A Guidebook for Assessing Mathematical Logic Intelligence in Kindergarten

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A B S T R A K

Masih banyak anak yang belum memahami tentang bilangan, anak juga masih belum bisa membedakan seperti bentuk bulat, segitiga, dan kotak. Selain itu guru hanya melakukan asesmen pada saat akhir semester pembelajaran dan belum menggunakan panduan asesmen terutama pada aspek kecerdasan logika matematika anak dalam kegiatan sehari-harinya di sekolah. Berdasarkan hal tersebut, tujuan penelitian ini yaitu mengembangkan buku panduan asesmen kecerdasan logika matematika di Taman Kanak-Kanak. Jenis penelitian ini yaitu penelitian pengembangan. Penelitian ini menggunakan model ADDIE. Subjek penelitian yaitu ahli media pembelajaran dan ahli materi pmebelajaran. Subjek uji coba yaitu lima belas orang guru. Metode yang digunakan dalam mengumpulkan data yaitu wawancara, dokumentasi dan angket. Instrumen pengumpulan data menggunakan lembar kuesioner. Teknik analisis data yang digunakan adalah analisis statistik deskriptif kuantitatif. Hasil penelitian yaitu hasil uji validasi media materi dengan nilai persentase pengujian 96,3% dengan kriteria kelayakan "sangat valid". Penilaian dari ahli media yaitu 98,7% dengan kriteria kelayakan "sangat valid". Skor penilaian dari ahli instrumen efektivitas dengan nilai persentase pengujian 97% dengan kriteria kelayakan "sangat valid". Uji efektivitas uji coba perorangan mendapatkan 95,69% "sangat efektif" dan kelompok kecil 91,67% "sangat efektif". Sehingga dapat disimpulkan bahwa uji coba efektivitas pada guru di taman kanak kanak terhadap buku panduan asesmen kecerdasan logika matematika di Taman Kanak-Kanak yang dikembangkan peneliti mendapatkan penilaian positif dengan kriteria penilaian sangat efektif. Disimpulkan bahwa buku panduan asesmen kecerdasan logika matematika sangat layak dan efektif digunakan pada guru di Taman Kanak-Kanak. Implikasi penelitian yaitu buku panduan asesmen kecerdasan logika matematika yang dikembangkan dapat digunakan dalam kegiatan pembelajaran.

A B S T R A C T

Many children still need help understanding numbers; children also cannot differentiate between round, triangular, and square shapes. Apart from that, teachers only carry out assessments at the end of the learning semester and do not use assessment guides, especially on aspects of children's mathematical logic intelligence in their daily activities at school. Based on this, this research aims to develop a guidebook for assessing mathematical logic intelligence in kindergarten. This type of research is development research. This research uses the ADDIE model. The research subjects are learning media experts and learning material experts. The test subjects were fifteen teachers. The methods used to collect data are interviews, documentation, and questionnaires. The data collection instrument uses a questionnaire sheet. The data analysis technique used is quantitative descriptive statistical analysis. The research results are the results of material media validation tests with a test percentage value of 96.3% and the eligibility criteria being "very valid." The assessment from media experts was 98.7%, with the eligibility criteria being "very valid." The assessment score from the effectiveness instrument expert has a test percentage value of 97%, with the eligibility criteria being "very valid." The effectiveness test of individual trials were 95.69% "very effective" and small group 91.67% "very effective". It was concluded that the mathematical logic intelligence assessment guidebook is very suitable and adequate for teachers in kindergarten. The research implication is that the developed mathematical logic intelligence assessment guidebook can be used in learning activities.

1. INTRODUCTION

Early childhood is in the golden age so optimal stimulation will optimize children's growth and development. All aspects of child development influence each other with other aspects (Ismaniar & Utoyo, 2020; Putri & Eliza, 2022).Early childhood education is aimed at preschool children so that children can develop their potential from an early age, namely by providing educational stimulation to help children's physical and spiritual growth and development (Fitri & Nurhafizah, 2023). Early childhood education is very important education because early childhood education is basic education which is the basis for

continuing education to a higher level. Children's growth and development must be developed optimally (Amalia et al., 2019; Juwantara, 2019). Early childhood is a period of development that occurs in various aspects of child development and also occurs very quickly (Ismaniar & Utoyo, 2020; Mustika & Nurwidaningsih, 2018).Teachers are one of the important factors in realizing the growth and development of children of this age.

The teacher's ability to understand, detect and stimulate the development of social and emotional competencies has a very important role (Ismaniar & Utoyo, 2020; Putri & Eliza, 2022). Therefore, the role in developing abilities and aspects of children's development is very important for teachers to pay attention to and also be supported by parents. Parents must play an active role in their children's development, and be aware of the importance of education since their children are at an early age (Vishnu & Komang, 2019; Yulianingsih et al., 2020). Early childhood education is an ideal phase for training and developing intelligence and all aspects of each individual. In the process of learning activities, teachers must understand how children think, understand what children need and teachers must be able to develop the multiple intelligence abilities of early childhood through the process of learning activities (Hulukati & Maryam, 2020; Widaningtyas & Sugito, 2022).One type of multiple intelligence is mathematical logical intelligence.

Mathematical logic intelligence is the intelligence that children have in understanding numbers according to the child's age range (Pramuditya et al., 2018; Zukhairina et al., 2022).Mathematical logic intelligence is very important in stimulating children's thinking abilities and memory as well as influencing the development of other aspects. Mathematical logic intelligence is intelligence in an understanding of using patterns, relationships and statements through logical experimentation and classification (Fauzi & Lu'luilmaknun, 2019; Zukhairina et al., 2022).Mathematical logic intelligence is the ability to solve problems logically. Mathematics learning is learning related to numbers and analysis (RK Dewi et al., 2019; Maharani et al., 2020). For young children, mathematics is understanding numbers, measuring and classifying. Children can be introduced to mathematical skills in the ability to match, group, organize, count, separate, measure and compare (Mirawati, 2017; Rekysika & Haryanto, 2019).Children can also be introduced to mathematical activities in the concept of space, numbers, number symbols and the concept of shape (Fauzi & Lu'luilmaknun, 2019; Zukhairina et al., 2022). Activities to develop children's mathematical logic intelligence also need to be assessed or assessed.

However, the current problem is that there are still many teachers who do not optimize learning activities. This is supported by previous findings which state that there are still many children who are not properly stimulated (Mirawati, 2017; Tatminingsih, 2019).Other research also states that there are still many children who do not understand mathematical concepts well (Albar & Pramesti, 2021; Jundu et al., 2019).Based on observations at the Delima Bandara Kindergarten, it was found that there were still many children who did not understand numbers. Children also still cannot differentiate between round, triangular and square shapes. Apart from that, children also cannot say how numbers correspond to real pictures. Based on questionnaires distributed to several kindergartens in Padang and interviews conducted with the principal of Delima Bandara Kindergarten, it was also found that teachers still experience problems when implementing the independent learning curriculum and teachers only carry out assessments at the end of learning. The teacher's lack of understanding regarding the types of assessments has an impact on cognitive development, especially in the mathematical logic intelligence aspects of children who are not properly stimulated. This certainly has an impact on children's low mathematical abilities.

One solution offered to overcome this problem is to develop a guidebook for assessing mathematical logic intelligence. Assessment is a process or method of assessment by collecting information about children by collecting some evidence and then organizing and interpreting that information (Dewi, 2018; Simanjuntak et al., 2019).Assessments are carried out to see the child's understanding of their academic achievements and to see that the child is ready to move to the next grade level (Fadlilah, 2021; García et al., 2020; Menéndez et al., 2019; Suyadi, 2017).To obtain information or data regarding the child's development, appropriate data collection techniques are needed according to the characteristics of early childhood. There are several types of assessment, namely observation, anecdotal notes, interviews (conversations), performance, assignments, portfolios, and work results (Fatmawati, 2022; García et al., 2020).In essence, assessments need to be carried out as a step to correct, minimize and correct delays in aspects of a child's development.

Previous research findings stated that guidebooks can help teachers in carrying out learning activities in the classroom (Cholimah et al., 2020; Hamidah & Simatupang, 2020).Other research also states that it is very important for teachers to carry out assessments so that they know how to develop children's cognitive development at school and provide stimuli that can be given so that they can support children's development (Nugroho et al., 2021; Simanjuntak et al., 2019). Efforts made by teachers are when there is a delay in a child's cognitive development, the teacher will evaluate the child, so that he can overcome the child's developmental delays. This is what makes the role of teachers very important in stimulating

children's development. By carrying out formative assessments in the classroom, it will help teachers and school administrators in formulating steps to support teachers in carrying out assessments of children. In this way, teachers play a very important role in carrying out formative assessments and can effectively carry out assessments well. However, there has been no study regarding guidebooks for assessing mathematical logic intelligence in kindergarten. Based on this, the aim of this research is to develop a guidebook for assessing mathematical logic intelligence in kindergarten.

2. METHODS

This research is included in research and development (Research and Development/R & D) because this research produces a product in the form of an assessment guidebook. This development research resulted in a guidebook for assessing mathematical logic intelligence in Kindergarten. The method used in developing the assessment guidebook is ADIEE. The ADDIE model was chosen because this model is very simple when compared to other models. The systematic structure from the first stage to the fifth stage cannot be ordered randomly because it has the characteristics of a procedural model. The ADDIE model is a model developed by Robert Maribe Branch. The research procedure in the ADDIE model consists of five stages, namely Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). At stage Analysis is carried out, namely curriculum analysis, analysis of students and teachers. At stage Design is carried outGuidebook for assessing mathematical logic intelligence in kindergarten. At stage Development namely the product which has been created as an initial stage for validation by a team of experts(validator). At stage Implementation namely the product in Testing the assessment guide by teachers on children, so they can see to what extent the product that has been made is usable. At the Evaluation stage, revisions are carried out in the product development process stage which is linked to the previous step. Product revision is intended as a step-in reviewing product that have been developed with the aim of making improvements.

The research subjects are learning media experts and learning material experts. Test subjects in the guidebook assessment of mathematical logic intelligence children aged 4-6 years tested on Padang City Kindergarten teachers. The method used in collecting data is interviews, documentation and questionnaires. Interviews were conducted with school principals to obtain initial needs data. Documentation is used to collect data describing the implementation of research activities in the form of photos and videos. Questionnaires are used to validate instruments, materials, media and the effectiveness of assessment guidebook products. The data collection instrument is a questionnaire sheet. The instrument grid for collecting data in research is in Table 1, Table 2, Table 3, and Table 4.

Table 1. The Instrument Grid Validation Instrument Sheet

No.	Aspect	Indicator	Descriptor	No
1	Fill	Completeness of contents	The instruments are described in full	1
		Suitability of assessment items	Instruments according to the function and objectives of the research	2,3
2	Language	Language use	The instrument uses good language	4
		Clarity of content	The instrument contains clear and easy to understand content	5
3	Graphics	Layout	The preparation or layout of the instrument contents is good and suitable as a research tool	6

Table 2. The Material Validation Instrument Grid

No.	Aspect	Indicator	Descriptor	No
1.	Fill	Eligibility of content	1. Suitability of material to teacher needs	1
			2. Suitability to student needs	2
			3. Conformity with KD-Indicators	3
			4. Suitability of the material to the needs of teaching materials	4
			5. Benefits of material to increase knowledge insight	5
			6. The language used is easy to understand.	6
2.	Language	Language use	7. Do not use words/sentences that give rise to different interpretations	7
			8. Conformity with Indonesian language rules	8

No.	Aspect	Indicator	Descriptor	No
3.	Graphics	Serving	9. Clarity of purpose	9
			10. Serving order	10
			11. Completeness of Information	11

Table 3. The Media Validation Instrument Grid

No.	Aspect	Indicator	Descriptor	No
1	Graphics	Image/illustration	1. Attractive cover design	1
			2. Image size used	2
			3. Matching the colour of the image to the media	3
			4. Appropriate font size for each sentence	4
		Display design	5. Accuracy of printing paper type	5
			6. Suitability of guide shape	6
			7. Colour suitability on the cover of the assessment guide	7
			8. Appropriate writing on the cover	8
			9. Media appeal	9
			10. Appropriate book size	10
2	Fill	Presentation technique	11. Clarity of instructions for using the assessment guide	11
			12. Accuracy of table of contents layout	12
			13. Completeness of the material is in accordance with the indicators of mathematical logic intelligence	13
			14. Suitability to teacher needs	14
			15. Use clear language	15

Table 4. The Effectiveness Instrument Grid

No.	Aspect	Indicator	Descriptor	No
1	Media Use	Easy to use	Assessment guide easy to use by teachers	1
		Makes learning easier	Assessment guide as a medium that facilitates the learning process	2
		The consistency of the assessment guide is in accordance with aspects of the child's development	Assessment guidelines are presented in accordance with aspects of early childhood development	3
2	Time	Efficient	Assessment guides can streamline children's learning time	4
		Effective	The assessment guide overcomes space and time limitations	5
		Appearance	The appearance of the assessment guide is attractive to teachers	6
		Explanation	Clarity of instructions for using the assessment guide	7
		Order	Accuracy of table of contents layout	8
3	Understanding Material Concepts	Clarity of instructions	The use of the assessment guide can be easily understood by teachers	9
		Material presented Systematic	Assessment guidance material is presented systematically	10
		Material completeness	The completeness of the material is in accordance with the indicators of mathematical logic intelligence	11
		Presentation technique	Suitability to teacher needs	12
		Presentation technique	Use clear language	13

The data analysis technique used is quantitative descriptive statistical analysis. Data analysis covers all activities from all data, namely by describing the level of validity of the guidebook assessment of mathematical logic intelligence. Data from testing results on the development of assessment guidelines were analyzed using a formula (Amirono & Daryanto., 2016).Analysis of data on the effectiveness of the assessment guide was followed by testing using a formula (Sudijono, 2018).

3. RESULT AND DISCUSSION

Results

This research aims to developdeveloping a guidebook for assessing mathematical logic intelligence in kindergarten using the ADDIE model. The research results are as follows. First, the analysis stage.At this stage, an analysis of the curriculum and characteristics of students and teachers is carried out. Curriculum analysis, namely the curriculum used in schools is an independent curriculum. The method applied at school is using project methods, storytelling and experiments. Next, analyzing the characteristics of students and teachers, in this context a needs assessment is carried out to identify the objectives of the product to be developed. The results of the observations obtained were that there were still many children who did not understand numbers, children also still could not differentiate between round, triangular and square shapes. Children also cannot say how numbers correspond to real pictures. In implementing the independent curriculum, teachers experience a few obstacles, so teachers are required to be active in using creative media, such as participating in webinar activities. There are still teachers who do not use assessment guides in any cognitive development, especially in aspects of children's mathematical logic intelligence in their daily activities at school, in fact these assessment activities are very rarely carried out during children's activities, teachers only carry out assessments at the end of the semester even though they should The assessment process is carried out during the learning process. Therefore, a teacher's guidebook is needed so that it can be used as a guide for teachers when carrying out assessments in each learning activity so that teachers can see how far their students have developed, especially in their mathematical logic intelligence.

Second, the design stage. At the design stage, prepare the product design guidebook. The design results are carried out through the stages of determining the development team, preparing product manufacture, creating flowcharts and story boards, as well as preparing assessment instruments. Preparation for making the product was carried out by looking for references taken from various sources that were in accordance with the mathematical logic intelligence material and also regarding assessments in kindergarten. Next, research instruments were prepared in the form of questionnaires for instrument validators, material validators, media validators, and effectiveness questionnaires for kindergarten teachers. Third, the development stage. At this stage, the product development of a guidebook for the assessment of mathematical logic intelligence in Kindergarten was carried out. On the first page there is a cover of the teacher's guide book with an interesting component, namely containing the title, and there is a picture on the cover of children playing with blocks. Chapter I contains background information, intended use, and instructions for using the manual. Chapter II contains an understanding of learning strategies and assessments for early childhood, indicators of mathematical logic intelligence and also contains examples of assessment formats for children aged 4-6 years. The book also contains indicators of mathematical logic intelligence for children aged 4-6 years. In this next section there is an example of an assessment format for children aged 4-6 years. On the last page is the back cover of the guidebook. On the back cover there is a summary of the contents of the manual. The results of product development are presented in Figure 1.

The Mathematical Logic Intelligence Assessment Guide that was developed was then tested bymaterial validator, media validator, and instrument validator. The material expert validation results were declared valid after obtaining an assessment score from 53 material experts, an average of 4.8 with a test percentage value of 96.3% with the eligibility criteria being "very valid". Based on the validation results from material experts, it was declared valid after obtaining an assessment score from media experts totaling 74, an average of 4.9 with a test percentage value of 98.7% with the eligibility criteria being "very valid". After the material and media for the assessment guidebook product are declared valid, the instrument grid is then developed in the form of an effectiveness instrument. Based on the expert validation results, the instrument was declared valid after obtaining an assessment score of 29, an average of 4.8 with a test percentage value of 97% with the eligibility criteria being "very valid". The assessment results are presented in Table 5.

Figure 1. The Results of Development of the Mathematical Logic Intelligence Assessment Guidebook

Table 5. The Overall Product Validation Results of the Assessment Guidebook

No.	Rated Aspect	Total Assessment Scores	Presentation	Category
1	Material	53	96.3%	Very Valid
2	Media	74	98.7%	Very Valid
3	Instrument	29	97 %	Very Valid
Average			**97.3 %**	**Very Valid**

The Mathematical Logic Intelligence Assessment Handbook has received very good qualifications, so the next step is implementation with an effectiveness test. Field implementation tests for small-scale groups were carried out at Padang Kindergarten. During small group trials, it is carried out primarily by giving instructions on how to fill out the questionnaire to the teacher. Next, provide an assessment guidebook to the teacher so that the teacher can use the assessment guidebook. Next, the teacher is asked to fill out a questionnaire which contains a statement regarding the mathematical logic intelligence assessment guidebook for children aged 4-6 years.

Next, trials were carried out for users, namely teachers as designers and implementers of the use of the assessment guidebook. The results of individual trials by teachers obtained an average of 0.9569 with a test percentage value of 95.69% with the criteria "very effective". So it can be concluded that the effectiveness trial on teachers in kindergarten of the guidebook for assessing mathematical logic intelligence in Kindergarten which was developed by researchers received a positive assessment with very effective assessment criteria. The results of small group trials in the Cempaka V Padang Cluster obtained an average of 0.9167 with a test percentage value of 91.67% with the criteria "very effective". So it can be concluded that the effectiveness trial on kindergarten teachers of the guidebook for assessing mathematical logic intelligence in Kindergarten which was developed by researchers received a positive assessment with very effective assessment criteria. Thus, the development of this assessment guidebook can be considered very feasible and effective for use by kindergarten teachers.

Discussion

The mathematical logic intelligence assessment guidebook developed is suitable for use in learning. This is due to the following factors. First, the mathematical logic intelligence assessment guidebook is suitable for use in learning because it makes it easier for teachers to carry out assessments. Teachers play an important role in the design and implementation of assessments in the classroom (Supriyadi et al., 2019; Yüksel & Gündüz, 2017).Assessments can help teachers monitor children's progress and make children active during classroom learning activities (Shafait et al., 2021; Suherman & Vidákovich, 2022).Assessment is the process of collecting information and data regarding a child's growth and development while at school, including looking at the child's mathematical logic intelligence (Azmita & Mahyuddin, 2021; Khadijah & Amelia, 2020). Assessments are carried out using authentic assessments, where assessments

are carried out on an ongoing basis with the aim of obtaining data regarding the child's development. Apart from that, one of the principles of assessment in early childhood is that it is objective where the assessment is carried out on all aspects of the child's development as they are (Hartati & Zulminiati, 2020; Saputri & Purwadi, 2017).There are eight assessment techniques used when assessing children, namely observation, anecdotal notes, interviews, performance, assignments, portfolios, photo series, and work results (Anawaty et al., 2023; Aszhari & Zulminiati, 2023; Mastikawati et al., 2022).The assessment guidebook developed meets the indicators that can measure children's mathematical logic intelligence.This is what led to the development of the assessment guidebookmakes it easier for teachers to carry out assessments.

Second, the mathematical logic intelligence assessment guidebook is suitable for use in learning because it can measure mathematical logic abilities in early childhood. Having a guidebook for assessing mathematical logic intelligence in kindergarten can be a learning strategy for teachers in assessing early childhood development before learning activities begin until the learning activities end. A learning strategy is a learning activity carried out by teachers and students to create an effective and efficient learning activity by applying various learning methods to achieve the expected goals (Fadlilah, 2020; Ichsan et al., 2020; Zahro et al., 2019).The material in the assessment guide is about the mathematical logic intelligence of children aged 4-6 years. Having assessments in every activity carried out by children also makes it easier for educators to know students' abilities (Dewi, 2018; Simanjuntak et al., 2019). In essence, assessments need to be carried out as a step to correct, minimize and correct delays in aspects of a child's development (Fadlilah, 2021; García et al., 2020; Menéndez et al., 2019; Suyadi, 2017). The sooner detection is carried out, the sooner intervention can be planned. Information obtained from observations can be used as material to determine each child's achievement in passing their developmental tasks.

Previous research findings stated that the existence of assessments in every activity carried out by children also makes it easier for educators to know the child's development and growth (Kemala & Rohman, 2021; Maulina & Hazilina, 2022).Other research also states that assessments need to be carried out as a step to optimize learning activities (Sari & Setiawan, 2012; Wulan, 2020).Assessment should be carried out in a comprehensive manner in the learning process so that cognitive, affective and psychomotor competencies can be properly considered. Assessment is an important component, learning activities without assessment cannot provide meaning and identity to children's developmental achievements (Damayanti et al., 2018; Hidayat & Andriani, 2020).A limitation of the research is that the assessment guidebook tested in this research is limited to material on the mathematical logic intelligence of children aged 4-6 years. It is recommended for teachers to create an assessment guidebook so they can measure other students' abilities. Thus, product quality is reviewed from the validity aspect only in the assessment material based on mathematical logic intelligence indicators. The research implication is that the Handbook for Assessment of Mathematical Logic Intelligence in Kindergarten can help teachers in carrying out assessments on children when they first come to school until the child comes home from school, especially when conducting assessments in mathematical logic intelligence. This can help learning activities run smoothly so that learning objectives can be achieved optimally.

4. CONCLUSION

Based on the results of data analysis, it shows that the guidebook for assessing mathematical logic intelligence in Kindergarten is very valid and effective. Results of the effectiveness test of the mathematical logic intelligence assessment guidebook with categoriesvery effective. It can be concluded that the guidebook for assessing mathematical logic intelligence in Kindergarten is very suitable for use by Kindergarten teachers. Assessment guidebooks can help teachers measure mathematical logic intelligence in kindergarten.

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