	-	6,11	-
Conclude	12	7	8	-

The level of suitability of the questions based on the table 10. the questions can determine, the matter of consideration about the terms of understanding of the matter of exchange is very easy, difficult and very difficult. Indicators make questions and answers about easy questions, and one hard question. The question of critical thinking with indicators explains maybe a very easy problem level, and two difficult questions. While the indicators determine each problem is very easy, easy and difficult. Overall critical questions must have a very easy level of 16.6%, for an easy level of 33.3% for a difficulty level of 41.7% and a very difficult level of 8.4%.

3.2.4 Passed Item Estimation Results (Fit)

To find out which questions are dropped or passed based on the OUTFIT value of the QUEST program. If the OUTFIT value is ≤2.00 then the item passes, and if the OUTFIT value is ≥2.00 the questions are dropped.

Table 11. Item Fit Recapitulation Results

Question number	OUTFIT value t	Information	Question number	OUTFIT value t	Information
1	-0.6	Pass	7	0.2	Pass
2	0.7	Pass	8	0.9	Pass
3	1.0	Pass	9	1.8	Pass
4	-1.2	Pass	10	-0.8	Pass
5	1.3	Pass	11	-1.4	Pass
6	-1	Pass	12	-0.6	Pass

Based on the table 10. above, it is known that all items pass so that all instrument questions can be used to see students' critical thinking skills in the learning process.

4. Conclusion

Based on the results of research and discussion of this study explains that the instrument of critical thinking questions based on local potential of Kampung Adat Kuta on the Interaction of Living Beings and the Environment that has been designed has a quality that is appropriate to use, and from the results of empirical tests estimation of item validation using the Rasch model for 12 suitable questions with a valid Rasch model, the value of reliability of item estimate is 0.64 with the weak category and the value of the reliability of case estimate is 0.75 with enough category. The results of the difficulty level of the

critical thinking problem indicator defining the terms consist of easy, difficult and very difficult levels. Indicators make questions and answers consist of easy and difficult levels. Indicators explain as many levels as possible very easy and difficult levels. The indicators conclude there are levels of questions that are very easy, easy and difficult. All critical thinking questions can be used based on the estimated OUTFIT value t ≤2.0.

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