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# Development of Computer Based Test Which is Integrated with Bengkulu Local Wisdom to Measure the Scientific Literacy Skills of Junior High School Students

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## Abstract

Scientific literacy is essential for students to master to solve scientific problems in society. Preparing an integrated science literacy instrument of local wisdom is an effort to measure and train these abilities so that students are ready to engage in activities related to science, technology, and the environment. The purpose of this study is to develop computer-based tests that integrate valid and practical local wisdom to measure the science literacy abilities of junior high school students. The instrument was developed using quizizz, which refers to the PISA scientific literacy framework and the local wisdom of Bengkulu. This research uses research and development methods with 4D development research models using steps to define, design, develop, and disseminate. The instrument consists of 20 multiple choice questions covering aspects of context, competence, and knowledge. The subject of this study consisted of 200 grade 7<sup>th</sup> and 8<sup>th</sup> students at a public junior high school, SMP 3 Rejang Lebong. Instruments were analyzed using expert assessment of 3 validators and classical test analysis, including item practicality and reliability. The results of the expert assessment obtained an average of 4.62 with very valid categories. An average of 3.31 with very practical criteria was obtained at the development test stage. Meanwhile, the instrument reliability distribution was 0.878, with a very high-reliability category. This shows that the integrated computer-based test of local wisdom to measure the science literacy ability of junior high school students is considered very valid and practical, and the reliability is very high.

**Keywords:** instrument, scientific literacy, PISA, local wisdom, Quizizz

## INTRODUCTION

Education was essential in developing science and technology during the industrial revolution era. A country's education can build the nation's life by utilizing the potential possessed by each individual (Atta et al. 2020). One of the crucial potentials is the individual's skills and knowledge in solving problems. Science education has a significant and strategic role in increasing the potential of quality human resources (Zahro et al. 2021). This potential can be realized if it can bring students proficient in their fields and successfully produce students skilled in problem-solving supported by logical, creative, critical, and adaptive thinking skills to changes and developments in the industrial revolution era (Zahro et al. 2021).

Science education can explain various phenomena that occur around daily life, culture, and Indonesian local wisdom by applying science literacy in the learning process. Scientific literacy

supports and assists students in mastering the skills needed to compete in the industrial revolution era (Atta et al. 2020). Students who have good scientific literacy skills will be cooperative in social life, are actively able to understand concepts and processes in problem-solving personally and socially, and are willing to apply their skills to participate in environmental activities related to science and technology (OECD 2018) (Nasution et al. 2019). However, in the implementation process, they are not competent in making decisions on science-related issues and solving problems (Sadler & Zeidler 2009). So that when a test is carried out related to the meaning and relevance to the environment, students do not have sufficient competence (Setiawan 2019).

The results of a study in 2018 conducted by The Program for International Student Assessment (PISA) for 15-year-old students show that of the 79 participating countries, Indonesia is ranked 75th with a score of 396, far below the highest average score of 489 (OECD 2018). Concurrently, the Suroso et al. (2021) study showed that the science literacy ability of students in East Java was 58.80%, with a low category. The same issue was also found Adnan et al. (2021) that showed that the science literacy ability of students in the southern regions was still relatively low. Ridho, Aminah, and Supriyanto (2018) did the same thing, and the results of the students' science literacy skills were meant in the medium category. As well as research conducted by Andriani, Saparini, and Akhsan (2018) to get results of students' science literacy skills in South Sumatera are still meager. Thus, it can be concluded that Indonesian students generally have low science literacy skills.

This can happen because of several things, including teachers do not maximize their role in supporting and facilitating students to develop science literacy skills in the learning process (Ridho, Aminah & Supriyanto 2018). Teachers still have difficulty carrying out meaningful, research-based, and fact-based learning, so students' potential has not been able to develop optimally (Kurniaman & Noviana 2017). Students are less trained in solving problems related to problem-solving which requires intellectual activity, argumentation, and creativity, then the assessment carried out by the teacher only focuses on science content that is not related to everyday life (Nasution et al. 2019), and the availability of instruments that do not accommodate the full criteria for assessing scientific literacy and the teacher's low ability to develop these questions (Afriana et al. 2016) (Kusuma et al. 2017) (Zahro et al. 2021).

Various alternatives are proposed to try to solve the problem, such as policy making, increasing efforts to implement learning, and curriculum changes that are more oriented toward students' science literacy competencies by PISA (Andriani, Saparini & Akhsan 2018). Another alternative that can be done is to develop an integrated science literacy instrument based on local wisdom. The preparation of this instrument is essential and indispensable to knowing the extent of the scientific concepts that have been studied. As well as integrating local wisdom can produce a much more complex science literacy instrument so that students are more trained in representing and bringing science closer to everyday life, as well as applying the concept of science in solving problems (Ikhwanudin 2018) (Maulida & Sunarti 2022).

The instrument developed in PISA can already be used to measure the science literacy abilities of learners (Sulistiawati 2015). However, even though the instrument already exists and can be used, the results shown from the international study are very general in Indonesia (Rusilowati et al. 2016). This is because of the different backgrounds of students in Indonesia and abroad, different learning processes and scientific phenomena presented in science learning, specifically physics, are not in harmony with the content and context of the PISA questions (Zahro et al. 2021), so that the authors develop scientific literacy instruments that can be used by Indonesian students as a training ground and measure scientific literacy skills, adapted to the educational curriculum and the discourse presented contains contextual phenomena with those in Indonesia, especially the area where students live.

Several studies related to the development of instruments that integrate science literacy with local wisdom, one of which is the research conducted by Maulida and Sunarti (2022), have succeeded in developing an instrument of local wisdom-based science literacy tests in Lamongan district that has good item reliability and validation. Then Zahro, Sumarni, and Linuwih (2021) were able to produce a science literacy instrument with a valid category at a percentage of 79.99%, instrument practicality with a very practical category of 87.5% student responses, and 94.23% teacher responses. As well as Atta et al. (2020) successfully developed a science literacy instrument with validity and reliability at 0.77 and 0.85 indexes. However, a few studies still develop an integrated science literacy instrument

based on local wisdom. Especially the sources that refer to science literacy instruments in the context of local wisdom in Bengkulu province.

The instrument's position as an evaluation tool is considered important in improving the quality of the learning process and making decisions about the next lesson plan (Kurniawati & Sukardiyono 2018) (Nasution et al. 2019). So it is necessary to follow up and innovate to improve questions' quality, especially instruments to measure students' scientific literacy skills. In the 21st century, the development of technology and information has entered the era of the internet of things (IoT) (Afrizal & Suprianto 2018) (Muchlis et al. 2018). IoT is the transfer of information and data through internet technology, formation, and communication that allows it to be connected to various objects (physical and virtual) that can be accessed anywhere and anytime (Gomez et al. 2013) (Wortmann & Fluchter 2015).

Integrating technology with assessment is one of the innovative and effective measures that must be considered, especially during the COVID-19 pandemic. The use of technology in assessment is known as the computer-based test (CBT) system. CBT is an assessment method by utilizes IT that provides better efficiency, effectiveness, and productivity (Sulistiyono et al. 2018) (Triansyah & Putra 2019). Maulidiansyah has conducted similar research using CBT, showing that the results of using CBT have excellent practicality, are effective, and can be used as an auxiliary medium in an assessment.

Based on this, it is necessary to make improvements by developing a CBT-based scientific literacy instrument that are integrated with local wisdom so that can be used on a small or large scale, and adapted to the context, content, and process of science in Indonesia, especially the Curup mountain area, Bengkulu with the theme of temperature and heat.

## METHODS

This research was conducted at public junior high school number 3 Rejang Lebong using research and development (R&D) methods. The subjects in this study were 200, 7th and 8th-grade students, with the distribution of students having varying levels of ability (high, medium, and low). The method used in this study is a research and development method with a 4D development model. The stages carried out using 4D stages consist of: defining, designing, developing, and disseminating (Thiagarajan et al. 1974) (Hidayat et al. 2017). The development steps carried out are as follows

At stage, define analysis of the characteristics of PISA questions, curriculum analysis, and application analysis were carried out through computer-based test (CBT). At this stage, a literature study is carried out, collecting and analyzing information related to scientific literacy so that the instrument questions developed can be adapted to the needs of students framework scientific literacy at PISA 2018 and the level of understanding of junior high school students, as well as facts about efficient, effective and interesting CBT applications used as media assessment for students with an average age of 15 years.

Stage design, the development of question instruments was carried out, starting with preparing question grids and question cards. In this study, the question grid was made according to the analysis of the existing PISA types of questions, framework PISA 2018 science literacy, science learning, and local wisdom. This question grid is used as a guide in the preparation of computer-based scientific literacy instruments that can be used to measure students' scientific literacy skills. Furthermore, the making of question cards based on the grid has been made while still paying attention to the PISA framework, especially on scientific literacy skills. The next stage is to prepare the answer key. The final stage in making questions is to input the questions that have been made into the selected application. The results of this stage of making questions are called initial product 1 (Draft I).

At stage development, instrument questions that have been developed are tested through expert appraisal and development testing. Expert appraisal or expert validation was carried out to test the validity of the computer-based scientific literacy instrument integrated with local wisdom that had been developed by asking for help from three expert lecturers of Physics Education at Sriwijaya University to assess 3 aspects, namely material, construct, and language aspects. The instrument used to measure validity is the Likert scale questionnaire with five categories made in the form of a checklist. Then the results of expert validation are processed using EQUATION (1).

$$V_a = \frac{\sum_{i=1}^n A_i}{n} \tag{1}$$

The average value obtained is then matched with the level of validity contained in TABLE 1.

**TABLE 1.** Validity Value Category (Sugiono 2016)

Answer Category	Scale
Highly Valid	4.21-5.00
Valid	3.41-4.20
Fairly Valid	2.61-3.40
Not Valid	1.81-2.60
Invalid	1.00-1.80

The next step is development testing, namely product testing, to students on a small scale as many as 30 students to see the product’s practicality level by filling out a practicality questionnaire on a google form. The data obtained will be analyzed using the Likert scale. The results of the questionnaire were calculated in percentage and categorized the level of practicality of using CBT-based science literacy instruments integrated with local wisdom. At this stage, the researcher gets advice and input from experts and learners on the instruments developed. Researchers will revise according to input and suggestions for improvement until the instrument is feasible.

Then step disseminate the dissemination of scientific literacy instruments to junior high school students on a broader scale. A total of 200 students will work on questions whose results are then analyzed using the Kuder-Richardson 20 (KR-20) method and SPSS 25 to see the reliability of the literacy science instrument-based computer, which is integrated Bengkulu local wisdom that has been developed.

## RESULTS AND DISCUSSION

### Stage Define

At this stage, the researcher analyzes the characteristics of the PISA questions, the curriculum, and the application of computer-based tests. This stage begins with analyzing PISA questions on scientific literacy abilities from various years. PISA assesses the achievement of scientific literacy skills of students aged around 15 years (OECD 2015). The scientific literacy ability used refers to the framework of scientific literacy at PISA 2018. So that the results from this stage can be used as a basis for developing questions. Based on PISA 2018, scientific literacy has three essential aspects: context, knowledge, and competency. In the context aspect, researchers focus on local wisdom and scientific phenomena that occur in the Bengkulu region by still including national and international phenomena, thus making this instrument different from the instruments that have existed before. The types of local wisdom raised in this study include the climbing of “Bukit Daun” in Rejang Lebong, the long beach of Bengkulu, and Bengkulu traditional cooking utensils related to the concept of temperature and heat matter physics. TABLE 2 describes local wisdom on the item questions.

**TABLE 2.** Type of Local Wisdom on The Question Item

Type of local wisdom	Question number
Climbing to Bukit Daun Rejang Lebong	4, 5, 6, 7, 8, 9, 10
Bengkulu Long Beach	11, 12, 13, 14
Bengkulu Traditional Cookware	18.19, 20

According to OECD (2018), scientific literacy knowledge includes three contents: physical systems, living systems, and earth and space systems. This research is focused on the content of physical systems, especially the material of energy and its transformation, which is adapted to the level of thinking of students and the place of research. The development of this question instrument is focused

on measuring the scientific literacy ability of students so that in the aspect of competence, it refers to scientific literacy competence, which consists of 3 indicators as follows: 1) Explaining phenomena scientifically, 2) Interpreting scientific data and evidence, 3) Designing and evaluating scientific research.

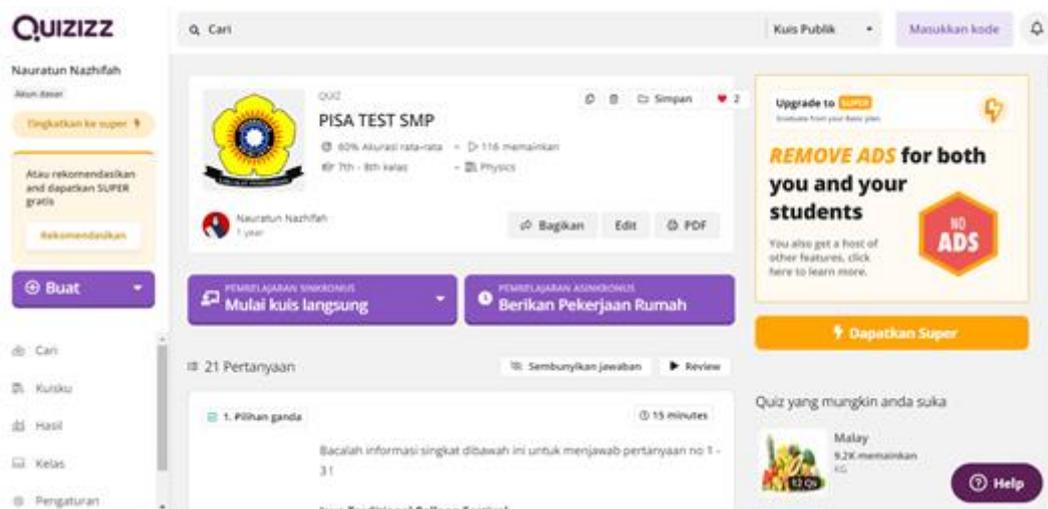
In curriculum analysis, at this stage, the researcher determines the material to be used in making question instruments that are adapted to the curriculum framework PISA 2018 science literacy and integrated science subjects for junior high school curriculum 2013 revision. This is so that there is a correlation between the content of scientific literacy knowledge and the level of thinking of students and does not deviate from the predetermined basic competencies. Basic competence 3.4 material temperature and heat correlate with aspects of knowledge and context according to framework PISA 2018, that the research area is known as one of the cold mountainous lands in Bengkulu province and can be explored to be used as a discourse in making scientific literacy instruments based on computer. However, it still includes other scientific phenomena related to national or international, to provide additional information to students and qualified for the preparation of science literacy instruments (OECD 2018).

Analysis of computer-based test (CBT) applications was conducted to determine the application that will be used in the research. Quizizz is a feature used in the learning process, especially for interactive quizzes that allow it to be accessed through applications and web tools on the Internet computer and smartphone. This application was chosen as an assessment medium in this study for several reasons, including it can be accessed on various types of devices, is user-friendly (Zhao 2019), attractive appearance, teachers can choose themes, memes, avatars, and music that can increase students' enthusiasm for learning (Purba 2019). Besides that, according to Orhan Gökşün & Gürsöy (2019), the types of questions can be adjusted to the needs of the teacher, the results of student answers are obtained in detail, and efficiently, and the teacher can add pictures, videos, audio, and formulas to the questions. The results of student work can be downloaded in the form of a spreadsheet in excel and the duration of quizzes can be set so that the implementation time can be more flexible (Yana et al. 2019). This application can also increase students' learning motivation, and competitiveness and quizzes can improve the experience and involvement of students in the learning process (Chaiyo & Nokham 2017).

According to the research, Purba's (2020) quizizz is effectively used as an assessment medium with a Sig. (2-tailed) value of 0.008. The opinion of Darmawan, Daeni also supports this in his article that using quizizz can reduce cheating and make the test more effective. As well as the use of quizizz applications in science literacy tests has been done by Agustia et al. (2021) and shows that students feel happy, motivated, and assisted in working on questions using quizizz. Therefore, researchers decided to use this application in developing science literacy instruments.

### Stage Design

In the stage design, the researchers prepared the grid and developed questions based on the analysis results at the stage defined. Preparing the question grid begins with making a matrix containing basic competencies, materials, scientific literacy competencies for each question, PISA context, question indicators, and question level. Furthermore, the grid was developed into a complete question which is made on a question card that consists of 30 multiple choice questions with 13 content, four answer choices, and consists of 3 levels of questions, namely high, medium, and low, which refers to the PISA 2018 framework (OECD 2018). The low question level includes the ability to remember lessons, the medium question level includes the ability to apply, classify and compare activities, and the high question-level includes the ability to criticize, reason, and logic (Gunawan & Palupi 2012). The instruments that have been developed are then included in the quizizz so that later it can be tested on students. FIGURE 1 shows the appearance of the Quizizz editor that has entered questions.



**FIGURE 1.** Quiz Editor View

Computer-based scoring system on quizizz has an attractive appearance that can eliminate students’ saturation in working on questions (Junior 2020). Rating on quizizz can be done with several options, such as direct tests, homework assignments or repeated tests, accessed using a code (Yana et al. 2019). So that in addition to being used as a scientific literacy assessment tool for students, quizizz can be used as a tool to train and improve students’ scientific literacy standards. It is hoped that Indonesia’s ranking in the PISA scientific literacy study will increase. In addition, in working on questions on quizizz, students can compete with each other by displaying their rankings while working on questions. This motivates them to study harder and more diligently (Junior 2020). This is in line with the opinion of Liana, Linuwih and Sulhadi (2020), who state that using computers can increase students’ interest and motivation and strengthen knowledge in learning.

### Stage Develop

At this stage, the researcher evaluates and sees the level of validity and practicality of the product that has been developed. This is done through 2 stages: expert appraisal and development testing. At the expert appraisal stage, the question instrument that has been developed is then validated by three validators who are lecturers of physics education at Sriwijaya University. The validator will assess three aspects: material, construct, and language. The validator’s opinion is described in a Likert scale with five categories of answers referring to Sugiyono (2016), which can be seen in TABLE 3.

**TABLE 3.** Category Validation Value

Answer Category	Scale
Very Suitable	5
In accordance quite appropriate	4
Not suitable	3
Non-Conforming	2
	1

**TABLE 4.** Results of the Validator’s Assessment at the Expert Appraisal Stage

The aspects studied	Assessment indicators	Number of Questions	Total score	Average	Average and Criteria
Content	The suitability of science literacy instruments with context aspects in the 2018 PISA framework	1	5	5.00	4.91 Very Valid
	The suitability of the science literacy instrument with the content aspects in the 2018 PISA framework	1	5	5.00	
	The suitability of the science literacy instrument with the indicators in the 2018 PISA framework	3	14	4.67	
	The suitability of science literacy instruments with the curriculum field	6	30	5.00	
Construct	Developing the literacy skills of students	2	8	4.00	3.94 Valid
	Conformity with the thinking skills of class 7 <sup>th</sup> and 8 <sup>th</sup> students	3	13	4.33	
	Quality of images, graphs, tables, diagrams or the like	4	14	3.50	
Language	Suitability of the language with the rules of the Indonesian language	3	15	5.00	5.00 Very Valid
	Clarity of information	2	10	5.00	

The assessment results from the expert at the stage it was found that the average value of the validity of the -based scientific literacy instrument was a computer 4.62 and is included in the very valid category and deserves to be tested. In addition, the validator also provides comments and suggestions on the instrument questions that have been developed and used as a basis for product improvement. Based on these comments and suggestions, the researcher made several improvements to the instrument, one of which was by combining questions with the same content so that there was no overlap between questions, improvements in word writing, language use, and punctuation. From the results of this improvement, draft II consists of 20 questions with five contents. TABLE 5 describes the distribution of instrument competencies to aspects of knowledge and context.

**TABLE 5.** Distribution of literacy scientific test items.

Competency	Knowledge	Context		
		Local	National	International
Explain phenomena scientifically	9	5	2	2
Interpreted data and evidence scientifically	8	7	-	1
Evaluate and design scientifically inquiry	3	2	1	-

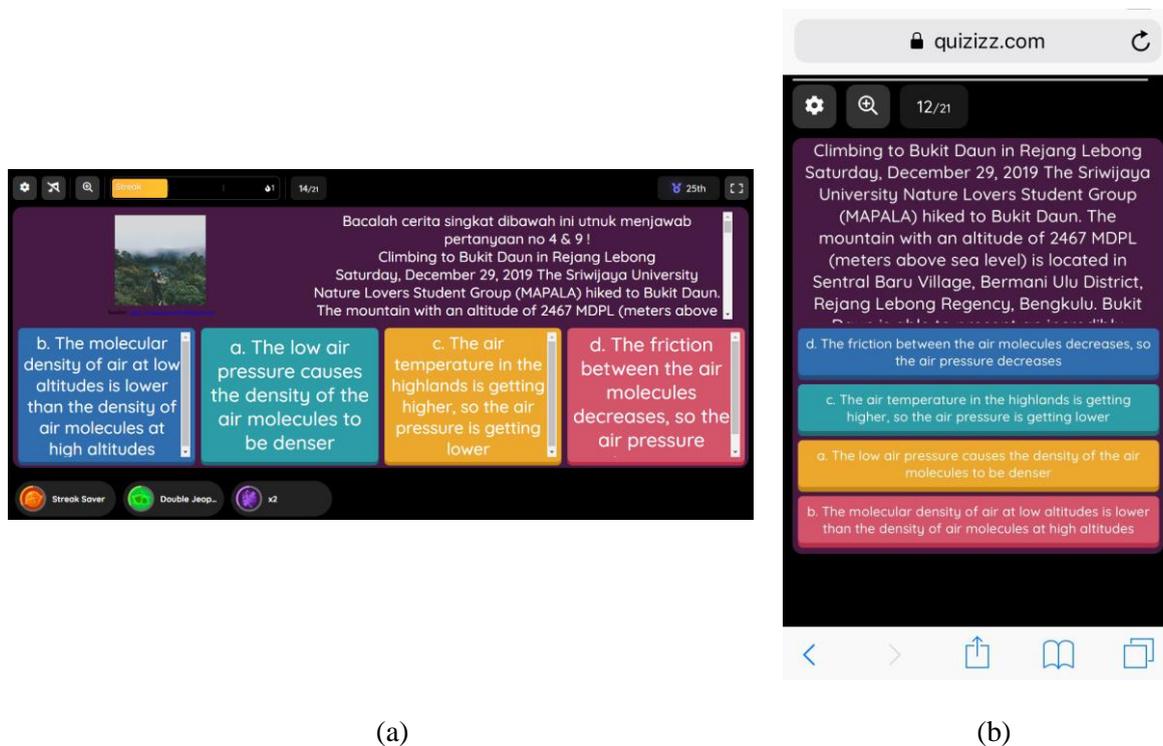
At stage development testing, students of public junior high school number 3 Rejang Lebong worked on science-based literacy instruments computer on *the* quiz. After that, they will fill out a student response questionnaire on the link google form to see the product’s practicality level. The students consisted of 30 grade VII students who had taken the material on temperature, heat, and heat transfer. The results of the student questionnaire assessment can be seen in TABLE 6. In addition to filling out questionnaires, students also provide comments and suggestions related to computer-based science literacy instruments integrated with local wisdom, which researchers will use to improve draft II to draft III. Based on the questionnaire, the average practicality of science-based literacy instruments was obtained *on the* computer which has been developed is 3.31 with a very practical category. There

are several revisions made by the author based on comments and suggestions from students, such as replacing unclear images and repairing editors who confuse students. FIGURE 2 shows the appearance of the revised draft III on different

Based on the questionnaire, it was found that the average practicality of computer-based science literacy instruments integrated with local wisdom that had been developed was 3.31, with a very practical category. This study succeeded in producing a computer-based scientific literacy instrument integrated with local wisdom that is valid and has a high level of practicality. This is in line with the research that has been done by Zahro, Sumarni & Linuwih (2021) able to produce a science literacy instrument with a valid category at a percentage of 79.99%, instrument practicality with a very practical category of 87.5% student responses and 94.23% teacher responses.

**TABLE 6** Results of Student Response Questionnaire Assessment at the Development Testing Stage.

No	Assessed Aspect Indicator	Average Score	Criteria
1	Easy to understand	3.13	Practical
2	Illustrations and pictures	3.23	Practical
3	The usefulness of the discourse given	3.43	Very practical.
4	Loading critical thinking	3.43	Very practical.
5	Information clarity	3.33	Very practical.
6	Benefits to add insight	3.37	Very practical.
7	Ease of display on quizzz	3.27	Very practical.
	Average	3.31	Very practical.



**FIGURE 2.** (a) Display of scientific literacy instruments on quizzz using a computer, (b) display of scientific literacy instruments on quizzz using a smartphone

### Stage Disseminate

Instrument questions that have gone through the stages of expert appraisal and development testing then tested on students on a larger scale, as many as 200 students. The results were then analyzed to see the reliability value of the question instrument using the Kuder-Richardson 20 (KR-20) method. The results of the product reliability analysis show a value of 0.878, which is then translated according to the reliability criteria according to Surapranata and Muhammad (2006) in TABLE 5, which shows that the scientific literacy instrument based on *the* computer has very high reliability. This means that

when the instrument is tested repeatedly, it will show relatively the same and constant measurement results (Alwi 2010). Meanwhile, in their research, Zahro, Sumarni and Linuwih (2021) produced a scientific literacy instrument with a KR-20 of 0.65. These results indicate that the computer-based scientific literacy instrument integrated with Bengkulu local wisdom has a higher reliability value than previous research. TABLE 7 shows the reliability results of the science literacy instruments based on the PISA framework using SPSS.

TABLE 7. Instrument Reliability Results Using SPSS

Cronbach's Alpha	Category	N of Items
0.878	Very Good	20

The majority of students responded positively to the use of quizizz in the assessment process in the pandemic era. This is in line with the research that Darmawan, Daeni have done show the positive responses of students more than 50% of the total students. At this stage, the instrument of science literacy on quizizz can be accessed anytime and anywhere by all Indonesian students without exception so that it makes it easier for students to access the question, especially during the COVID-19 pandemic. This allows for much wider use and the hope that this computer-based science literacy instrument integrated with local wisdom becomes an exercise material for students to train science literacy skills.

## CONCLUSION

Based on the results of the data analysis carried out, a computer-based science literacy instrument that is integrated with Bengkulu local wisdom has been produced to measure the scientific literacy ability of junior high school students, which is tested valid with an average validation score of 4.62, practical with an average student response questionnaire of 3.31 and has high reliability with cronbach's alpha value of 0.878. A total of 20 question instruments were developed covering 3 aspects, namely: context aspects, knowledge aspects, and competency aspects, according to the 2018 PISA framework. As well as the phenomena and problems presented in the questions are adjusted to the thinking patterns of junior high school students and local wisdom in the area where students live so that it can be used well to measure and train the science literacy skills of junior high school students.

The researcher suggests that further research should be done on the discussion of different content, considering the many choices of content based on the framework of scientific literacy PISA 2018. Then develop local wisdom science literacy instruments in other areas. In addition, it is necessary to take an attitude toward junior high school students' low scientific literacy skills and further research related to the learning process to improve students' scientific literacy skills.

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