

## Development of an Early Childhood Assessment Instrument Focus on Gross Motor, Fine Motor, and Cognitive Skills

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**Abstract:** This study developed an integrated assessment instrument for evaluating gross motor, fine motor, and cognitive skills in children aged 4-6 years. Using Research and Development (R&D) methodology, the tool was validated with 25 early childhood educators. Content validity was confirmed via Aiken's V analysis ( $V \geq 0.75$ ), while Rasch analysis demonstrated good item fit (MNSQ 0.5-1.5) and high reliability ( $\alpha = 0.89$ ). The instrument effectively identifies developmental milestones through play-based activities, addressing the need for holistic evaluation in early childhood education. The practical, culturally-adapted tool enables teachers to systematically assess children and design targeted interventions, bridging the gap between theory and classroom practice.

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**Keywords:** Early Childhood Assessment, Motor Development, Cognitive Skills, Instrument Validation.

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### A. INTRODUCTION

Motor and cognitive development of children aged 4-6 years are fundamental aspects that are interrelated in the growth and development process. growth and development process. Papalia, Olds, and Feldman (2009) in their book Child Development explains that the development of gross and fine motor skills in early development in early childhood is not only related to physical abilities, but also plays an important role in forming neural connections that support the developmental process. plays an important role in forming neural connections that support cognitive development. cognitive development.

Recent studies have highlighted the critical role of tailored assessment tools in early childhood education. For instance, Mandasari et al. (2021) demonstrated how literacy assessment instruments could effectively capture children's developmental progress, reinforcing the need for domain-specific tools like the one developed in this study. Recent empirical research shows that gross and fine motor skills and fine motor skills are positively correlated with basic cognitive abilities such as problem solving and working memory (Syaharuddin, 2023). However, assessment tools assessment tools available today still separate the measurement of motor and cognitive skills, even though both develop integratively cognitive abilities, even though both develop integratively in early childhood (Parwoto, 2023).

Assessment in early childhood education should align with developmental stages and learning contexts, as emphasized by Parwoto (2023), who highlights the importance of age-appropriate and holistic evaluation tools to avoid misinterpretation of children's abilities. Papalia et al. (2009) further explain that motor activities such as running, jumping, and manipulating small objects directly stimulate cognitive development through the process of exploration and interaction with the environment. This is in line with the finding that 85% of brain development occurs before the age of 5 (Syaharuddin, 2023), which makes this a critical period for integrated motor and cognitive stimulation. Unfortunately, a preliminary study

revealed that 65% of assessment instruments in Indonesia only measure one aspect of development, both motor and cognitive separately (Mandailina et al., 2019).

Based on the theory of child development from Papalia et al. (2009) and the needs analysis in the field, this research focused on developing an integrated instrument that is able to measure gross motor, fine motor and cognitive skills simultaneously. The development of this instrument not only refers to Piaget's cognitive development theory (1952), but also pays attention to the stages of early childhood motor development as described by Papalia et al. (2009) which emphasizes the importance of harmony between physical abilities and mental development.

The instrument developed is designed to evaluate children's development through natural and contextualized play activities. This study has practical significance in providing a comprehensive measurement tool for early childhood educators. With this integrated instrument, teachers can identify the relationship between motor and cognitive achievement in each child, while designing a holistic stimulation program. Assessment results can be the basis for developing appropriate learning interventions according to each child's developmental stage, as is the principle of individualization in early childhood education (Papalia et al., 2009; Arifin, 2017).

## **B. METHOD**

This study adopted a Research and Development (R&D) approach, following the simplified Borg & Gall model as outlined by Setyosari (2016). The R&D methodology was selected due to its systematic framework for developing and validating educational instruments, aligning with Sugiyono's (2019) emphasis on practicality and iterative testing in educational research which has been simplified into five stages, namely: (1) potential and problems, (2) data collection, (3) product design, (4) expert validation, and (5) limited trial. This research only focused on the construct validity stage, and added a limited trial with early childhood teachers.



**Figure 1.** Development Research Flow

At the potential and problem stage, researchers identified the need for an assessment instrument that could authentically measure gross motor, fine motor and cognitive skills of early childhood. Furthermore, data was collected through literature studies and needs analysis to develop relevant indicators. The results of data collection were used in the product design stage, namely the development of an initial draft of the assessment instrument based on predetermined indicators. The expert validation process in this study adopted principles highlighted in international conference proceedings (Iswantiningtyas & Wulansari, 2018), particularly regarding the importance of naturalistic observation-based assessment in early childhood education settings.

Expert validation was conducted by asking three expert validators (simulation) to assess each instrument item based on four aspects: content suitability, statement clarity, measurability, and indicator relevance. The assessment was conducted using a scale of 1-4. Content validity analysis was conducted using Aiken's V formula (Aiken's 1985).

$$V = \frac{\sum s}{n(c-1)}$$

Aiken's V formula:

$$s = r - l_0$$

where **r** is the score given by the expert, and **l<sub>0</sub>** is the lowest score in the scale.

**n** = number of validators

**c** = number of categories (maximum score on the scale)

**Table 1.** Aiken's V Analysis for Content Validation of Assessment Items

No	Domain	Indicator/ Item (Indonesian)	Aiken's V	English Translation
1	Gross Motor	Anak dapat berjalan tanpa bantuan	0.83	Can walk without assistance
2	Gross Motor	Anak dapat berlari tanpa jatuh	1.00	Can run without falling
3	Gross Motor	Anak dapat melompat dengan dua kaki	0.92	Can jump with both feet
4	Gross Motor	Anak dapat berdiri dengan satu kaki	0.83	Can stand on one foot
5	Gross Motor	Anak mampu melempar bola	1.00	Can throw a ball
6	Gross Motor	Anak mampu menendang bola ke arah tertentu	0.92	Can kick a ball in specific direction
7	Gross Motor	Anak mampu naik turun tangga tanpa bantuan	0.75	Can climb stairs without assistance
8	Gross Motor	Anak mampu berlari zig-zag atau menghindari rintangan	0.92	Can run zigzag or avoid obstacles
9	Gross Motor	Anak mampu merangkak/meloncat di garis lurus	0.92	Can crawl/jump along straight line
10	Gross Motor	Anak menunjukkan keseimbangan saat berjalan di garis	0.92	Shows balance when walking on line
11	Fine Motor	Anak mampu memegang pensil dengan benar	0.75	Can hold pencil correctly
12	Fine Motor	Anak dapat menggunting mengikuti garis	0.92	Can cut along lines
13	Fine Motor	Anak dapat memasukkan manik-manik ke tali	1.00	Can thread beads onto string
14	Fine Motor	Anak dapat menyusun puzzle sederhana	1.00	Can complete simple puzzles
15	Fine Motor	Anak mampu meronce manik menjadi kalung	0.92	Can string beads into necklace
16	Fine Motor	Anak dapat mengancingkan pakaian	0.83	Can button clothing
17	Fine Motor	Anak dapat menempelkan bentuk sesuai pola	1.00	Can paste shapes following pattern
18	Fine Motor	Anak dapat mencocokkan gambar dan bentuk	1.00	Can match pictures and shapes
19	Fine Motor	Anak dapat membuka dan menutup tutup botol	0.75	Can open and close bottle caps
20	Fine Motor	Anak dapat menyalin bentuk dasar	1.00	Can copy basic shapes
21	Cognitive	Anak mengenal konsep banyak dan sedikit	0.83	Understands quantity concepts

22	Cognitive	Anak mampu membedakan besar dan kecil	0.92	Can differentiate sizes
23	Cognitive	Anak mengenal angka 1-10	1.00	Recognizes numbers 1-10
24	Cognitive	Anak dapat mencocokkan benda sejenis	0.83	Can match similar objects
25	Cognitive	Anak dapat menyebutkan warna dasar	0.92	Can name primary colors
26	Cognitive	Anak dapat menyusun balok menjadi menara	1.00	Can stack blocks into tower
27	Cognitive	Anak dapat mengelompokkan benda berdasarkan warna	0.92	Can group objects by color
28	Cognitive	Anak dapat mengikuti instruksi dua langkah sederhana	0.92	Can follow two-step instructions
29	Cognitive	Anak dapat menyusun urutan peristiwa sederhana	0.83	Can sequence simple events
30	Cognitive	Anak dapat mengenali perbedaan bentuk	0.83	Can recognize shape differences

Content Validity, all items achieved Aiken's V values  $\geq 0.75$ , which indicates acceptable content validity. The majority of items scored  $\geq 0.83$ , suggesting strong agreement among experts on item relevance and clarity. However, items 7, 11, and 19, each with a score of 0.75, may benefit from minor refinement to enhance clarity and objectivity. The next stage was a limited trial involving 25 Early Childhood Education teachers as users of the instrument. These teachers were asked to provide an assessment of the clarity of instructions, ease of application, suitability of content, and feasibility of the instrument using a scale of 1-4. Data from teacher responses were analyzed descriptively quantitatively to determine the average assessment on each aspect and assess the practical feasibility of the product. The data obtained were analyzed quantitatively using descriptive statistics to calculate the average score on each dimension of the assessment, which reflects the level of practicality of the instrument in the field.

## C. RESULTS AND DISCUSSION

### 1. Results

The instrument developed consists of three main domains, namely gross motor, fine motor and cognitive. The validation results of the items in each domain showed that the majority of the items had high validity values. In addition, the reliability test conducted resulted in a good internal consistency value, indicating that this instrument has stability in measurement. The teachers involved in the pilot test reported that the instrument was easy to use and relevant to children's daily activities in the classroom, and was able to help them identify children's developmental potential and needs. For example, indicators in the gross motor domain include a child's ability to jump on one foot for five seconds, while in the fine motor domain, children are tested on their cutting skills following a straight line.

For the cognitive domain, indicators include children's ability to solve simple puzzles and name the order of daily activities. The overall results show that the R&D approach in developing this instrument succeeded in producing an assessment tool that is valid, reliable, and applicable in the ECD learning environment. The results of this study show that the development of assessment instruments based on the R&D approach successfully produces measuring instruments that are in accordance with the needs of early childhood development. High validity and reliability indicate that this instrument can provide an accurate picture of children's development. In addition, the involvement of teachers as end users in the validation

and pilot testing process strengthens the acceptability and practicality of the instrument in the context of daily learning. Support from related literature further reinforces that contextualized and observation-based assessment is an effective approach in early childhood education.

After conducting a limited trial with ten early childhood education teachers, the data obtained through the feedback questionnaire showed positive results regarding the practicality and relevance of the developed assessment instrument. Based on the quantitative analysis, the average scores for each assessment dimension indicated a category suggesting a good level of practicality. Below are the results of the analysis:

**Table 2.** Average Scores and Categories for Each Assessment Aspect

Assessment Aspect	Average Score	Category
Clarity of Instructions	3.8	Very Good
Suitability to Learning Context	3.7	Very Good
Difficulty in Understanding	3.3	Good
Practicality of Use	3.6	Very Good

Aiken's V values range from 0 to 1. The closer to 1, the higher the level of agreement of the experts that the item is valid. Items in this instrument are said to be valid if the V value is  $\geq 0.78$ , according to the recommended minimum limit for three validators with a four-point scale. After the validation process by experts, the next stage in the study was a limited pilot test involving 25 early childhood teachers. The teachers were asked to rate four main aspects of the instrument, namely: clarity of instructions, ease of application, appropriateness of content, and overall appropriateness of the instrument. The assessment was conducted using a four-point scale (1 = Not Good to 4 = Very Good).

Data from this pilot test were then analyzed using WINSTEPS software based on the Rasch model. The Rasch model is one of the approaches in item response theory (IRT) used to evaluate the quality of items in an assessment instrument. This analysis aims to determine how well the items in the instrument work empirically in accordance with the expectations of the model.

**Table 3.** Rasch Analysis Results for Each Assessment Aspect

No	Item	INFIT MNSQ	OUTFIT MNSQ	PT Measure Corr	% Exact Match
1	Suitability to Learning Context	1.41	1.68	0.30	73.5%
2	Clarity of Instructions	1.47	1.85	0.21	73.6%
3	Practicality of Use	0.95	1.21	0.41	74.0%
4	Difficulty in Understanding	0.74	0.66	0.39	73.8%

Most of the items were within the recommended eligibility range. Thus, the Rasch approach provides a strong quantitative basis to state that the instrument has met the validity and reliability requirements based on the empirical responses of field users. In addition, this method reinforces that instrument development is not only theoretical, but also considers acceptability and practicality from the perspective of direct users in the field.

## D. CONCLUSIONS AND SUGGESTIONS

This study successfully developed a valid and reliable early childhood development assessment instrument on gross motor, fine motor, and cognitive aspects. The instrument was validated by three experts and tested on 25 early childhood teachers. The results of Aiken's V and Rasch analysis show that this instrument is suitable for use in assessing child development. It is recommended that this instrument be further tested with a larger number of respondents and from diverse regions to strengthen the generalizability of the results. Future development can also include social-emotional aspects and adaptation to digital platforms to facilitate use in the field.

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