INNOVATIONS IN ASSESSING STUDENTS' DIGITAL LITERACY SKILLS IN LEARNING SCIENCE: EFFECTIVE MULTIPLE CHOICE CLOSED-ENDED TESTS USING RASCH MODEL

Fitria LAFIFA

ORCID: 0000-0003-3636-5581
Faculty of Mathematics and Natural Sciences
Yogyakarta State University
Yogyakarta, INDONESIA

Dr. Dadan ROSANA

ORCID: 0000-0003-4987-7420
Faculty of Mathematics and Natural Sciences
Yogyakarta State University
Yogyakarta, INDONESIA

Received: 21/09/2023 **Accepted:** 15/11/2023

ABSTRACT

This research goal to develop a multiple-choice closed-ended test to assessing and evaluate students' digital literacy skills. The sample in this study were students at MTsN 1 Blitar City who were selected using a purposive sampling technique. The test was also validated by experts, namely 2 Doctors of Physics and Science from Yogyakarta State University. The test instrument was developed based on five aspects of digital literacy skills: information, communication, content creation, security and problem-solving. Data have been analyzed descriptively and inferentially using the Rasch version and the assist of Quest software. The results showed that eight multiple-choice closed-ended test instruments were declared valid based on expert validation with an Aiken V value of 1.00. The reliability result is 0.97 with a very high category, and the INFIT MNSQ standard deviation value is 0.86 - 1.16, so seven items are by the Rasch model. Thus, the seven items in the multiple-choice closed-ended test instrument can be used to assessing and evaluate students' digital literacy skills in learning science.

Keywords: Closed-ended test, digital literacy, science learning, rasch model.

INTRODUCTION

In the modern era marked by the rapid advancement of digital technology, digital literacy has become essential for individuals to participate actively in an increasingly technologically connected society (Muhali, 2019; Nicholson, 2017). The increased use of digital devices and online platforms in various aspects of life has strengthened the importance of mastering digital literacy skills, especially among students, for future provision (Mardhiyah et al., 2021; Rahayu et al., 2022; Reddy et al., 2023). The increased use of digital technology in various aspects of life has confirmed the importance of mastering digital literacy skills for students and has an impact on education (Chetty et al., 2018; Churchill, 2020).

Technological developments have changed the paradigm of traditional learning. This is in line with the transformation of education driven by technology. Students not only understand academic material, but must also be able to interact with digital technology, understand online information, and think critically about widespread digital content (C. Hague & Payton, 2021; Tang & Chaw, 2016; Tristiana & Kayyis, 2022). Digital literacy involves utilizing technology to access, acquire, understand, analyze, evaluate, create and communicate knowledge in various contexts (Alexander et al., 2016; Dwyer, 2023). Learners need to develop skills in understanding the content of technology-based digital media contexts to become better

prepared to live and interact in a digital-based society (Erwin et al., 2022). Digital literacy is understanding and using information from various sources widely accessed via computers (Gilster, 1997).

Learning using digital media can make students have an attitude of understanding, appreciating and being involved in social interaction and collaboration, interpersonal and communication skills, this is because the media can be used flexibly and is able to create interaction (Gilpin, 2020). When using social media, you must have digital literacy skills because when using media, students are required to be creative and create learning experiences (Romero-Hall & Li, 2020). Schools all over the world need digital literacy skills in learning for both teachers and students because digital literacy can help teachers and students develop their critical thinking skills in dealing with situations (Coker, 2020).

The results of initial observations, most students can operate digital devices such as smartphones. However, students need help using various applications and platforms to facilitate learning, such as Google Meet and Google Classroom. Even though there are efforts to use digital technology, some students still need help to complete assignments, even though digital technology has been involved. The digital literacy skills possessed by students at MTsN 1 Blitar City can be described as having mastery over technological developments, where they have skills in using digital media in learning contexts. However, there still needs to be more understanding of using digital media for educational purposes and the ability to manage and interpret information obtained through digital media.

In addition, the problem is that most schools still need to thoroughly teach digital literacy as a basis for literacy, which is equivalent to literacy in reading, arithmetic and writing (Coffin Murray & Perez, 2014). Research that has been conducted has found that the level of digital literacy skills of students is classified as moderate (Ussarn et al., 2022). In addition, currently, Indonesia has begun to develop students' digital literacy skills; this is evidenced by the existence of several efforts from educators, beginning with the use of gear in gaining knowledge of, the use of digital media in training, then additionally analyzing the effect of virtual literacy in information, digital literacy, digital competence, digital literacy abilties, digital collaboration, digital generation, literacy, generation, pc literacy, and others (Ibda & Syamsi, 2023; Ibda et al., 2023).

Developing adequate test kits is essential to assessing students' digital literacy skills. In learning, a test or question can be grouped into two: closed-ended and open-ended. Closed-ended such as true-false, multiple choice, and matching. At the same time, open-ended are free-response, short answer, and essay writing (Brassil & Couch, 2019). Multiple choice tests contain several questions to be answered by test takers whose answers are clear, right and wrong, and there is only one correct answer (Sukendra & Atmaja, 2020). Objective tests have several advantages. That is, the coverage of material on objective tests is relatively broad, the level of validity and reliability is very high, and it can be used for many participants (Widiyanto, 2018).

Closed-Ended questions in a survey or questionnaire require respondents to choose answers from a predetermined set of choices (Klofstad, 2005). Closed-ended is more accessible online because it requires only one button or response but can bias the reaction (Connor Desai & Reimers, 2019). The advantages of closed-ended are that respondents can answer questions quickly, it's easier to answer, and the data obtained is faster to analyze (Hyman & Sierra, 2016).

The Rasch model is a statistical model used to develop test items and provide information relevant to student learning progress (Boone, 2016). Analysis using the Rasch model can increase reliability and validity due to the separation with the diagnosis of analysis of items suitable for use and samples not eligible for use (T. Bond, 2015). When used in testing data collection instruments, research using the Rasch model can produce precise and accurate data analysis (Rabbitt, 2018; Bambang Sumintono, 2018).

This instrument can provide an overall picture of the extent to which students have digital literacy skills. In addition, this instrument can also assist in designing a curriculum that is more in line with the demands of 21st-century digital literacy. Considering the current global context where technology is increasingly penetrating every aspect of life, innovation in measuring students' digital literacy skills is essential in shaping young people ready to face future challenges.

Based on this description, the hassle in the area is figuring out the extent of digital literacy competencies of junior high school students. So it is necessary to research developing evaluation instruments to assessing and evaluate students' digital literacy abilities. This research aims to create a multiple-choice closed-ended

test instrument to measure and assess digital literacy skills that are valid, feasible, and reliable. The results of this study can be the basis for measuring students' digital literacy skills. Thus, this research can contribute to education development in Indonesia.

METHOD

This research is quantitative research with a survey method. This study aims to develop a multiple choice closed-ended test to assessing students' digital literacy skills. The effects of this study can be the premise for measuring college students' virtual literacy talents. statistics had been analyzed descriptively and inferentially with the Rasch model the use of Quest. Analysis the usage of the Rasch version is used to expect missing object statistics primarily based at the consequences of response styles (B. Sumintono & Widhiarso, 2014).

Participants

The research sample was MTsN 1 Blitar City students, with a total sample of 127 students and two doctors Yogyakarta State University. The sample selection technique is purposive sampling.

Data Collection and Analysis

The first stage in developing the test is defining digital literacy skills and synthesizing digital literacy ascpects from several experts used in developing the test. The aspects used in the post-modification test are internet searches, hypertext guides, content and information evaluation, and knowledge compilation. According to Gilster (1997), digital literacy aspects are internet searching, hypertextual navigation, content evaluation, and knowledge assembly. According to Bawden (2008), digital literacy aspects are content evaluation, hypertext navigation, knowledge assembly, and internet search. Meanwhile, according to Hague and Payton (2013), aspects of digital literacy are functional skills and beyond, creativity, collaboration, communication, e-safety, critical thinking and evaluation, and the ability to find and select information. Aspects from several experts were synthesized and modified to produce several aspects used in this research. The indicators resulting from modification of these aspects are arranging ways of searching for information from the media, optimizing directions in the media, clarifying the truth of the information content, assessing the suitability of the information content, and building new knowledge. At this stage, it also carried out the preparation of research instrument drafts. At this stage, we start compiling a multiple-choice closed-ended instrument grid. The draft instrument that has been made will be assessed by experts to see the suitability of the aspects with the tests on each instrument item. The test developed is a multiple choice closed-ended test with 13 items. This test is to assessing students' digital literacy skills. There are four choices for each question.

The stage is submitting content validation which is carried out by 2 Doctors who are experts in their fields. The instrument for assessing content validity is an assessment sheet filled in by the validator. The assessment sheet contains valid and invalid aspects with a concordance between the question items and digital literacy aspects, accompanied by a column for suggestions and comments. The scale used in assessing validity uses a Likert scale with a level of 5 (Likert, 1932). The content validation stage was carried out by 1 Doctor of Physics and 1 Doctor of Science from Yogyakarta State University, who were asked to review 13 item questions. The validator assesses the question items based on the digital literacy test criteria on the validation sheet. The validation sheet has been tested for the validity of the instrument. The validators report their validation results and provide feedback on items they think require revision, and all necessary revisions have been made.

Content validation is the stage that indexes the validity of the test to measure what is to be measured (Cheng et al., 2021). Content material validity is related to whether the items in the test constitute the components of the content material of the material being measured or the quantity to which the object is by using the factors being measured (Azwar, 2012). Items that meet the standards and requirements will pass, but items that do not meet the criteria will be discarded (Ayre & Scally, 2014). The validation sheet is filled using a Likert Scale with five scales. The scores obtained from the validation results were analyzed statistically to determine content validity based on expert agreement with Aiken's validity content. Determination of Aiken's validity content by comparing the assessment of one item assessed by n raters with a value range of V

from 0-1. Aiken's validity content is an index of expert agreement on the suitability of the indicator items to be measured using these items. Aiken's validity content formula is as follows (Aiken, 1985).

$$V = \frac{\Sigma s}{[n\,(c-1)]}$$

$$s = r - lo$$

In which r is the category score given by means of the rater, lo is the lowest score in the scoring class, c is the number of categories the rater can pick out from, and n is the range of validators or raters. The product content material validity criteria had been decided based on Aiken's V , as presented in Table 1.

Table 1. The minimum value of Aiken's V

No. of Items (m) or Raters (n)	Number of Rating Categories (c)											
	2		3		4		5		**6**		**7**	
	V	p	V	p	V	p	V	p	V	p	V	p
1							1.00	0.040	1.00	0.28	1.00	0.020
2							1.00	0.008	1.00	0.005	1.00	0.003
3			1.00	0.37	1.00	0.16	0.92	0.032	0.87	0.046	0.89	0.029

Then perform the examine via growing a multiple choice closed-ended tool layout on Google forms. This goals to make it easier for college students to fill inside the device. An analysis of empirical tests or field exams is achieved to decide the characteristics or validity of the gadgets. Item evaluation turned into performed with the assist of an object evaluation program, the hunt software. Object evaluation turned into finished to decide the reliability and trouble stage of the gadgets. The items will healthy in the event that they comply with the Rasch version, with the INFIT MNSQ price being between 0.77 – 1.33 and the OUTFIT t ≤ 2 with a chance of 0.5. Evaluation the use of the Rasch version has the gain that there's a level of man or woman potential or settlement, and the level of issue of the objects to be authorized can be defined with a statistical precis.

FINDINGS

In this section, the research results are presented. the results of research on Digital Literacy Multiple Choice Closed-Ended Test Aspects are presented in Table 2. Meanwhile, examples of development results can be seen in Figure 1.

Table 2. Digital Literacy Multiple Choice Closed-Ended Test Aspects

Aspects	Indicators	Items
Internet searching	Develop procedures for searching for information on the internet and digital learning media	1
		2
	Collect information from the internet and media effectively and efficiently	3
		4
		5
Hypertextual navigation	Optimizing hypertext navigation in digital learning media and websites	6
		7
Content evaluation	Clarify the validity and completeness of the information content obtained	8
		9
	Assess the appropriateness of the information content	10
		11
Knowledge assembly	Build knowledge from information	12
		13

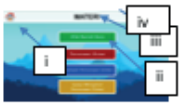
Aspek	Indikator	Indikator soal	Soal
	Mengumpulkan informasi dari internet dan media secara efektif dan efisien	Memilih sumber informasi untuk membuat karya tulis ilmiah	Yana akan membuat karya tulis ilmiah mengenai solusi untuk pemanasan global berupa mobil panel surya. Untuk membuat karya tulis yang baik, dia harus mencari sumber informasi terbaru. Agar hal itu dapat tercapai, maka yang perlu dilakukan Yana adalah.... A. menonton youtube, lalu menulis sesuai solusi yang ditunjukkan B. membaca blog tentang panel surya C. berdiskusi dengan teman di media sosial D. mengunduh hasil jurnal penelitian yang inovasi
Pandu arah (Hypertextual navigation)	Mengoptimalkan pandu arah (navigasi) hypertext dalam media pembelajara digital dan website	Memilih pandu arah untuk animasi efek rumah kaca	Perhatikan gambar di bawah ini!  Indah ingin memilih animasi efek rumah kaca. Petunjuk yang memudahkan untuk memilih animasi efek rumah kaca adalah.... A. i B. ii C. iii D. iv
		Menjalankan simulasi tentang efek rumah kaca	Perhatikan langkah-langkah menjalankan simulasi online efek rumah kaca pada website di bawah ini. i. Memilih topik yang sesuai dengan simulasi

Figure 1. Example of Digital Literacy Multiple Choice Closed-Ended Questions

The results of content validation carried out by experts can be seen in Table 3.

Table 3. Content Validation Results based on Aiken's V

Indicator	Sub Aspect	Items	V'Aikens _	V 'Aikens Per aspect	Category
Internet searching	Develop procedures for searching for information on the internet and digital learning media	1	1	1	High
		2	1		High
	Collect information from the internet and media effectively and efficiently	3	0.88		High
		4	0.75	0.88	Currently
		5	1		High
Hypertextual navigation	Optimizing hypertext navigation in digital learning media and websites	6	1	1	High
		7	1		High
Content evaluation	Clarify the validity and completeness of the information content obtained	8	1	0.94	High
		9	0.88		High
	Assess the appropriateness of the information content	10	0.88	0.94	High
		11	1		High
Knowledge assembly	Build knowledge from information	12	1	0.94	High
		13	0.88		High

The results of the Rasch model analysis using Quest are described in Figure 2 is a map of items and persons, Figure 3 shows the items' distribution based on their fit with the Rasch model, and Figure 4 of item difficulty level.

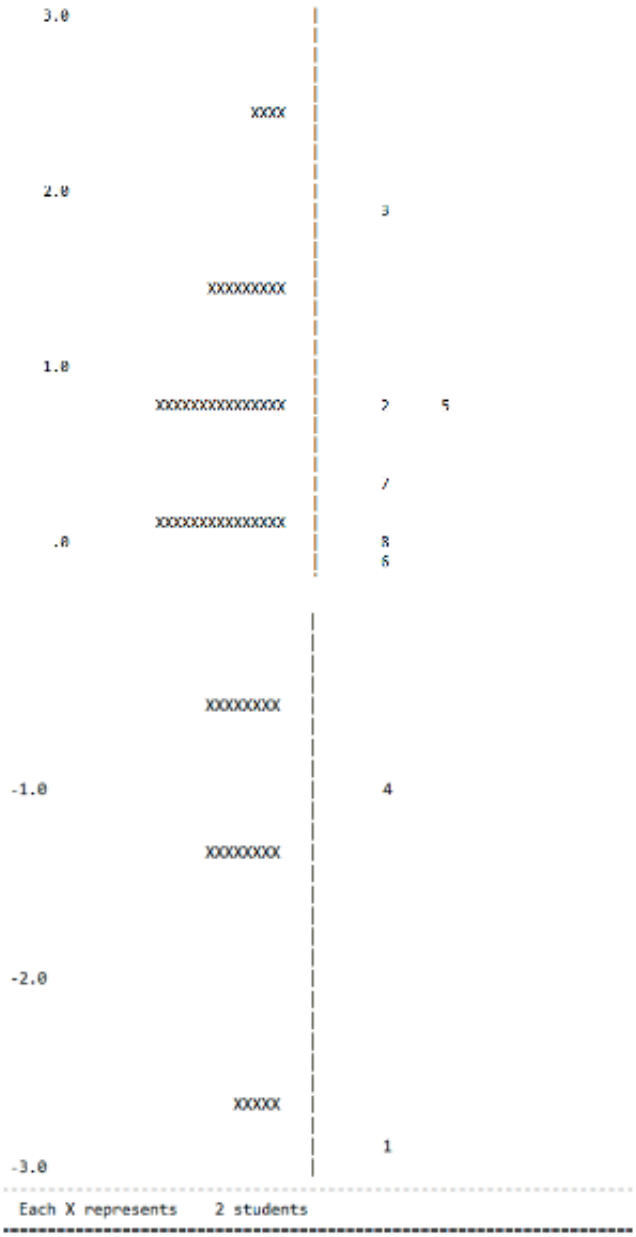


Figure 2. Item and person map

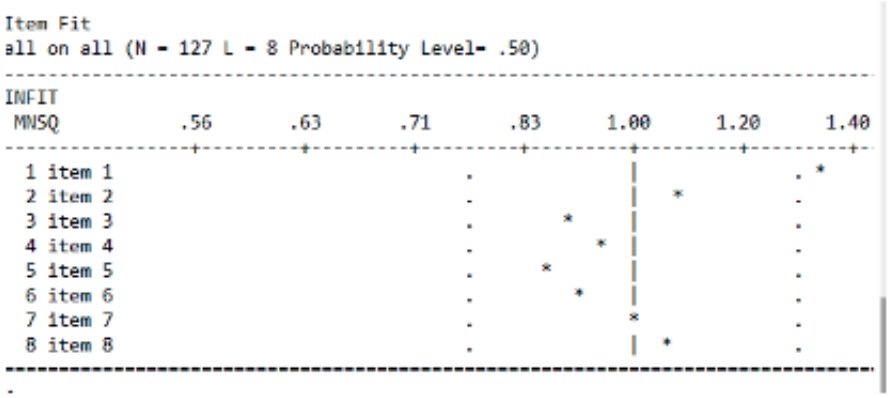


Figure 3. Distribution of items

	ITEM NAME	SCORE	MAXSCR	THRSH 1	INFT MNSQ	OUTFT MNSQ	INFT t	OUTFT t
1	item 1	116	127	-2.90 .40	1.33	2.01	1.2	1.3
2	item 2	44	127	.85 .21	1.07	1.10	.8	.5
3	item 3	21	127	1.92 .26	.89	.81	-.7	-.4
4	item 4	92	127	-1.08 .24	.95	.83	-.4	-.6
5	item 5	45	127	.81 .21	.87	.73	-1.6	-1.3
6	item 6	69	127	-.09 .21	.91	.83	-1.0	-1.0
7	item 7	55	127	.43 .21	1.01	1.06	.1	.4
8	item 8	65	127	.06 .21	1.07	1.05	.8	.4
Mean				.00	1.01	1.05	-.1	-.1
SD				1.46	.15	.41	1.0	.9

Figure 4. Item difficulty level

Table 4 describes the fit and misfit items. The manner to discover healthy and misfit gadgets is to evaluate the INFIT MNSQ value with the sum of the mean and preferred deviation values.

Table 4. Empirical Test Results or Reliability

Mean	SD	SD (adjusted)	Reliability of estimate	Infit Mean Square		Outfit Mean Square		Infit t		Outfit t	
				Mean	SD	Mean	SD	Mean	SD	Mean	SD
0.00	1.46	1.44	0.97	1.01	0.15	1.05	0.41	-0.08	0.98	-0.08	0.88

DISCUSSIONS and CONCLUSION

On this segment, it's miles explained the outcomes of research and on the equal time is given the comprehensive discussion. The dialogue can be made in numerous sub-sections.

Development of Multiple Choice Closed-Ended Tests

In an era characterized by rapid advances in digital technology, digital literacy has become necessary for individuals to participate effectively in a modern, increasingly technologically connected society. With the increasingly widespread use of digital devices and internet access, digital literacy skills are fundamental in accessing, understanding, and interacting with digital information. Therefore, developing effective measurement instruments to assessing students' digital literacy skills is becoming increasingly important, especially in education, which is increasingly integrated with technology.

Within the scope of education, educators and educational institutions are responsible for preparing students to face an increasingly technologically connected world. Effective digital literacy assessingment instruments will help identify areas where students need to improve in terms of digital literacy skills. In addition, this instrument can also guide educators in designing learning that is more relevant to the demands of 21st-

century digital literacy. In growing this instrument, important elements of digital literacy, which includes the capability to use technology, apprehend statistics severely, and think creatively in a virtual surroundings, had been considered.

The Digital Literacy ability of students currently needs to improve. consequently, primarily based on the needs analysis that has been performed and the facts inside the area, it's miles essential to expand a take a look at to assessing college students' digital literacy abilities. The check advanced is within the shape of a multiple desire closed-ended check with 4 answer picks. This test targets junior high school students in grades 7 to 9. The aspects and indicators used in the preparation of this test refer to digital literacy aspects from several experts, namely internet searches, hypertext guides, evaluation of content and information, and compilation of knowledge (Bawden, 2008; Eshet-Alkali & Amichai-Hamburger, 2004; Gilster, 1997; Cassie Hague & Payton, 2013). Digital literacy aspects and an explanation of each item's questions can be seen in Table 2. Meanwhile, examples of development results can be seen in Figure 1.

Content Validation by Experts

The results of content validation carried out by experts can be seen in Table 3. In Table 3, it can be seen that five items have a value of less than 1. Item 3 has an aiken v value of 0.88; item 4 has a value of 0.75; items 9, 10, and 13 have a value of 0.88. These five items have a value of less than 1, so they are not sufficient for the rules of Aikens V (Aiken, 1985). Due to inadequate, these five items need to be revised. The validators provided suggestions and comments for improvement, namely in written item questions and the relevance of animations in questions related to aspects.

Reliability test using the Rasch Model

After going through the validation stage by expert lecturers, the digital literacy ability test instrument is then carried out in empirical or reliability trials. Empirical check analysis or evaluation of the Rasch version became done using the QUEST program. The ability of digital literacy tested as many as eight closed-ended multiple choices. The results of the Rasch model analysis using Quest are described in Figure 2 is a map of items and persons, Figure 3 shows the items' distribution based on their fit with the Rasch model, Figure 4 of item difficulty level, and Table 4.

Figure 2 is a map of objects and individuals. The right side is the object quantity, while the left is the respondents' distribution, wherein each pass represents 127 respondents. The distribution of objects and respondents is arranged at the identical scale in order that, in fashionable, the items have a better degree of difficulty than the respondents' capacity. Object range 3 is the maximum difficult object.

Figure 3 shows the items' distribution based on their fit with the Rasch model. Content validity uses the Rasch model to determine whether an item's score is significant, meaningful, useful, and purposeful (Mohamad et al., 2015). Whether an item is valid or not can also be determined if the MNSQ Infit value = 0.77-1.30 (Adams & Kho, 1996) and outfit (-2.0 to +2.0) (T. Bond, 2015). The vertical dotted line indicates the range of accepted INFIT MNSQ values. Figure 3 shows seven questions are at the acceptance limit, while 1 question, item 1, is outside the acceptance limit. The acceptance limit for the Rasch model is that the INFIT MNSQ is between 0.77 – 1.33 and the OUTFIT t ≤ 2, so the seven questions follow the Rasch model (Rostina, 2016). Item 1 is outside the acceptance limit, so that item does not fit the Rasch model. This item should be revised or discarded.

Figure four indicates that object 1, out of 127 respondents who spoke back, 116 replied effectively. While the wide variety -2.90 represents the difficulty degree of item (b). The higher the score, the extra hard the hassle. A fee towards -2 manner the object is simply too clean, and vice versa; closer to 2 means the object is too hard. INFIT and OUTFIT values are used to check the accuracy of gadgets with the Rasch model. The quest determines that an object will healthy the model if the INFIT MNSQ cost ranges from zero.77 to one.33 (Adam & S.T., 1996). Some use checks primarily based on the INFIT t fee, specifically, the range between -2 and +2 (T. G. Bond & Fox, 2015).

Item quantity has a fee of 0.85 with a high degree of problem. Object range three has a price of 1.92, that is rather difficult. Item range four has a price of -1.08 which has a low problem level. Item range 5 has a fee of 0.eighty one which has a excessive issue degree. Object range 6 has a fee of 0.43 which has a medium difficulty stage. Object number 7 has a price of 0.forty three which has a medium issue degree. Object wide variety eight has a fee of zero.06 which has a medium problem level.

Table 4 describes the match and misfit gadgets. The manner to discover in shape and misfit items is to compare the INFIT MNSQ price with the sum of the imply and general deviation values. The results of the Quest analysis obtained that the average value Infit MNSQ was 1.01 with a standard deviation of 0.15, and the average value of the Outfit Mean Square was 1.05 with a standard deviation of 0.41. The Infit Mean Square value is 1.01 ± 0.15 or 1.01- 0.15 = 0.86 to 1.01 + 0.15 = 1.16 while the Outfit Mean Square value is 1.05 ± 0.41 or 1.05 - 0.41 = 0.64 to 1.05 + 0.41 = 1.46. The results show that the value of INFIT Mean of INFIT t is -0.08 with a standard deviation of 0.98, and the value of OUTFIT Mean of OUTFIT t is -0.08 with a standard deviation of 0.88. The INTFIT Mean of INFIT t value is -0.08 ± 0.98 or -0.08 -0.98 = -1.06 to -0.08 + 0.98 = 0.9 while the OUTFIT Mean of INFIT t value is -0.08 ± 0.88 or -0.08 – 0.88 = -0.96 to -0.08 + 0.88 = 0.8.

The reliability value indicates that 0.97 belongs to the reliable category and is very high for tests used in learning (Budiastuti & Bandur, 2018). This value indicates that the test instrument developed is a valid test. Consequently, the seven virtual literacy talents questions advanced observe the Rasch model and may be used. This is based at the outcomes of the analysis received. The suggest square infit is within the variety 0.86 -1.16, and the value of outfit t ≤ 2, so usual, seven questions are underneath the Rasch model and can be used to assessing virtual literacy abilties.

The results showed that the development of this multiple-choice closed-ended test instrument succeeded in producing a assessingment tool that could comprehensively assessing students' digital literacy skills. The test instrument has high-quality content validity after going through the stages of expert review and validation. Analysis of the test instrument shows that the test instrument has strong validity in measuring students' digital literacy skills. In addition, instrument reliability testing is carried out to ensure the consistency of assessingment results. In this case, this test instrument shows a high level of reliability, indicating that this instrument can be used for evaluation.

Educational institutions can use this effective multiple-choice closed-ended test instrument to assessing and understand students' digital literacy levels. Assessingment results can provide insight to teachers in designing more effective learning approaches. In addition, this instrument can also assist educational institutions in creating digital literacy programs that suit the needs of students.

An effective digital literacy test tool must assessing various essential aspects of digital literacy skills. The closed-ended test format with multiple choice was chosen because it can provide advantages in objectively measuring digital literacy skills, assessing knowledge and understanding, and assessing applications. It is easy to manage and can be used for various samples in a limited time (AA et al., 2005; Rodriguez, 2015). Closed-ended multiple-choice tests allow examiners to evaluate students' understanding and knowledge more efficiently (Semyonov-Tal & Lewin-Epstein, 2021).

This research relates to the field of open and distance learning. The digital literacy test developed can be used to evaluate students' digital literacy skills in open and distance learning environments. This research can help identify the extent to which students can adapt and participate in the online learning environment. The results of digital literacy tests can provide insight into students' digital literacy abilities. This information can be used to develop and adapt curricula and learning materials to better suit students' digital literacy needs in open and distance learning contexts. The research results guide developing more effective digital learning materials aligned with students' digital literacy needs. This test can help identify aspects that need improvement in digital skills, such as online navigation, information evaluation, and virtual collaboration. Valid and feasible tests can be an effective monitoring tool to measure students' digital literacy progress during the distance learning period. Data from these tests can be used to provide ongoing feedback to students and teachers regarding their digital literacy progress. Implementing digital literacy tests can help improve the quality of online learning by ensuring that students have the skills necessary to succeed in a digital learning environment. Thus, this research can significantly contribute to understanding and improving students'

digital literacy in the context of open and distance learning, which is increasingly important in this digital era. According to experts, there are many aspects of digital literacy skills. For further research can develop tests on other aspects. The number of samples used can be expanded on a large scale to get more accurate results.

Acknowledgements: Author thanks the Research and Community Service Program 2023 DRTPM Ministry of Education, Culture, Research and Technology, Indonesia in most cases, sponsor and financial support.

BIODATA and CONTACT ADDRESSES of AUTHORS

Fitria LAFIFA is a master's student in science education at Yogyakarta State University. Her areas of academic interest are learning analysis, STEM, evaluation questions for critical thinking, educational multimedia, open and distance learning, and the use of the internet and technology in education. She has several journal articles published in international indexes. There are many national and international articles. The papers were submitted and presented at an international seminar and have been published. She also has several copyrights for the learning media she developed.

Fitria LAFIFA
Department Master of Science Education, Faculty of Mathematics and Natural Sciences
Address: Yogyakarta State University, Postal Code 55281, Yogyakarta, Indonesia
Phone: +6285708946764
E-mail: fitrialafifa.2021@student.uny.ac.id

Prof. Dr. Dadan ROSANA is a professor at the Faculty of Mathematics and Natural Sciences, Yogyakarta State University. He also serves as Dean of the Faculty of Mathematics and Natural Sciences, at Yogyakarta State University. His areas of academic interest are learning analysis, curriculum and evaluation questions, educational multimedia, open and distance learning, the future of education, e-learning, the use of the internet, and technology in education. It has many journal articles published in international indexes. There are several learning books and many other national and international articles. Papers were submitted and presented at international seminars. And has several scientific copyrights.

Dadan ROSANA
Department Master of Science Education, Faculty of Mathematics and Natural Sciences
Address: Yogyakarta State University, Postal Code 55281, Yogyakarta, Indonesia
Phone: +6281392859303
E-mail: danrosana@uny.ac.id

REFERENCES

AA, A.-H., EA, A.-F., IA, A., & MO, A.-R. (2005). The criteria and analysis of good multiple choice questions in a health professional setting. *Saudi Medical Journal*, *26*(10), 1505–1510.

Adam, R. J., & S.T., K. (1996). *Acer Quest: The Interactive Test Analysis System*. Victoria: The Australia Council for Educational Research.

Adams, R., & Kho, S.-T. (1996). *Acer Quest version 21*. Victoria: Victoria: The Australian Council for Educational Research.

Aiken, L. R. (1985). Three Coefficients for Analyzing the Reliability, and Validity of Ratings. *Educational and Psychological Measurement*, *45*, 131–142.

Alexander, B., Adams Becker, S., & Cummins, M. (2016). Digital Literacy. *An NMC Horizon Project Strategic Brief*, *3*(3), 1–16. https://doi.org/10.1038/scientificamerican0995-190

Ayre, C., & Scally, A. J. (2014). Critical values for Lawshe's content validity ratio: Revisiting the original methods of calculation. *Measurement and Evaluation in Counseling and Development*, *47*(1), 79–86. https://doi.org/10.1177/0748175613513808

Azwar, S. (2012). *Penyusunan Skala Psikologi edisi 2*. Yogyakarta: Pustaka Pelajar.

Bawden, D. (2008). *Origins and Concepts of Digital Literacy dalam Lankshear, C. dan Knobel, M., Editors (Eds.), Digital Literacies: Concepts, Policies and Practices*. New York: Peter Lang Publishing Inc.

Bond, T. (2015). Applying the Rasch Model. In *Fundamental Measurement in the Human Sciences* (Third Edit, p. 406). New York. https://doi.org/https://doi.org/10.4324/9781315814698

Bond, T. G., & Fox, C. M. (2015). *Applying the Rasch Model Fundamental Measurement in the Human Sciences, Third Edition*. New York: Routledge.

Boone, W. J. (2016). Rasch analysis for instrument development: Why,when,and how? *CBE Life Sciences Education*, *15*(4). https://doi.org/10.1187/cbe.16-04-0148

Brassil, C. E., & Couch, B. A. (2019). Multiple-true-false questions reveal more thoroughly the complexity of student thinking than multiple-choice questions: a Bayesian item response model comparison. *International Journal of STEM Education*, *6*(1). https://doi.org/10.1186/s40594-019-0169-0

Budiastuti, D., & Bandur, A. (2018). Validitas dan Reliabilitas Penelitian. In *Mitra Wacana Media*.

Cheng, L. … Zhu, J. (2021). Upper Ocean Temperatures Hit Record High in 2020. *Advances in Atmospheric Sciences*, *38*(4), 523–530. https://doi.org/10.1007/s00376-021-0447-x

Chetty, K., Qigui, L., Gcora, N., Josie, J., Wenwei, L., & Fang, C. (2018). Bridging the digital divide: Measuring digital literacy. *Economics*, *12*(1). https://doi.org/10.5018/economics-ejournal.ja.2018-23

Churchill, N. (2020). Development of students' digital literacy skills through digital storytelling with mobile devices. *Educational Media International*, *57*(3), 271–284. https://doi.org/10.1080/09523987.2020.1833680

Coffin Murray, M., & Perez, J. (2014). Unraveling the Digital Literacy Paradox: How Higher Education Fails at the Fourth Literacy. *Issues in Informing Science and Information Technology*, *11*, 085–100. https://doi.org/10.28945/1982

Coker, H. (2020). Why Does Digital Learning Matter? Digital Competencies, Social Justice and Critical Pedagogy in Initial Teacher Education. *Journal of Teaching and Learning*, *14*(1), 133–141. https://doi.org/10.22329/jtl.v14i1.6259

Connor Desai, S., & Reimers, S. (2019). Comparing the use of open and closed questions for Web-based measures of the continued-influence effect. *Behavior Research Methods*, *51*(3), 1426–1440. https://doi.org/10.3758/s13428-018-1066-z

Dwyer, B. (2023). E-texts and e-books: constructing meaning with and from texts in an online and digital world. In *International Encyclopedia of Education* (Fourth Edi, pp. 551–562). Elsevier. https://doi.org/https://doi.org/10.1016/B978-0-12-818630-5.07113-X.

Erwin, K., Digital, S., Erwin, K., & Mohammed, S. (2022). *Digital Literacy Skills Instruction and Increased Skills Proficiency To cite this article : Digital Literacy Skills Instruction and Increased Skills Proficiency*.

Gilpin, S. (2020). A Framework for Fostering Emerging Online Learner Persistence: The Role of Asynchronous and Synchronous Discussions. *Journal of Teaching and Learning*, *14*(1), 29–42. https://doi.org/10.22329/jtl.v14i1.6253

Gilster, P. (1997). *Digital Literacy*. New York: Willy.

Hague, C., & Payton, S. (2021). *Digital literacy across the curriculum: a Futurelab handbook*. The National Foundation for Educational Research in England and Wales.

Hague, Cassie, & Payton, S. (2013). Digital Literacy across the Curriculum. In *Literacy across the Curriculum*. https://doi.org/10.18848/978-1-61229-143-7/cgp

Hyman, M. R., & Sierra, J. J. (2016). *Open- versus close-ended survey questions*. (February).

Ibda, H., & Syamsi, I. (2023). *Digital literacy competency of elementary school teachers : A systematic literature review*. *12*(3). https://doi.org/10.11591/ijere.v12i3.24559

Ibda, H., Syamsi, I., & Rukiyati, R. (2023). Professional elementary teachers in the digital era: A systematic literature review. *International Journal of Evaluation and Research in Education*, *12*(1), 459–467. https://doi.org/10.11591/ijere.v12i1.23565

Klofstad, C. A. (2005). Interviews. In *Encyclopedia of Social Measurement* (pp. 359–363). Elsevier. https://doi.org/https://doi.org/10.1016/B0-12-369398-5/00033-5

Likert, R. (1932). A Technique for the Measurement of Attitudes,. In Woodworth (Ed.), *Encyclopedia of Research Design* (140th ed.). New York: Archieves Of Psychology. https://doi.org/10.4135/9781412961288.n454

Mardhiyah, R. H., Aldriani, S. N., Chitta, F., & Zulfikar, M. R. (2021). Pentingnya Keterampilan Belajar di Abad 21 sebagai Tuntutan dalam Pengembangan Sumber Daya Manusia. *Jurnal Pendidikan*, *12*(1), 29–40. Retrieved from https://kns.cnki.net/kcms/detail/11.1991.n.20210906.1730.014.html

Mohamad, M. M., Sulaiman, N. L., Sern, L. C., & Salleh, K. M. (2015). Measuring the Validity and Reliability of Research Instruments. *Procedia - Social and Behavioral Sciences*, *204*(November 2014), 164–171. https://doi.org/10.1016/j.sbspro.2015.08.129

Muhali, M. (2019). Pembelajaran Inovatif Abad Ke-21. *Jurnal Penelitian Dan Pengkajian Ilmu Pendidikan: E-Saintika*, *3*(2), 25. https://doi.org/10.36312/e-saintika.v3i2.126

Nicholson, K. (2017). 4 - Objectives and actions. In *Innovation in Public Libraries* (pp. 127–135). Chandos Publishing. https://doi.org/https://doi.org/10.1016/B978-0-08-101276-5.00004-1.

Rabbitt, M. P. (2018). Causal inference with latent variables from the Rasch model as outcomes. *Measurement: Journal of the International Measurement Confederation*, *120*(May 2017), 193–205. https://doi.org/10.1016/j.measurement.2018.01.044

Rahayu, R., Iskandar, S., & Abidin, Y. (2022). Inovasi Pembelajaran Abad 21 Dan Penerapannya Di Indonesia. *Jurnal Basicedu*, *6*(2), 2099–2104. Retrieved from https://jbasic.org/index.php/basicedu/article/view/2082/pdf

Reddy, P., Chaudhary, K., & Hussein, S. (2023). A digital literacy model to narrow the digital literacy skills gap. *Heliyon*, *9*(4), e14878. https://doi.org/10.1016/j.heliyon.2023.e14878

Rodriguez, M. C. (2015). *Selected-Response Item Formats in Test Development*. New York: Routledge.

Romero-Hall, E., & Li, L. (2020). A Syllabi Analysis of Social Media for Teaching and Learning Courses. *Journal of Teaching and Learning*, *14*(1), 13–28. https://doi.org/10.22329/jtl.v14i1.6246

Semyonov-Tal, K., & Lewin-Epstein, N. (2021). The importance of combining open-ended and closed-ended questions when conducting patient satisfaction surveys in hospitals. *Health Policy OPEN*, *2*(December 2020), 100033. https://doi.org/10.1016/j.hpopen.2021.100033

Sukendra, I. K., & Atmaja, I. K. S. (2020). Instrumen Penelitian. In *Journal Academia*. Pontianak: Mahameru Press.

Sumintono, B., & Widhiarso, W. (2014). *Application of the Rasch model to social science research*. Cimahi: Cimahi: Trim Komunikata Publishing House.

Sumintono, Bambang. (2018). *Rasch Model Measurements as Tools in Assesment for Learning*. *173*(Icei 2017), 38–42. https://doi.org/10.2991/icei-17.2018.11

Tang, C. M., & Chaw, L. Y. (2016). Digital Literacy: A Prerequisite for Effective Learning in a Blended Learning Environment? *Electronic Journal of E-Learning*, *14*(1), 54–65.

Tristiana, N. E., & Kayyis, R. (2022). the Students Response of Using Google Classroom for Online Class. *Journal of English Language Teaching and Applied Linguistics*, *8*(1), 19–27.

Ussarn, A., Pimdee, P., & Kantathanawat, T. (2022). Needs assessment to promote the digital literacy among students in Thai community colleges. *International Journal of Evaluation and Research in Education*, *11*(3), 1278–1284. https://doi.org/10.11591/ijere.v11i3.23218

Widiyanto, J. (2018). Evalusi Pembelajaran. In *Angewandte Chemie International Edition, 6(11), 951–952.* (Vol. 3). Madiun: UNIPMA Press. Retrieved from https://medium.com/@arifwicaksanaa/pengertian-use-case-a7e576e1b6bf