Instruments for Early Mapping of Preschool Numeracy and Literacy

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A B S T R A K

Telah teridentifikasi ketiadaaan instrumen pemetaan awal literasi dan numerasi anak usia dini yang valid yang dapat digunakan oleh guru untuk mengukur kemampuan literasi dan numerasi anak. Hal tersebut menyebabkan guru kesulitan untuk mengetahui perkembangan kemampuan literasi dan numerasi anak. Tujuan dari penelitian ini untuk mengembangkan instrumen pemetaan awal kemampuan literasi dan numerasi anak dan mengetahui tingkat kelayakan dari instrumen yang telah dikembangkan. Metode penelitian ini menggunakan jenis R&D model 3D (define, design, develop). Sumber data dalam penelitian ini terdiri dari dua orang ahli sebagai validator instrumen. Teknik pengumpulan data menggunakan angket. Teknik analisis data menggunakan uji validitas dan Cronbach Alpha untuk uji reliabel instrumen. Hasil penelitian menunjukan bahwa hasil Validasi ahli untuk Instrumen literasi awal AUD dihitung koefisien validitas isi dengan menggunakan formula Gregory diperoleh koefisien validitas isi untuk instrumen Literasi AUD dengan kategori sangat tinggi. Hasil uji reliabilitas instrumen literasi awal dapat disimpulkan bahwa semua item butir valid. Nilai Cronbach's Alpha adalah 0,933 masuk kategori sangat reliabel. Uji ahli instrumen numerasi awal AUD memperoleh hasil validitas isi untuk instrumen Numerasi AUD dengan kategori sangat tinggi. Untuk uji reliabilitas instrumen numerasi, semua item butir valid. Nilai Cronbach's Alpha adalah 0,914 masuk kategori sangat reliabel. Dari temuan ini, pengembangan instrumen ini dapat digunakan untuk mengukur kemampuan literasi dan numerasi sebagai bentuk pemetan awal aspek perkembangan AUD.

A B S T R A C T

Understanding the early childhood mapping resources that are now available so that educators can assess students' literacy and numeracy It makes it challenging for teachers to assess how well their students are reading and using numbers. The aim of this research is to create early mapping tools for children's literacy and numeracy skills and to determine the instruments' levels of worth. The R&D 3D model (define, design, and extent) is used in this research technique. Two academics who served as the instrument's validators are the source of the data used in this investigation. A questionnaire is used in the data collection process. Techniques for analysing data that use Cronbach alpha for instrument reliability and validity tests. According to research, coefficiencies of application for a high-category early child literacy instrument are obtained by using the Gregory formula to the results of expert validation for early childhood literacy instruments. These yields coefficients of content. According to preliminary literacy instrument test findings, every item is valid. With a score of 0.933, Cronbach's alpha falls into the highly reliable category. Early evaluations of early childhood numerical instruments indicated a very high content. All qualifying items in the reliability testing of numerating instruments have a Cronbach's alpha score of 0.914, bringing them in a highly reliable category. Based on these results, the instrument can be used to assess early childhood development through assessing abilities in numeracy and literacy.

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1. INTRODUCTION

Considering the rapid changes occurring in practically every aspect of life, it is imperative that the next generation of human resources be prepared. Future generations must be adequately prepared in order to expect this shift. Among these skills are critical, imaginative, and cooperative thinking. Developing education at an early age and helping youngsters become more literate and numerate are two of the steps that need to be taken to enhance competence (Purpura et al., 2017; Rahelly, 2018; Soedarto et al., 2021). One of the foundational phases of higher education is early childhood education. According to previous study the education of children is a six-year developmental endeavour that aims to help children grow physically and spiritually and prepare them for their transition to higher education (Apriyanti et al., 2020; Kilis & Yildirim, 2019). Children from birth to age six are the target audience for this educational stimulation. Because they hold the future of Indonesian human existence, children are the nation's future owners, both currently and in the future (Ita, 2018; Maruti, 2022). They need to be equipped with all of the fundamental reading and early numeracy skills because they will be the ones managing the country's youth for the foreseeable future. Early development of the skills of first literacy and numeration is crucial in determining future academic achievement. Children need to be able to read and count as basic skills (Kovas et al., 2013; Ross & Joseph, 2019). According to previous study the main goals of early childhood education are literacy and numeracy in order to help children communicate, interact socially, and solve problems in their daily lives (Fleer & Raban, 2015).

Everyday activities help children develop their language and literacy skills, and engaging conversation with new terminology can help them learn it as well. Early literacy is the capacity of a young kid to utilise language, starting with spoken words and progressing to written ones. In a way, this literacy is the capacity for linguistic reasoning. A child's comprehension of one language may assure comprehension of other areas, such social, emotional, and cognitive development. Literacy for young children can be developed through such fun and meaningful playing activities as inviting children to talk and read together, reading poetry, playing clapping and syllables, motion and song, role-playing, searching for treasure (letters or words), and reading and writing activities by teachers, parents, and adults around the child (Daniels et al., 2020; Ratnasari, 2020). In addition, teachers need to devise a strategy to develop a child's literacy ability through the provision of rich reading corners and the zapping of neighbourhoods so that the child's literacy ability can be optimally stimulated (Bekker et al., 2015; Yulia & Eliza, 2021).

The capacity to solve practical problems in a variety of everyday circumstances by utilising the different numbers and symbols connected with basic arithmetic is known as numeration. Numerical data is a part of daily existence. According to previous study numeration is the capacity to reason through ideas, methods, information, and resources in order to find solutions to everyday issues in a variety of pertinent situations that affect people both as Indonesian citizens and globally (Liswati et al., 2021). In order to prepare for the formal numeration of higher education, it is therefore advisable to introduce children to numbers at a young age. Early children's sensitivity to numeration is an indication of how important numerical literacy (Birgisdottir et al., 2020; Roberts & Rochester, 2021).

Some experts have highlighted the significance of numeration in early childhood education, stating that developing numerical literacy at a young age is a critical skill for preparing oneself for the future (Novitasari et al., 2022; Ratnasari, 2020). Learning while playing might be the starting point for early numeration introduction to prevent children from being saturated. It is crucial to establish the concept of numeration in older children through numeration education. The use of numbers, information, or mathematical symbols is known as numeration (Maruti, 2022; Ulia & Kusmaryono, 2021). These abilities include the ability to apply mathematical ideas, perform calculations, and decipher quantitative data from the environment.

According to numeration involves the skill of likening mathematical concepts and rules to everyday real-life situations where the problem is often unstructured, has many solutions or no complete solution, and is related to nonmathematical factors (Alvionita et al., 2022; Mahmud & Pratiwi, 2019). Numeration is defined as the ability a person has in his or her use of mathematical knowledge to explain events, solve problems, or make decisions in daily life (Litkowski et al., 2020; Nesbitt et al., 2019). Numeration for young children is developed through playing activities that include counting, reading the hours, knowing the numbers, and a variety of other daily activities in the home. Therefore, teachers need to know children's literacy and numeration ability by making early maps of children (Nur et al., 2022; Ratnasari, 2020; Wolf & McCoy, 2019).

Teachers' early mapping exercises call for tools related to literacy and numeracy (Indriati, 2022; Litkowski et al., 2020). However, the professors had some trouble carrying out the initial mapping because to the lack of reliable and religious devices. Questionnaires are the instruments that will be created for this study. In order to collect data for early reading related literacy and numeration in accordance with those areas designated to refer to child development standards, the validity and religious capacities of the

instruments will be tested before to their implementation. Measurement and precise preliminary mapping findings can be obtained with reliable and trustworthy instruments. Learning is determined by one's proficiency in reading, writing, and math (Asokan et al., 2019; Nurlaili, 2022).

Based on the above problems and exposed theoretical studies and the importance of these problems to overcome, it is necessary to develop early detection tools for the literacy and numeration of children. The study aims to develop early mapping tools that document the literacy and numeration of children at an early age and discern the worthiness of those early ready-of-age mapping instruments and numerical figures.

2. METHOD

A modified version of the 4D model's define, design, and develop research and development paradigm is used in this study methodology (Lestari, 2018). The defining phase (define) involves doing a literature review to identify a suitable aspect of a validation instrument. Creating a statement based on a predetermined design stage aspect is the first step in designing an instrument. In order to deem instruments usable, a validity test of content and a religious test must be conducted. Two academics who served as the instrument's validators are the source of the data used in this investigation. A questionnaire is used as part of the data collection method. Cronbach alpha is used for instrument recalls in data analysis procedures, while Aiken's formula is utilised for valification testing. Content validation is the process of verifying the initial literacy and numeracy instruments by asking two academics to be considered. Table 1 displays the results of a cross tabulation of four columns that comprised the assessments of two experts.

Table 1. A Cross Tabulation of Gregory

		Expert II	
		Irrelevant	**Relevant**
Expert I	Irrelevant	A	B
	Relevant	C	D

Base on Table 1, a column represented a cell where the two assessors' dissatisfaction was shown. The difference in opinion between the first and second assessors is displayed in cells b and c (first judges agree, second judges disagree, or the other way around). The cell in column d displays a legitimate agreement between the two judges. Coefficient judgements range from very low to very high, with criteria moving from 0.0 to 1.0. Table 2 displays all criterion and coefficient judgements.

Table 2. The Validity Assessment Criteria of Content

Value	Criteria
0.80-1.00	Very high
0.60-7.90	higher
0.40-0.59	medium
0.20-0.39	low
0.00-0.19	Very low

The process of analysing data is descriptive. It is explained through data on validity and religious ability that the instruments created can be used to gauge early childhood numeracy and literacy skills. Analysis is also carried out to talk about and contrast the study's results with other pertinent results and the results' contribution to the development of science.

3. RESULT AND DISCUSSION

Result

Literacy instruments are tested through expert validation and empirical validation. The first test was an expert validation test. The step made in testing the validity of the content of the research instrument was to consider that two experts could be appointed in the same field of study who had adequate qualifications and work experience. In harmony with what Mehrens & Lehman state, that is, the validity of content can be determined by asking experts for consideration on the tests used. The results of the validation of the early literacy test are presented in Table 3.

Table 3. Initial Early Childhood Literacy Instruments' Validation

No	Literacy aspect	Literacy description		Code	Judgment		Suggested improvement by experts
					Expert 1	Expert 2	
1	Understanding language	a)	Understand several instructions simultaneously	L1a	relevant	relevant	Understand a few instructions at once
		a)	Rephrase the more complex	L1b	relevant	relevant	Repeating more complicated sentences
		b)	Understanding the rules of a game	L1c	relevant	relevant	
		c)	Delight and appreciate the reading	L1d	relevant	relevant	
2	Expressing language	a)	Answering more complex questions	L2a	relevant	relevant	
		b)	Describe the group of pictures that have the same phonic	L2b	relevant	relevant	Mentions a group of pictures that have the same phonic alphabet
		c)	Communicate orally, have vocabulary, and be familiar with symbols in preparation for reading, writing, and arithmetic	L2c	relevant	relevant	
		d)	Put together simple sentences in a complete structure (main sentence-predicate-adverb	L2d	relevant	relevant	Simple sentence with complete structure (subject-predicate-object)
		e)	Have more words to express ideas in others	L2e	relevant	relevant	Have more words to pass on ideas to others
		f)	Moving on with some of the stories that had been played	L2f	relevant	relevant	Continuing the already-heard story section
		g)	Shows understanding of concepts in the storybook	L2g	relevant	relevant	shows an understanding of concepts in the storybook
3	Comprehension literacy	a)	Mentioned the familiar letter symbols	L3a	relevant	relevant	Names of known letters
		b)	Recognize the initial sound of the names of things around them	L3b	relevant	relevant	mentions the group of pictures that have the same initial sound
		c)	Mention the group of pictures that have the same beginning sound	L3c	relevant	relevant	
		d)	Understand the relationship between sounds and letters	L3d	relevant	relevant	understanding the relationship between voice and font form

No	Literacy aspect	Literacy description	Code	Judgment		Suggested improvement by experts
				Expert 1	Expert 2	
		e) Read your own name	L3e	relevant	relevant	
		f) Write your own name	L3f	relevant	relevant	
		g) Understanding the meaning of words in the story	L3g	relevant	relevant	Understanding the meaning of the words in the story

Based on Table 3, an expert assessment of a relevant category comes with 18 items, either from expert 1 or expert 2. From these results, put them into Table 4, thus obtaining a table of expert validation calculations.

Table 4. The Result Gregory Cross Tabulation of Early Literacy Instrument

		Expert II	
		Irrelevant	Relevant
Expert I	Irrelevant	0	0
	Relevant	0	18

Base on Table 4, the expert validation value is determined to be 1 by applying the content validation formula given in the technique section. The next step involves applying Gregory's formula to calculate the content validity coefficient, which is derived from the assessment data of the two experts, to determine the validity coefficient. Early childhood literacy tools have very high-quality content. The second validation test is the empicical validation. The score of Cronbach's alpha for each item of the early literacy instruments is presented at Table 5.

Table 5. The Value of Cronbach's Alpha for Every Detail of the Initial Literacy Instrument

Instrument items	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
L1a	42.5000	36.205	0.591	0.930
L1b	42.7000	35.703	0.651	0.929
L1c	42.8000	36.728	0.498	0.932
L1d	42.4750	36.820	0.492	0.932
L2a	42.7750	36.076	0.491	0.933
L2b	42.7750	35.461	0.715	0.927
L2c	42.6000	34.605	0.699	0.928
L2d	42.5000	36.205	0.591	0.930
L2e	42.7000	35.344	0.643	0.929
L2f	42.7750	36.589	0.513	0.931
L2g	42.6750	34.584	0.701	0.927
L3a	42.4750	35.538	0.727	0.927
L3b	42.7250	34.820	0.813	0.925
L3c	42.6000	36.451	0.521	0.931
L3d	42.6750	34.892	0.791	0.926
L3e	42.6250	34.497	0.862	0.924
L3f	42.5000	36.923	0.463	0.932
L3g	42.6750	35.302	0.718	0.927

Base on Table 5 show statistics statistics Cronbach's alpha for 18 article of the literation instrument is 0.933. All the original correlation values are greater than the r_{table} value is 3.14; That means all items are valid. Cronbach's alpha's score is 0.933 in the highly category. As with literacy instruments, numeration instruments are also tested through expert validation and empirical validation. The first testing was an expert validation test. The description of the suggestions and comments on the application of the content is presented at Table 6.

Tabel 6. The Result of Expert Validation Numeration Instrument

No	Numeration aspect	Numeration Description	Code	Judgment		Suggested Improvement by Experts
				Expert 1	**Expert 2**	
1	Algebra	a) Sorting, grouping, making patterns	N1a	Relevant	Relevant	
		b) Size, space awareness solves the problem	N1b	Relevant	Relevant	Uses size and understanding of space to solve problems.
2	Number	a) Correct sequencing	N2a	Relevant	Relevant	
		b) Correspondence one-on-one	N2b	Relevant	Relevant	
		c) Cardinality	N2c	Relevant	Relevant	Understanding Numbers
		d) Wrote a numerical insignia	N2d	Relevant	Relevant	
		e) Relation between Numbers: comparing larger and smaller	N2e	Relevant	Relevant	Comparing Numbers to knowing the larger and the smaller
		f) Correlation between numbers: sort some groups	N2f	Relevant	Relevant	Sequencing several sets of Numbers
		g) Arithmetic operations: addition	N2g	Relevant	Relevant	Carry out addition operations
		h) Arithmetic operation: subtraction	N2h	Relevant	Relevant	Carry out subtraction operations
3	Geometry	a) Understanding shapes including two-dimensional and three-dimensional objects.	N3a	Relevant	Relevant	Understand shapes, including two-dimensional and three-dimensional objects.
		b) Understanding spatial relationships and position	N3b	Relevan	Relevan	Understand spatial relationships and object positions.
4	Measurement	a) Understanding the attributes of objects-objects: building up the concept of length measurement	N4a	Relevan	Relevan	Understanding object attributes: building the concept of length measurement.
		b) Understanding the attributes of objects-objects: build the concept of area measurement	N4b	Relevan	Relevan	
		c) serialization: a higher capacity than comparison	N4c	Relevan	Relevan	
5	Data Analysis	a) Collect information, organize information simply, ask and answer questions regarding the information collected with the organization	N5a	Relevan	Relevan	Gather information, organize information simply, ask, and answer questions based on the information gathered
		b) Chance: the possibility of an event occurring	N5b	Relevan	Relevan	

Based on Table 6, expert assessments with pertinent categories yielded 17 items from experts 1 and 2. An expert validation calculation table was produced with these results into Table 7.

Table 7. The Result Gregory Cross Tabulation of Early Numeration Instrument

		Expert II	
		Irrelevant	**Relevant**
Expert I	Irrelevant	0	0
	Relevant	0	18

By using the formula for calculating content validation as presented in the method section, the calculated expert validation value is 1. Based on the assessment data, the content validity coefficient for the early childhood numeracy instrument is in the very high category. The second validation test is empirical validation. The Cronbach's alpha value for each item of the early childhood numeration instrument is presented in Table 8.

Tabel 8. Cronbach's Alpha Value for Each Item of the AUD Early Literacy Instrument

Instrument items	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
N1a	38.6500	27.618	0.657	0.908
N1b	39.1750	29.635	0.361	0.916
N2a	38.6000	27.887	0.743	0.905
N2b	38.4500	29.485	0.466	0.913
N2c	38.6500	27.618	0.657	0.908
N2d	39.1750	29.635	0.361	0.916
N2e	38.4750	29.128	0.528	0.911
N2f	38.6000	27.887	0.743	0.905
N2g	38.7000	27.703	0.710	0.906
N2h	38.5750	27.635	0.797	0.904
N3a	38.6750	27.558	0.813	0.903
N3b	38.6500	29.515	0.426	0.914
N4a	38.8750	29.446	0.520	0.911
N4b	38.4250	28.969	0.586	0.910
N4c	38.5750	28.199	0.684	0.907
N5a	39.0000	30.154	0.343	0.916
N5b	38.7500	28.090	0.728	0.906

Base on Table 8, the statistical test results show that Cronbach's alpha reliability statistics for the 17 numeracy instrument items are 0.914. All corrected item-total correlation values are greater than the r_{table} value, namely 3.14, meaning that all item items are valid. The Cronbach's alpha value is 0.914, which is in the very reliable category.

Discussion

Based on research, eighteen measures have been designed to assess early literacy skills. To assess early childhood numerical abilities, 17 instruments have also been developed. Studies indicate that these tools are reliable and valid. Results from expert evaluations show that the instrument fits within the appropriate category and has improved in certain areas, supporting this. Following an evaluation, statistical tests are conducted to ascertain the reliability and validity of each tool. In order to determine the extent of the accuracy and thoroughness of a measurement of the learner's study, validity refers to the degree of measurement in the accuracy of a device in the study of contents or variables that are actually measured. The development of these early years of numerical mapping instruments coincides with earlier developments. Studies indicate that early childhood literacy and numeration instruments are successful and valid for use (Nurlaili, 2022; Yulia & Eliza, 2021). The developed instruments have been used to measure aspects of childhood literacy and numeration. Literacy and numerical instruments can also be developed by incorporating religious and other content (Umbara & Suryadi, 2019; Yazon et al., 2019).

It is necessary to validate before literacy and numerical instruments are passed, so that the developed assessments must be appropriate and appropriate to the needs of learners. A test would be highly valid if it could serve its function as a measuring device and be able to give precise and accurate measurements according to the purpose of the instrument's development (Andriani et al., 2021; Johana &

Ardipal, 2021). When an assessment instrument has low validity, the resulting data is said to be irrelevant or inaccurate. How to measure a child's capabilities and achieve the learning programme that has been performed is through assessment. The activity of measurement and assessment is an effort to collect correct information about the learning achievements of students. That information will then be used as the basis for policy decision-making both locally and nationally for correct and accurate information on which decision-making is essential for good measuring tools that meet the requirements of both validity and religion (Indriati, 2022; Litkowski et al., 2020). Holistic awareness of the development of both basic and early breeding skills, especially in the institution of kindergarden.

Literacy development is vital from an early childhood (Arsa, Atmazaki, and Juita, 2019). Studies demonstrate the importance of examining aspects of literacy and numeration. Literacy can be enhanced through various media and learning resources (Laksana, Lawe, et al., 2023; Maharani et al., 2023; Satriana et al., 2022). In addition to using media, literacy and language learning can be enhanced by using a variety of learning methods and strategies. Knowing the initial literacy skills can be used as a study tool to develop good learning media (Amri, 2018; Handoko et al., 2019; Ningrum et al., 2022). In addition, instruments developed for various aspects of early-age development have been successfully developed and used to measure the rate of early-age development by way of more valid results (Anggreni et al., 2022; Arsa et al., 2019).

The process of maximising a child's reading and writing skills is known as linguistic literacy development, and it follows a pattern and approach that is customised to the child's requirements. This is consistent with a study that defines literacy as a stimulus process for enhancing a child's language skills, with a focus on letter knowledge and phonological awareness. Reading books to children, having them mimic writing, introducing vocabulary through pictures, and engaging them in other reading-related activities are some ways to foster this development (Afnida & Suparno, 2020; Binsa & Khasanah, 2022). Local languages and a range of factual media and educational resources can be used in language development exercises (Laksana, Dolo, et al., 2023; Ria et al., 2023). A variety of educational resources can help improve one's ability to enumerate (Annisa et al., 2020; Maharani et al., 2023). Initial numeration skills can be utilised to research the creation of effective learning resources and techniques (Ayuni & Setiawati, 2019; DeChambrier et al., 2021). One of the skills required to understand more complicated mathematics is numeracy. Furthermore, logical intelligence and analysis in children should be encouraged (Bopo et al., 2023; Simanowski & Krajewski, 2019). Children's ability to count can be improved by using numerating media.

Literacy is one of the six basic ones a child should have. The development of the linguistic literacy was adjusted to the child's stage. Each stage of the child's development has a characteristic that requires distinct stimulus (Dhiu & Laksana, 2021; Inko-Tariah, 2014). The older the children get, the more complex they become. For example, four-year-old language skills, one is understanding two commands simultaneously. While at the age of five, children's language is increasingly complex, enabling children to understand several commands simultaneously. The complexity of children's development needs to be underpinned by literacy and numeration ability (Nur et al., 2022; Ratnasari, 2020).

Literacy and numeration provide a basis for honing students' ability to reason. The implementation of numeration literacy programs has been done in accordance with the three stages of school literacy. The stage includes: a) the breeding stage focuses on implanting basic mathematical concepts through reading activities. The literature or books of mathematics correspond to numerical literacy, such as the encyclopedia, to mathematical inventors and so forth. B) the stage of development is oriented toward understanding the basic concept of mathematics by completing and discussing numerical literation materials. It can either be adapted to the learning materials or the problem unsuited to the learning materials. This is in order for students to understand the material that has been studied. The learning phase focuses on applying mathematical concepts in the practice of learning and peer tutors. Mathematical activities or practices are carried out in two ways that include mathematical materials and active learning activities outside of class (Clements, 2020; Esplin et al., 2021). Mathematical practice activities can be done by adjusting mathematical subjects and themes materials to thematic studies related to numerical literacy. Another activity carried out at the learning stage is a peer tutor. Peer tutoring activities include group discussion activities, interfriends answer and questions, games and presentations.

The process of mapping literacy and numeracy skills can be improved by creating this first early childhood literacy and numeracy mapping instrument. This instrument's components can test early childhood literacy and numeracy skills in a valid and reliable manner. Appropriate treatment or subsequent learning activities will be influenced by the quality of the first mapping results. Effective preliminary mapping can also give differentiated learning—that is, learning based on the needs of the child—meaning.

4. CONCLUSION

Based on the foregoing study's findings and discussion, it can be said that a valid and ready-to-use instrument has been developed to assess early childhood literacy and numeracy skills. The early childhood education teachers can use this tool to assess students' skills in these areas. Here are some recommendations: 1) For early childhood education teachers, must test children's abilities using reliable instruments, particularly when it comes to literacy and numeracy. 2) For students doing research, valid instruments must be used to assess students' literacy and numeracy skills in schools.

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