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Validity of Instruments for Assessing Numeration, Digital, and Cultural Literacy Skills for Class VII Junior High School Students

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ABSTRACT

Objective: The research aims to produce an instrument for assessing class VII students' numeracy, digital, and cultural literacy skills. **Method:** This study employed a research and development (R&D) approach using the 4-D model, consisting of the Define, Design, Develop, and Disseminate stages, with the research conducted up to the Develop stage due to time and cost constraints. The method involved expert validation of the numeracy, digital, and cultural literacy assessment instruments using validation sheets that evaluated content, construction, and language, with expert feedback used to refine the instruments. **Results:** The research shows that the numeracy, digital, and cultural literacy assessment instruments are valid and reliable, with validity scores for the three instruments in the very valid category. This indicates that the numeracy, digital, and cultural literacy assessment instruments can be used to measure students' abilities in these literacies. **Novelty:** These findings imply that valid and reliable assessment instruments can strengthen the implementation of competency-based assessment by providing teachers with practical tools to measure numeracy, digital, and cultural literacy skills. Consequently, the instruments can facilitate evidence-based learning evaluation and support educational policies aimed at developing students' 21st-century competencies.

INTRODUCTION

Education is one of the main pillars in forming competent and competitive quality human resources (Sass et al., 2020). In the era of globalization and the Industrial Revolution 4.0, numeracy, digital, and cultural literacy skills are crucial for students to face future challenges, especially at the junior high school level (Akcanca, 2021; Onur & Kozikoglu, 2020; Sass et al., 2021). Numeracy literacy skills help students understand and use numerical information in everyday life, which plays a role in developing logical and analytical thinking skills. Digital literacy is important to ensure students can use information and communication technology effectively. Students with digital literacy skills can master information technology, which increasingly dominates various aspects of life. Meanwhile, cultural literacy helps students understand and appreciate cultural diversity, which is important in forming national character and identity, thereby creating an inclusive and harmonious society (Pratama et al., 2020; Rahmawati & Suhendri, 2016; Salsabella & Juanengsih, 2021).

Students cannot easily acquire numeracy, digital, and cultural literacy skills. However, improving literacy skills requires practice, perseverance, and cooperation among various parties (Elliot & Southern, 2021; Govorova et al., 2020; Herman et al., 2022; Jackson, 2022; Molina-Muñoz et al., 2023). Ways that can improve numeracy, digital, and cultural literacy skills include developing assessment instruments (Prayitno et al., 2023; Wardhani

& Oktiningrum, 2022). Having an instrument for assessing numeracy, digital, and cultural literacy skills can help students train their critical thinking skills regarding problems that can occur in everyday life (Kurniasi et al., 2023; Wardhani & Oktiningrum, 2022; Yasin et al., 2023). Therefore, it is important to know to what extent the development of assessment instruments can improve students' abilities in terms of numeracy, digital, and cultural literacy. So, the resulting assessment instrument can be used as evaluation and reflection material to measure students' numeracy, digital, and cultural literacy skills. As well as improvement in education (Purnomo et al., 2022).

Assessment of junior high school students' numeracy, digital, and cultural literacy skills is crucial to ensure they possess the competencies needed to meet future challenges (Hapsarini et al., 2023). However, the assessment must be accurate and valid, so a tested and reliable assessment instrument is needed. A valid assessment instrument provides reliable results and aligns with the measurement objectives (Elliot & Southern, 2021; Maulana, 2022). The validity of assessment instruments includes several aspects, including content validity, construct validity, and external validity. Content validity ensures that the instrument covers all aspects to be measured; construct validity ensures that the instrument measures the construct in question. External validity ensures that the assessment results can be generalized to a wider context (Dewi et al., 2020).

Many studies have been conducted on the validity of numeracy and digital literacy assessment instruments in various countries, such as those focused on the development of digital literacy instruments (Nugrahini & Fajaryati, 2023), as well as those focused on numeracy literacy (Apipah et al., 2023; Zulfayani et al., 2024). However, comprehensive research on cultural literacy assessment instruments is still limited. In addition, research tends to focus on only one type of literacy (for example, numeracy or digital literacy), without integrating the three types of literacy into one instrument.

Therefore, this study aims to test the validity of instruments for assessing numeracy, digital, and cultural literacy skills in junior high school students. With a valid instrument, it is hoped that accurate data can be obtained regarding students' abilities in these three domains, which can then be used to develop more effective curricula, teaching methods, and educational policies. This research is also expected to make a significant contribution to efforts to improve the quality of education in Indonesia, especially at the junior secondary education level.

RESEARCH METHOD

This research is development research (R&D) aimed at producing an instrument for assessing numeracy, digital, and cultural literacy skills among junior high school students using the 4-D Development Model. The stages of the 4-D Development Model are Define, Design, Develop, and Disseminate (Hariyanti & Rindawati, 2022). In this research, we only reached the Develop stage due to time and cost limitations, so the Disseminate stage was not carried out. The modified 4D model is shown in Figure 1 below.

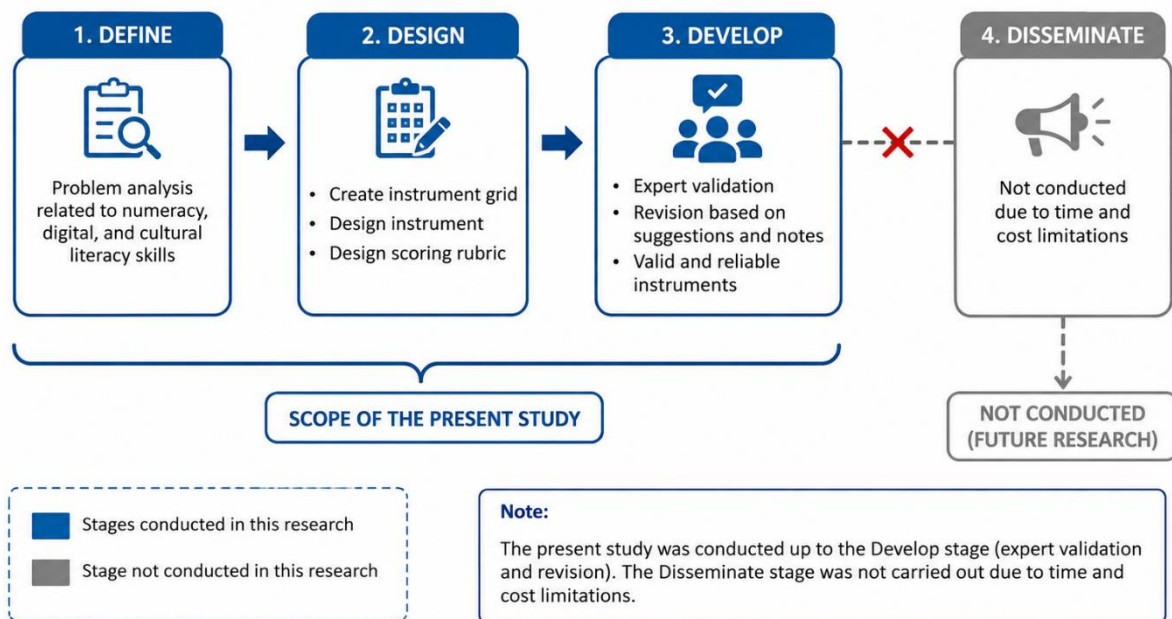


Figure 1. 4D design modification

The data taken is the result of expert validation regarding instruments for assessing numeracy literacy, digital literacy, and cultural literacy skills. The validation process for digital literacy and cultural literacy assessment instruments was conducted by two validators, namely education expert lecturers, especially in the field of assessment and evaluation. In comparison, the numeracy literacy assessment instrument was assessed by three validators, namely two mathematics education lecturers and one junior high school mathematics subject teacher. The assessment given to validators is in the form of a validation sheet containing content aspects, construction aspects, and language aspects (Husnaini, 2022). There are also instructions for filling out the validation sheet, which contains an assessment score of 1–4 for each question item for each aspect. Apart from that, there are also validator suggestions and notes as improvements for researchers to produce better assessment instruments.

The data from the validation of the instrument for assessing numeracy, digital, and cultural literacy were analyzed quantitatively descriptively, followed by a reliability analysis of the data from the validation analysis to measure validator agreement using the percentage agreement formula where the instrument is said to be reliable if it has a percentage agreement $\geq 75\%$ or as much as 75% of the average validator score is in the valid category. The instrument for assessing numeracy literacy, digital literacy, and cultural literacy skills is said to be valid if it gets an assessment score ≥ 2.51 . To determine the validity of the instrument, the validation results are interpreted using the criteria (Asy'ari et al., 2018; Rahmawati & Trimulyono, 2021).

RESULTS AND DISCUSSION

Results

This research produced an instrument for assessing numeracy literacy, digital literacy, and cultural literacy skills for junior high school students. The steps for making an

instrument consist of the define, design, and develop stages. This research was carried out only up to the development stage due to time and cost constraints, so the dissemination stage was not conducted. At the define stage, researchers analyzed existing problems in schools (Sass et al., 2021). These were related to numeracy, digital, and cultural literacy skills. Problem analysis was carried out on class VII students of State Middle Schools in South Palu District, namely SMP Negeri 6 Palu and SMP Negeri 21 Palu. The results show that students' numeracy and cultural literacy skills are in the low category, while digital literacy skills are in the medium category.

Next, during the design stage, researchers developed an instrument to assess numeracy, digital, and cultural literacy skills among junior high school students. The instrument design produced a grid of questions and a scoring rubric. The design of the instrument grid for assessing numeracy literacy skills is presented in Table 1.

Table 1. Numeracy literacy question item grid

Basic Competencies	Indicators	Cognitive Level	Question Numbers	Question Form
3.2 Explain and perform arithmetic operations on whole numbers and fractions by utilizing various operational properties.	3.2.4 Able to solve mathematical problems involving integer arithmetic operations by utilizing the properties of operations that have been understood.	Understanding	1, 2	Multiple choice
		Application	3, 4	Multiple choice
		Reasoning	5	Multiple choice

The instrument for assessing numeracy literacy abilities comprises 5 multiple-choice questions with 4 answer choices, covering the cognitive levels of understanding, application, and reasoning. In the numeracy literacy instrument, the questions are given in the form of story questions, which are preceded by a fragment of the folk story "Raja Nggaluku," which originates from Central Sulawesi.

Apart from designing assessment instruments, researchers also designed answer keys as an aid in checking student answer sheets. The instrument for assessing digital literacy skills uses a measurement framework originating from the Ministry of Communication and Informatics, which consists of seven indicators in four dimensions. The grid on the digital literacy instrument is presented in Table 2.

Table 2. Digital literacy instrument grid

Aspects	Indicators	Item
Information and Data Literacy	Information and Data Literacy	1, 2, 3, 4
	Critical Thinking	5, 6, 7, 8
Communication and Collaboration	Communication Ability	9, 10, 11, 12
	Ethics in Technology	13, 14, 15, 16
Security	Personal Security	17, 18, 19, 20
	Device Security	21, 22, 23, 24
Technology Capabilities	Ability to use Technology	25, 26, 27, 28

The digital literacy skills instrument produces 28 questions in questionnaire form. Meanwhile, the cultural literacy instrument refers to the culture found in Central Sulawesi Province, where the grid is presented in Table 3. The cultural literacy ability assessment instrument produces 21 questions in the form of a multiple-choice test, as seen in Table 3.

Table 3. Cultural literacy instrument grid

Aspects	Indicators	Item
Introduction to Culture	Ethnicity and Tribe	1
	History	2
	Historical Heritage Site	3
	Cultural heritage	4
History and Cultural Heritage	Local language	5, 6, 7
	Folklore	8, 9
	Traditional weapon	10
	Regional Traditional House	11
	Traditional game	12
	Folk songs	13
	Traditional musical instruments	14
Art and culture	Regional Dance	15
	Festival	16
Traditional Traditions and Ceremonies	Traditional Traditions and Ceremonies	17, 18
Culinary/Traditional Food	Traditional food	19
Cultural Participation	Cultural Activities	20, 21

The next stage is the development stage, where expert validation is conducted on the assessment instrument developed by the researcher (Sass et al., 2021). This research aims to produce valid and reliable instruments for assessing numeracy, digital, and cultural literacy skills (Elliot & Southern, 2021). The characteristics of the questions are said to be good, one of which is that they are valid. Test questions declared valid are obtained through a validation process, an important step in instrument development to ensure suitability for use at the next stage (Putra, 2022). This validation process aims to determine the validity and reliability level of an instrument (Cuervo Sánchez et al., 2021; Rahmawati & Trimulyono, 2021).

Validation results for the numeracy literacy instrument were obtained from two mathematics lecturers and one junior high school mathematics teacher. The three validators provided input and suggestions for the development of the instrument. The validation results from the three validators were then analyzed by averaging the assessment results of the three validators and then calculating the average for each item. Analysis of reliability results using the percentage agreement formula assessed the consistency between the three validators in assessing the numeracy literacy assessment instrument that has been developed. The percentage agreement results from the three validators are presented in Table 4.

Table 4. Percentage agreement results for numeracy literacy instruments from three validators

Items	Aspects	A-B	A+B	Difference Ratio	Agreement Value	Percentage Agreement	Reliability Score	Information
1	Content	0.5	7.5	0.067	0.933	93.3%	96.4%	Reliable
	Construction	0.13	7.88	0.016	0.984	98.4%		
	Language	0.2	7.8	0.026	0.974	97.4%		
2	Content	0.5	7.5	0.067	0.933	93.3%	96.4%	Reliable
	Construction	0.13	7.9	0.016	0.984	98.4%		
	Language	0.2	7.8	0.026	0.974	97.4%		
3	Content	0.5	7.5	0.067	0.933	93.3%	96.4%	Reliable
	Construction	0.13	7.9	0.016	0.984	98.4%		
	Language	0.2	7.8	0.026	0.974	97.4%		
4	Content	0.25	7.75	0.032	0.968	96.8%	97.5%	Reliable
	Construction	0.13	7.9	0.016	0.984	98.4%		
	Language	0.2	7.8	0.026	0.974	97.4%		
5	Content	0.25	7.75	0.032	0.968	96.8%	97.5%	Reliable
	Construction	0.13	7.9	0.016	0.984	98.4%		
	Language	0.2	7.8	0.026	0.974	97.4%		

Based on the results of the analysis above, the degree of reliability criteria based on the percentage agreement formula of the three validators is declared reliable because the average score calculation obtained is $\geq 75\%$ for all items (Asy'ari et al., 2018; Rahmawati & Trimulyono, 2021). Furthermore, in Table 5 the results of the validation of the numeracy literacy ability assessment instrument are presented.

Table 5. Validation results of the numeracy literacy instrument from three validators

Items	Aspects	Averages	Validity Scores	Categories
1	Content	3.83	3.87	Very Valid
	Construction	3.92		
	Language	3.87		
2	Content	3.75	3.85	Very Valid
	Construction	3.96		
	Language	3.87		
3	Content	3.83	3.87	Very Valid
	Construction	3.92		
	Language	3.87		
4	Content	3.92	3.9	Very Valid
	Construction	3.92		
	Language	3.87		
5	Content	3.92	3.9	Very Valid
	Construction	3.92		
	Language	3.87		

Based on the results of the percentage agreement analysis, which falls within the reliable category, and all question items are in the very valid category, the developed numeracy literacy ability assessment instrument can be used as a reference in the next stage, namely the trial stage (Elliot & Southern, 2021). Validation results for digital literacy instruments were obtained from two education lecturers, especially in learning assessment and evaluation. Both validators provided assessments without any revisions. In other words, the instrument can be used immediately. To analyze the reliability results

using the percentage agreement formula as consistency between the two validators in assessing the digital literacy ability assessment instrument, it is presented in Table 6 below.

Table 6. Percentage agreement results for digital literacy instruments from two validators

Aspects	A-B	A+B	Difference Ratio	Agreement Value	Percentage of Agreement	Reliability Score	Information
Content	0.5	6.5	0.08	0.923	92.3%	94.58%	Reliable
Construction	0.0	8.0	0.00	1.000	100.0%		
Language	0.6	7	0.09	0.914	91.4%		

Based on the results of the analysis in Table 6, based on the percentage agreement formula from the two validators, it is stated that the instrument for assessing digital literacy skills is reliable because the average score obtained is $\geq 75\%$ (Asy'ari et al., 2018; Rahmawati & Trimulyono, 2021). Furthermore, in Table 7 the results of the validation of the digital literacy ability assessment instrument are presented. Based on the results of the percentage agreement analysis which is in the reliable category and the validation results are in the very valid category, the instrument for assessing digital literacy skills can be used in the next stage, namely trial (Elliot & Southern, 2021).

Table 7. Validation results of digital literacy instruments from two validators

Aspects	Averages	Validity Scores	Categories
Content	3.25	3.58	Very Valid
Construction	4		
Language	3.5		

Validation results for the cultural literacy instrument were also obtained from two expert lecturers in education, particularly in learning assessment and evaluation (Tajeddin et al., 2022). The two validators also provided input and suggestions for the progress of the cultural literacy ability assessment instrument being developed. The validation results from the two validators are then averaged. To find the results of the reliability analysis, use the percentage agreement formula to assess consistency between the two validators in assessing the cultural literacy assessment instrument being developed. Based on the percentage agreement formula from the two validators, it is stated that the instrument for assessing cultural literacy abilities is reliable because the average score obtained is $\geq 75\%$ (Asy'ari et al., 2018; Rahmawati & Trimulyono, 2021). The percentage agreement results from the two validators are presented in Table 8.

Table 8. Percentage agreement results for cultural literacy instruments from two validators

Aspects	A-B	A+ B	Difference Ratio	Agreement Value	Percentage of Agreement	Reliability Score	Information
Content	0.5	6.5	0.08	0.923	92.3%	94.58%	Reliable
Construction	0.0	8.0	0.00	1.000	100.0%		
Language	0.6	7.0	0.09	0.914	91.4%		

Table 9. Validation results of cultural literacy instruments from two validators

Aspects	Averages	Validity Scores	Categories
Content	3.25	3.58	Very Valid
Construction	4		
Language	3.5		

Based on the results of the percentage agreement analysis which is in the reliable category and the validation results are in the very valid category, the cultural literacy ability assessment instrument can be used in the next stage, namely trial (Elliot & Southern, 2021).

Discussion

The findings demonstrate that the developed instruments for assessing numeracy, digital, and cultural literacy skills achieved high levels of validity and reliability through expert validation. The numeracy literacy instrument consists of five multiple-choice items contextualized with local folklore, the digital literacy instrument comprises 28 questionnaire items based on the national digital literacy framework, and the cultural literacy instrument includes 21 reasoned multiple-choice items reflecting the local culture of Central Sulawesi. All instruments were classified as very valid, with percentage agreement values exceeding the minimum reliability criterion of 75%, indicating strong consistency among validators and confirming their suitability for subsequent field testing (Asy'ari et al., 2018; Elliot & Southern, 2021; Sass et al., 2021).

Numeracy, digital, and cultural literacy represent complementary competencies that collectively support students' readiness to meet the demands of 21st-century learning. Numeracy literacy enables students to apply mathematical reasoning to solve contextual problems; digital literacy equips them to access, evaluate, and use digital information responsibly; while cultural literacy fosters awareness and appreciation of local values and identities. Therefore, integrating these three domains within a single assessment framework provides a more comprehensive evaluation of students' competencies than assessing each literacy independently, allowing teachers to capture cognitive, technological, and socio-cultural dimensions of learning simultaneously.

The developed assessment instruments provide teachers with valid and reliable tools to measure students' competencies in numeracy, digital, and cultural literacy, thereby supporting competency-based assessment practices in junior high schools. Beyond evaluating learning outcomes, these instruments can generate evidence to inform instructional planning, identify students' learning needs, and promote the integration of local cultural contexts with digital learning environments (Nugrahini & Fajaryati, 2023). Consequently, their implementation has the potential to strengthen students' essential competencies while supporting the realization of more authentic, contextual, and technology-oriented education (Akcanca, 2020).

CONCLUSION

Fundamental Findings: The development process successfully produced instruments for assessing numeracy, digital, and cultural literacy skills using the 4-D development model up to the Develop stage. Expert validation demonstrated that all three instruments achieved very high validity and reliability, with percentage agreement values exceeding the minimum threshold of 75%, indicating strong consistency among validators. These findings confirm that the developed instruments are suitable for proceeding to field testing as tools for assessing students' 21st-century competencies. **Implication:** The validated instruments provide teachers with standardized and reliable assessment tools for evaluating students' numeracy, digital, and cultural literacy skills in an integrated manner. Their implementation can support competency-based assessment practices and provide evidence to inform instructional planning and learning improvement. Furthermore, the instruments help prepare students with the essential competencies required for learning and participation in the 21st century. **Limitation:** The research was limited to the Develop stage of the 4-D model and therefore did not include field testing or the Disseminate stage. The quality of the instruments was evaluated solely through expert judgment without empirical testing involving students. Consequently, evidence regarding the instruments' practicality, construct validity, and effectiveness in real classroom settings has not yet been established. **Future Research:** Future research should conduct pilot and large-scale field testing to examine the practicality, validity, and reliability of the developed instruments using empirical data. Further studies are also needed to evaluate the instruments' effectiveness in measuring students' numeracy, digital, and cultural literacy skills across diverse educational contexts. Completing the Disseminate stage and implementing the instruments in broader school settings would provide stronger evidence of their applicability and contribution to competency-based assessment practices.

AUTHOR CONTRIBUTIONS

Indah Suciati conceived the study, developed the conceptual framework, supervised the research process, coordinated the project, and led the manuscript preparation. **Mohammad Jamhari** contributed to the conceptual framework, literature review, and validation of the research instruments. **Ratman** contributed to statistical analysis, data visualization, and interpretation of the results. **Astija** contributed to research supervision, overall evaluation, and final manuscript review. All authors reviewed, revised, and approved the final version of the manuscript.

CONFLICT OF INTEREST STATEMENT

The authors confirm that there are no conflicts of interest, either financial or personal, that may have influenced the content or outcome of this study.

ETHICAL COMPLIANCE STATEMENT

This manuscript complies with research and publication ethics. The authors affirm that the work is original, conducted with academic integrity, and free from any unethical practices, including plagiarism.

STATEMENT ON THE USE OF AI OR DIGITAL TOOLS IN WRITING

The authors acknowledge the use of digital tools, including AI-based technologies, as support in the research and writing stages of this article. Specifically, Grammarly was employed for correcting writing and grammar errors. All outputs generated with digital assistance were critically evaluated and revised to ensure academic rigor and ethical standards were upheld. The final responsibility for the manuscript rests entirely with the authors.

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