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Development of a Multiple Intelligences-Based Interest and Aptitude Instrument for Elementary School Students

Pengembangan Instrumen Minat dan Bakat Berbasis *Multiple Intelligences pada Siswa Sekolah Dasar*

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Abstract

Interest and aptitude are essential aspects in developing students' potential from an early age. Elementary school represents the initial phase for shaping children's potential and character. However, the availability of valid and comprehensive instruments to identify students' interests and aptitudes at an early stage remains limited. The development of students' interests and aptitudes aligns with national education goals to optimize learners' potential. Accurate identification enables educators and parents to direct students' development in a more systematic manner as preparation for future education. This study aimed to examine the psychometric properties of the Interest Blank scale based on Multiple Intelligences theory in identifying elementary school students' interests and aptitudes. A quantitative approach was employed through reliability analysis, item discrimination analysis, and construct validity using Exploratory Factor Analysis (EFA), followed by Confirmatory Factor Analysis (CFA). The participants consisted of 367 elementary school students in grades 4–6. The study involved 367 elementary school students in Grades 4–6, recruited using a non-probability sampling technique with a convenience sampling approach, in which the entire target population at the research site was included (total sampling). The results indicated that three dimensions met the reliability criterion (α > 0.70), while the remaining five dimensions were below the recommended threshold. Most items demonstrated adequate discrimination (r ≥ 0.30), although several items still require evaluation. Factor analysis showed that the data were suitable for analysis; however, the empirical structure did not fully replicate the eight-factor Multiple Intelligences model. Furthermore, the CFA results indicated that the proposed model did not achieve a satisfactory fit. These findings suggest that the Interest Blank scale has potential for further development through refinement of items and construct structure.

Keywords: *Instrument Construction, Interest Blank, Multiple Intelligences*

Abstrak

Minat dan bakat merupakan aspek penting dalam pengembangan potensi siswa sejak usia dini. Jenjang Sekolah Dasar (SD) menjadi fase awal pembentukan potensi dan karakter anak. Namun, ketersediaan instrumen yang valid dan komprehensif untuk mengidentifikasi minat dan bakat siswa sejak dini masih terbatas. Pengembangan minat dan bakat sejalan dengan tujuan pendidikan nasional untuk mengoptimalkan potensi peserta didik. Identifikasi yang tepat memungkinkan pendidik dan orangtua mengarahkan pengembangan potensi secara lebih terencana sebagai bekal pendidikan selanjutnya. Penelitian ini bertujuan menguji kualitas psikometrik skala *Interest Blank* berbasis teori kecerdasan majemuk dalam mengidentifikasi minat dan bakat siswa. Pendekatan kuantitatif digunakan melalui analisis reliabilitas, daya beda aitem, dan validitas konstruk menggunakan *Exploratory Factor Analysis* (EFA) dan analisis lanjutan yaitu *confirmatory factor analysis* (CFA). Subjek penelitian berjumlah 367 siswa SD kelas 4–6 yang diperoleh melalui teknik *non-probability sampling* dengan pendekatan *convenience sampling*, serta melibatkan seluruh populasi sasaran (total sampling) di lokasi penelitian. Hasil menunjukkan tiga dimensi memenuhi kriteria reliabilitas (α > 0,70), sedangkan lima dimensi lainnya masih di bawah batas yang direkomendasikan. Sebagian besar aitem memiliki daya beda memadai (r ≥ 0,30), meskipun beberapa masih perlu evaluasi. Analisis faktor menunjukkan data layak dianalisis, tetapi struktur empiris belum sepenuhnya mereplikasi model delapan kecerdasan majemuk. Hasil uji CFA menunjukkan model yang diajukan belum fit. Temuan ini menunjukkan skala *Interest Blank* berpotensi dikembangkan lebih lanjut melalui penyempurnaan aitem dan struktur konstruk.

Kata Kunci : Interest Blank, Kecerdasan Majemuk, Konstruksi Instrumen

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INTRODUCTION

The development of students' interests and talents is aligned with the objectives of national education to optimize children's potential holistically (Directorate General of Vocational Education, Ministry of Education, Culture, Research, and Technology, 2023). Early identification of children's potential is essential to assist parents and educators in providing appropriate stimulation, thereby enabling optimal development in accordance with children's characteristics. Understanding one's own potential also contributes to the enhancement of self-concept and self-confidence, which ultimately supports the effectiveness of the learning process (Haque et al., 2022).

In the educational context, differentiated learning emphasizes the adaptation of instruction based on students' interests, learning styles, and readiness (Aghnia & Fiandita, 2023). However, the implementation of this approach still faces several challenges, one of which is the limited availability of assessment instruments capable of comprehensively identifying students' potential. In addition, limited time and opportunities for self-exploration also hinder the development of children's interests and talents (Khanesa et al., 2022). Therefore, understanding children's potential from an early age has become an essential need (Anggraini, Utami, & Rahma, 2020).

The Multiple Intelligences theory proposed by Howard Gardner provides a broader conceptual framework for understanding intelligence, extending beyond academic ability to encompass various aspects of individual capabilities (Davis, 2011; Morgan, 2021; Hoerr, 2000). In the educational setting, understanding multiple intelligences is important because each student possesses a unique combination of intelligences, requiring more individualized and meaningful learning approaches. The results of multiple intelligences assessments can also serve as a basis for designing appropriate instructional strategies and optimizing students' potential (Berliana et al., 2023). Furthermore, recognizing children's intelligence profiles may help support the development of other intelligences as well (Tulika et al., 2022).

Nevertheless, currently available multiple intelligences assessment instruments still present several limitations, particularly for elementary school students in Indonesia. Harb et al. (2025) reported a scarcity of multiple intelligences assessments supported by adequate empirical evidence, and no instrument has yet been considered fully trustworthy, reliable, and valid for comprehensively measuring these intelligences. Multiple intelligences assessment at the elementary school level has been conducted by Jahroh and Baidi (2022); however, their approach relied primarily on cognitive, affective, and psychomotor evaluations rather than psychometrically validated instruments.

Other studies involving elementary school students were also conducted by Ismah et al. (2020) at Madrasah Ibtidaiyah Al-Inayah Pasar Rebo, involving 42 students. In addition, Wei et al. (2025) developed a multiple intelligences instrument for elementary school students in China, while similar studies were conducted in India (Tulika et al., 2022) and Portugal (Margarida & Cristina, 2021). Findings from these studies indicate that multiple intelligences assessments among elementary school students have been widely conducted across various countries. Nevertheless, to date, no standardized multiple intelligences instrument with strong evidence of validity and reliability has been identified within the Indonesian context. Therefore, a research gap remains in the absence of a valid, reliable, and culturally appropriate multiple intelligences instrument for elementary school students in Indonesia.

Several previous studies have attempted to develop multiple intelligences assessment instruments. The Directorate General of Vocational Education, Ministry of Education, Culture, Research, and Technology (2023) developed a Multiple Intelligence assessment instrument intended for vocational high school students; however, it has not been widely applied to elementary school students. Hasanuddin (2021) also developed a multiple intelligences instrument consisting of 63 items for university students, but the instrument has not been tested among elementary school populations. Furthermore, Ilyas (2019) developed the Multiple Intelligence System (MIS) at Rumah Sekolah Cendekia Makassar, although sufficient information regarding the instrument's validity and reliability was not available. Similarly, Firmansyah and Amalia (2021) developed an expert system for identifying elementary school students' interests and talents based on multiple intelligences; however, the instrument lacked adequate information concerning item construction, validity, and reliability.

On the other hand, the process of identifying children's potential is still frequently conducted without standardized assessment instruments. Identification is more commonly carried out through observations of extracurricular activities and classroom learning processes (Ilham, 2014; Saputri & Sa'adah, 2021; Dewi, Aprianti, Octavia, & Mulyana, 2023). These studies demonstrated that extracurricular activities may help identify children's interests and talents; however, they are often not accompanied by specific strategies to optimally direct children's potential (Saputri & Sa'adah, 2021; Dewi, Aprianti, Octavia, & Mulyana, 2023). Ilham (2014) also found that educators tend to identify children's potential solely based on classroom learning activities and extracurricular participation without utilizing more accurate and standardized instruments.

Based on preliminary interviews conducted by the researchers in 2025 with 10 parents of elementary school students, it was found that the identification of children's interests and talents is still commonly carried out using a trial-and-error approach, such as enrolling children in various courses or activities without structured assessment foundations. Parents reported that this approach requires considerable time and financial resources and may potentially reduce children's motivation when the activities provided are not aligned with their characteristics, interests, and potential. These findings are consistent with previous studies showing that the congruence between individual characteristics, interests, and learning environments plays an

important role in improving motivation and performance (Duarte, 2024), academic achievement and personal development (González-Treviño et al., 2020), as well as creativity (Aguayo et al., 2021). This condition indicates the need for systematic, valid, and contextual instruments to support the early identification and understanding of children's potential.

Based on these conditions, it can be concluded that although various efforts have been made to develop multiple intelligences assessment instruments, most of them remain limited to specific age groups, such as university students and vocational high school students, or still lack strong evidence of validity and reliability. Furthermore, assessments conducted among elementary school students continue to rely predominantly on observational and non-psychometric approaches, which are insufficient for providing objective and comprehensive descriptions of children's potential. This condition indicates a research gap in the absence of a valid, reliable, and developmentally appropriate multiple intelligences instrument for elementary school students in Indonesia. Therefore, this study aims to develop an interest and talent assessment instrument based on the Multiple Intelligences theory specifically designed for elementary school students.

This instrument represents a newly developed construct rather than merely an adaptation of existing instruments, as it was designed by considering children's cognitive developmental characteristics, language abilities, and self-reflective capacities. The assessment results generated by this instrument are expected not only to provide profiles of students' interests and multiple intelligences but also to be integrated into educational and parenting practices. For educators, information regarding students' dominant intelligences and interests may serve as a basis for designing differentiated instruction, including the selection of teaching methods, media, and learning activities suited to students' characteristics. Teachers may also gain a better understanding of students' characteristics, thereby creating more engaging and enjoyable learning experiences (Jahroh & Baidi, 2022). Meanwhile, for parents, the assessment results may serve as guidelines for providing more targeted stimulation at home, including the selection of extracurricular activities and learning assistance. In addition, the assessment profile may become a foundation for communication between parents and educators in developing more consistent and sustainable strategies for children's development. Thus, this instrument is expected to function not only as an assessment tool but also as a basis for planning more contextualized and individualized educational and parenting interventions.

RESEARCH METHODS

The participants in this study were 367 students from an Islamic Integrated Elementary School (SDIT) in Bekasi City. The sampling process was conducted offline using a non-probability sampling technique with a convenience sampling approach. The participants consisted of fourth- to sixth-grade students, involving the entire target population at the research site (total sampling). The selection of students from grades 4–6 was based on children's reading abilities, as students at this level are generally able to read fluently and therefore expected to respond to the research instrument properly without reading difficulties.

Data collection in this study employed a questionnaire/scale referred to as the Interest Blank. Since this study focused on instrument development, several procedures were undertaken in constructing the scale, including identifying the purpose of the instrument, defining domain boundaries, operationalizing dimensions, writing items, conducting readability testing, pilot testing, expert judgment evaluation, field testing, and selecting final items based on quantitative evaluation (Azwar, 2013). In general, the process involved test conceptualization, test construction, pilot testing, item analysis, and item revision (Cohen & Swerdlik, 2009). The procedures for developing this multiple intelligences instrument were conducted through several stages as follows:

(a) Preparation. The researchers first determined the construct to be measured, namely multiple intelligences. In developing this instrument, the definition of multiple intelligences proposed by Howard Gardner was adopted (Davis et al., 2011; Morgan, 2021), which defines intelligence as an individual's ability to solve problems or create products that are valued within one or more cultural contexts. In other words, intelligence is not limited to academic abilities but also encompasses skills that are appreciated across different cultures. Gardner identified eight types of intelligence: linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, and naturalistic intelligence. Based on these definitions and components, the researchers operationalized the multiple intelligences construct into several behavioral indicators. Each behavioral indicator was subsequently translated into instrument items.

(b) Population Determination and Sample Selection. At this stage, the researchers determined elementary school students as the target population, while the research sample was selected from one Islamic Integrated Elementary School (SDIT) in Bekasi City.

(c) Instrument Construction and Try-Out. This stage involved operationalizing the construct into measurable indicators and transforming the indicators into instrument items. After the instrument had been developed, the researchers determined the scoring technique and prepared the administration instructions. The blueprint of the Interest Blank instrument is presented as follows:

Table 1. Interest Blank Blueprint

Aspects	Items	Total Number of Items
Linguistic Intelligence	1, 2, 3, 4, 5, 6	6
Logical-Mathematical Intelligence	7, 8, 9, 10, 11, 12	6
Spatial Intelligence	13, 14, 15, 16, 17, 18	6
Bodily-Kinesthetic Intelligence	19, 20, 21, 22, 23, 24	6
Musical Intelligence	25, 26, 27, 28, 29, 30	6
Interpersonal Intelligence	31, 32, 33, 34, 35, 36	6
Intrapersonal Intelligence	37, 38, 39, 40, 41, 42	6
Naturalistic Intelligence	43, 44, 45, 46, 47, 48	6
Total		**48**

Afterward, psychometric attribute testing was conducted based on the try-out results, including reliability testing, validity testing, and item analysis. Reliability testing employed the internal consistency approach using Cronbach's Alpha coefficient. Validity testing involved both content validity and construct validity. Content validity was assessed through readability testing and expert judgment evaluation. The expert judgment process involved psychologists and fifth-grade elementary school students. Construct validity was examined using factor analysis techniques, specifically Exploratory Factor Analysis (EFA).

In addition, the items of the multiple intelligences instrument were analyzed both qualitatively and quantitatively. Qualitative item analysis was conducted during the readability testing stage. The readability assessment included evaluations of the questionnaire format, clarity of wording, layout, and the items contained within the instrument. This qualitative evaluation aimed to determine whether the item wording was effective and whether the items adequately represented the multiple intelligences construct. Quantitative item analysis was conducted by examining item discrimination using the correlation between item scores and total scores (Corrected Item-Total Correlation/CrIT). Norm development was carried out using within-group norms through a standard score technique based on Z-scores.

The try-out stage was conducted on a pilot sample consisting of 30 fourth- to sixth-grade students from an elementary school in Bekasi City. During this stage, the questionnaire was administered and quantitatively analyzed using the SPSS program. The results of the try-out provided the researchers with information for determining whether items should be revised, retained, or eliminated. The finalized items from the try-out stage were subsequently administered to participants during the field testing or main data collection process.

(d) Data Collection and Reassessment. At this stage, data were collected from 367 participants consisting of fourth- to sixth-grade elementary school students. A larger sample size increases the likelihood of representing the overall population more adequately (Field, 2016). The collected data were subsequently analyzed to determine whether the multiple intelligences instrument demonstrated satisfactory psychometric properties.

(e) Data Analysis. The data analysis techniques employed in this study included reliability testing using Cronbach's Alpha, item analysis using the Corrected Item-Total Correlation technique, and construct validity testing using Exploratory Factor Analysis (EFA).

RESULTS

Based on the collected data, the results were analyzed, and the following psychometric testing results were obtained:

Results of Reliability Testing

The psychometric evaluation of the Interest Blank scale began with reliability testing and the examination of item discrimination indices. The reliability of the Interest Blank instrument was assessed using the Cronbach's Alpha method to measure the internal consistency of the scale. Reliability testing was conducted using SPSS version 26, and different reliability coefficients were obtained for each dimension of the instrument.

Table 2. Reliability Coefficients of Multiple Intelligences Dimensions

Dimension	Cronbach's Alpha Coefficient	Criteria	Interpretation
Linguistic	0,407	>0,70	Not Reliable
Logical-Mathematical	0,675	>0,70	Not Reliable
Spatial	0,618	>0,70	Not Reliable
Kinesthetic	0,539	>0,70	Not Reliable
Musical	0,783	>0,70	Reliable
Interpersonal	0,723	>0,70	Reliable
Intrapersonal	0,663	>0,70	Not Reliable
Naturalistic	0,748	>0,70	Reliable

Based on Table 2, the reliability coefficient scores of each dimension indicate that only three dimensions can be considered reliable, as they meet the recommended criterion of $\alpha > 0.70$. According to Nunally and Bernstein (1994), an instrument can be regarded as reliable and trustworthy when it demonstrates a reliability coefficient ranging from 0.70 to 0.90, particularly in exploratory research contexts. Since the present instrument is still in the developmental stage, the minimum criterion of 0.70 was adopted. However, as shown in Table 2, five dimensions still exhibited reliability coefficients below 0.70.

Item Analysis

Furthermore, an item analysis was conducted, particularly examining item discrimination using the corrected item-total correlation technique in SPSS version 26. The criterion applied was $r > 0.30$, as Field (2013) suggested that one indicator of good item quality is an item discrimination index exceeding 0.30. The results of the item discrimination analysis varied across dimensions and are presented in Table 3.

Table 3. Item Discrimination of Multiple Intelligence Dimensions

Dimension	Indicator	r Coefficient	Criteria	Interpretation
Linguistic	IB1	0,318	≥0,30	Acceptable
	IB2	0,175	≥0,30	Unacceptable
	IB3	0,221	≥0,30	Unacceptable
	IB4	0,287	≥0,30	Unacceptable
	IB5	0,166	≥0,30	Unacceptable
	IB6	0,005	≥0,30	Unacceptable
Logical-Mathematical	IB7	0,519	≥0,30	Acceptable
	IB8	0,440	≥0,30	Acceptable
	IB9	0,236	≥0,30	Unacceptable
	IB10	0,493	≥0,30	Acceptable
	IB11	0,250	≥0,30	Unacceptable
	IB12	0,489	≥0,30	Acceptable
Spatial	IB13	0,449	≥0,30	Acceptable
	IB14	0,507	≥0,30	Acceptable
	IB15	0,307	≥0,30	Acceptable
	IB16	0,165	≥0,30	Unacceptable
	IB17	0,227	≥0,30	Unacceptable
	IB18	0,474	≥0,30	Acceptable
Kinesthetic	IB19	0,165	≥0,30	Unacceptable
	IB20	0,307	≥0,30	Acceptable
	IB21	0,329	≥0,30	Acceptable
	IB22	0,192	≥0,30	Unacceptable
	IB23	0,353	≥0,30	Acceptable
	IB24	0,363	≥0,30	Acceptable
Musical	IB25	0,442	≥0,30	Acceptable
	IB26	0,542	≥0,30	Acceptable
	IB27	0,622	≥0,30	Acceptable
	IB28	0,587	≥0,30	Acceptable
	IB29	0,438	≥0,30	Acceptable
	IB30	0,579	≥0,30	Acceptable
Interpersonal	IB31	0,349	≥0,30	Acceptable

	IB32	0,474	≥0,30	Acceptable
	IB33	0,445	≥0,30	Acceptable
	IB34	0,550	≥0,30	Acceptable
	IB35	0,465	≥0,30	Acceptable
	IB36	0,509	≥0,30	Acceptable
Intrapersonal	IB37	0,461	≥0,30	Acceptable
	IB38	0,310	≥0,30	Acceptable
	IB39	0,359	≥0,30	Acceptable
	IB40	0,451	≥0,30	Acceptable
	IB41	0,413	≥0,30	Acceptable
	IB42	0,385	≥0,30	Acceptable
Naturalistic	IB43	0,369	≥0,30	Acceptable
	IB44	0,422	≥0,30	Acceptable
	IB45	0,555	≥0,30	Acceptable
	IB46	0,502	≥0,30	Acceptable
	IB47	0,555	≥0,30	Acceptable
	IB48	0,552	≥0,30	Acceptable

Based on Table 3, several items demonstrated acceptable item discrimination, indicated by item-total correlation coefficients of ≥ 0.30. The dimensions in which all items showed acceptable discrimination were Musical, Interpersonal, Intrapersonal, and Naturalistic. When associated with the reliability coefficients, three of these dimensions were found to be reliable. However, the Intrapersonal dimension still demonstrated insufficient reliability. Nevertheless, the item discrimination results indicated that all items within the Intrapersonal dimension possessed acceptable discriminatory power. Therefore, decisions regarding item elimination should be conducted more comprehensively by taking multiple considerations into account.

Construct Validity Testing

Subsequently, the researcher conducted a validity test to estimate the construct validity of the instrument. Construct validity was examined through factor analysis using Exploratory Factor Analysis (EFA) to identify the number of latent factors underlying the set of items and to determine which items loaded onto each factor. The items were grouped based on their correlation patterns, such that items measuring similar constructs were expected to demonstrate high intercorrelations. These highly correlated items were then categorized within the same factor.

The multiple intelligence instrument was developed based on Gardner's Theory of Multiple Intelligences, which conceptualizes intelligence across eight distinct dimensions. Since the items were self-developed by the researcher and the factor structure had not previously been tested within the target population, the emergence of the eight dimensions as distinct and clean factors could not be assumed. Therefore, the researcher initiated factor analysis using EFA to examine the extent to which the theoretical framework aligned with the empirical data.

a. Kaiser-Meyer-Olkin (KMO) and Bartlett's test

Prior to conducting the Exploratory Factor Analysis (EFA), the researcher examined the adequacy of the data using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity. The results indicated that the Kaiser-Meyer-Olkin (KMO) value was 0.833 (> 0.50), suggesting that the sample size was adequate for factor analysis. In addition, Bartlett's Test of Sphericity was statistically significant, $\chi^2(1128) = 4920.400$, $p < 0.05$, indicating that the items were sufficiently correlated and suitable for factor analysis.

Based on these findings, the assumptions required for conducting factor analysis were fulfilled. The results of the factorability tests are presented in Table 4.

Table 4. Results of the KMO and Bartlett's Test of Sphericity

Test	Value
Kaiser-Meyer-Olkin (KMO)	0,833
Bartlett's Test χ^2 (1128)	4920.400
p	0.000

b. Exploratory Factor Analysis

The researcher continued the factor analysis using Exploratory Factor Analysis (EFA) by extracting eight factors in accordance with Gardner's theoretical framework. The EFA results showed that the cumulative variance explained up to the eighth factor was approximately 35%. These findings indicate that the factor structure was not yet sufficiently robust, as multidimensional social-psychological constructs are generally expected to explain approximately 40–60% of the total variance.

Furthermore, the communalities values indicated that several items demonstrated relatively low extraction values, such as IB2 = 0.096, IB6 = 0.146, and IB16 = 0.124. The criterion applied for communalities was ≥ 0.30. Therefore,

several items were considered insufficiently represented within the factor structure.

Table 5. Exploratory Factor Analysis of the Interest Blank Scale (N = 367)

Item	Mean	SD	Loading Factor							
			1	2	3	4	5	6	7	8
IB21	3.11	1,255	0,425							
IB25	4,52	0,782	0,482							
IB26	3,83	1,007	0,612							
IB27	3,85	1,128	0,745							
IB28	3,81	1,004	0,645							
IB29	3,33	1,088	0,428							
IB30	3,51	1,182	0,574							
IB7	3,31	1,038		0,738						
IB8	3,50	0,986		0,571						
IB10	3,38	0,947		0,625						
IB12	3,10	1,152		0,643						
IB32	4,10	0,928			-0,493					
IB34	4.05	0,725			-0,462					
IB35	3,79	0,924			-0,525					
IB36	4,03	0,764			-0,470					
IB13	3,73	1,156				0,680				
IB14	3,90	0,928				0,552				
IB18	3,74	1,017				0,670				
IB43	3,41	1,141					-0,427			
IB44	4,21	0,860					-0,561			
IB45	4,19	0,846					-0,697			
IB46	3,92	0,994					-0,570			
IB47	3,52	0,975					-0,562			
IB48	3,41	1,083					-0,525			
IB37	3,76	0,903						0,537		
IB40	3,98	0,730						0,447		
IB41	3,81	0,931						0,543		
IB23	3,07	0,984								-0,416
Kaiser-Meyer-Olkin Measure of Sampling Adequacy					**0,833**					
Barlett's Test χ^2 (1128)					**4920.400**					
p					**0.000**					
Eigenvalue (Cumulative%)			**15,655**	**20,224**	**24,040**	**26,977**	**29,568**	**31,730**	**33,646**	**35,116**
% of variance			**15,655**	**4,569**	**3,816**	**2,937**	**1,243**	**1,038**	**0,920**	**0,706**

c. Loading Factor

Factor loading represents the correlation between an item and a factor, where factor analysis produces a matrix showing the relationships between observed variables and latent factors (Gregory, 2013). A factor loading value above 0.40 is generally considered to indicate a strong relationship, whereas items with lower values should be reviewed and evaluated (Field, 2013). The factor loading values of the items in the Interest Blank scale are presented in Table 5.

Based on Table 5, several items demonstrated factor loadings above 0.40. However, there were also items that did not meet the acceptable criterion, as their factor loadings remained below 0.40. This indicates that the items in the Interest Blank scale do not yet fully demonstrate adequate construct validity. The factor loadings also provide information regarding the distribution of items across the eight factors aligned with Gardner's Multiple Intelligences theory.

Furthermore, the results of the EFA indicated that not all factors were sufficiently supported by strong and evenly distributed loadings. Some factors were formed by items with high loadings; however, several items showed low loadings (< 0.40). In addition, there were factors that did not contain any items with acceptable factor loadings. This suggests that the eight-factor structure is not yet fully stable. These findings may indicate potential over-extraction of factors or the need to eliminate items with low factor loadings.

The researcher then re-ran the EFA without fixing the number of eight factors to examine the underlying factor structure more freely. Based on the scree plot, the possible number of factors appeared to range between four, five, and six factors. Accordingly, EFA was conducted using fixed

solutions of four, five, and six factors, which were then compared. The comparative analysis indicated that the five-factor model provided a clearer separation of constructs, with more coherent factor structure and an adequate number of items loading on each factor. The item distribution and factor loadings for the selected model are presented below.

Table 6. Item Distribution and Factor Loadings in the Five-Factor Model

Pattern Matrix[a]					
	Factor				
	1	2	3	4	5
IB27	.743				
IB28	.657				
IB30	.637				
IB26	.626				
IB21	.521			.303	
IB25	.450				
IB29	.414				
IB3	.353				
IB42					
IB23					
IB22					
IB7		.714			
IB12		.646			
IB10		.623			
IB8		.526			
IB38		.385			
IB20		.347			
IB11					
IB2					
IB16					
IB32			-.515		
IB33			-.501		
IB34			-.493		
IB36			-.457		
IB31			-.435		
IB35			-.433		
IB37			-.409		
IB40			-.398		
IB39			-.375		
IB6			-.309		
IB5					
IB41					
IB17					
IB13				.672	
IB18				.643	
IB14				.505	
IB24				.411	
IB15					
IB4					
IB1					
IB45					-.698
IB46					-.567
IB47					-.565
IB48					-.561
IB44					-.558
IB43					-.444
IB19					
IB9					

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.[a]
a. Rotation converged in 10 iterations.

Based on Table 6, the results indicate that several items loaded clearly onto a single factor. However, there were also factors composed of items originating from different dimensions. In this context, for example, Factor 1 consisted of six items representing Musical intelligence and one item representing Kinesthetic intelligence. The combination and distribution of items across factors are presented in the following table.

Table 7. Multiple Intelligences in the Five-Factor Model

Factor	Item	Type of Intelligence
Faktor 1	IB25	Musical
	IB26	Musical
	IB27	Musical
	IB28	Musical
	IB29	Musical
	IB30	Musical
	IB21	Kinesthetic
Faktor 2	IB7	Logical-Mathematical
	IB8	Logical-Mathematical
	IB10	Logical-Mathematical
	IB12	Logical-Mathematical
Faktor 3	IB31	Interpersonal
	IB32	Interpersonal
	IB33	Interpersonal
	IB34	Interpersonal
	IB35	Interpersonal
	IB36	Interpersonal
	IB37	Intrapersonal
Faktor 4	IB13	Spatial
	IB14	Spatial
	IB18	Spatial
	IB24	Kinesthetic
Faktor 5	IB43	Naturalistic
	IB44	Naturalistic
	IB45	Naturalistic
	IB46	Naturalistic
	IB47	Naturalistic
	IB48	Naturalistic

Based on Table 7, several types of intelligence were found to form distinct factors, represented by items with satisfactory factor loadings and consistent with the item development grounded in Gardner's Theory of Multiple Intelligences. This can be observed in Factor 5, which exclusively contains all items representing Naturalistic intelligence without contamination from other intelligence domains. Factor 2 also demonstrated a consistent structure, although with a relatively small number of items. Both factors appear to be stable within the five-factor model.

For other factors, such as Musical, Interpersonal, and Spatial intelligence, the results were generally acceptable; however, some items from different intelligence domains were still observed within the same factors. This suggests that, at a conceptual level, certain constructs may be closely related and therefore perceived similarly by participants. For instance, one Kinesthetic item was loaded within the Musical factor, possibly because its wording involves rhythm-related content associated with music. Conversely, kinesthetic expression may also be linked to movement elicited by musical stimuli. This finding requires further conceptual examination, as it represents an interesting implication for construct development. From an instrument development perspective, this may indicate that some items within these dimensions are not yet sufficiently specific.

In addition, several intelligence domains were not clearly represented as distinct factors, as their items were dispersed across multiple factors. This indicates that some dimensions have not yet been adequately defined in a

discriminant manner within the instrument. This pattern was observed in Linguistic, Kinesthetic, and Intrapersonal intelligence. For Linguistic intelligence, its items were distributed across several factors, suggesting that the items may be overly general and require further refinement. For Kinesthetic intelligence, most items appeared within Factor 1, which was primarily dominated by Musical intelligence, possibly due to semantic overlap related to rhythm and movement. For Interpersonal intelligence, most items were loaded on Factor 3, indicating a relatively stronger coherence. This finding is noteworthy, as it may suggest that, within this population, the ability to understand others and oneself is closely related, potentially reflecting an underlying socio-emotional intelligence structure.

d. Confirmatory Factor Analysis

To confirm the results of the Exploratory Factor Analysis (EFA), a further analysis was conducted using Confirmatory Factor Analysis (CFA). The CFA was performed to test the fit of the measurement model consisting of five factors of multiple intelligences. Based on the CFA results using 28 items, the model yielded $\chi^2(340) = 703$, $p < 0.001$, with a Comparative Fit Index (CFI) of 0.857, Tucker-Lewis Index (TLI) of 0.841, Root Mean Square Error of Approximation (RMSEA)of 0.054, and Standardized Root Mean Square Residual (SRMR) of 0.058. In terms of factor loadings, several items demonstrated relatively low loadings in the model (< 0.50), specifically items 31, 32, 37, and 43.

After modifying the model by removing items with factor loadings below 0.50, CFA was conducted again. The second CFA results indicated $\chi^2(220) = 479$, $p < 0.001$, with CFI = 0.880, TLI = 0.862, RMSEA = 0.057, and SRMR = 0.059. Compared to the initial model, there was an improvement in both CFI and TLI values; however, these improvements did not reach the conventional threshold for good fit (≥ 0.90). Meanwhile, RMSEA and SRMR values remained within acceptable ranges, indicating an adequate level of approximate fit.

Overall, although item removal improved model fit indices, it did not fully resolve the model's underlying issues. The factor structure therefore still requires further refinement to better represent the theoretical construct. These findings suggest that the proposed model does not yet demonstrate a satisfactory fit, indicating that the developed items are not yet sufficiently valid for measuring the construct of multiple intelligences.

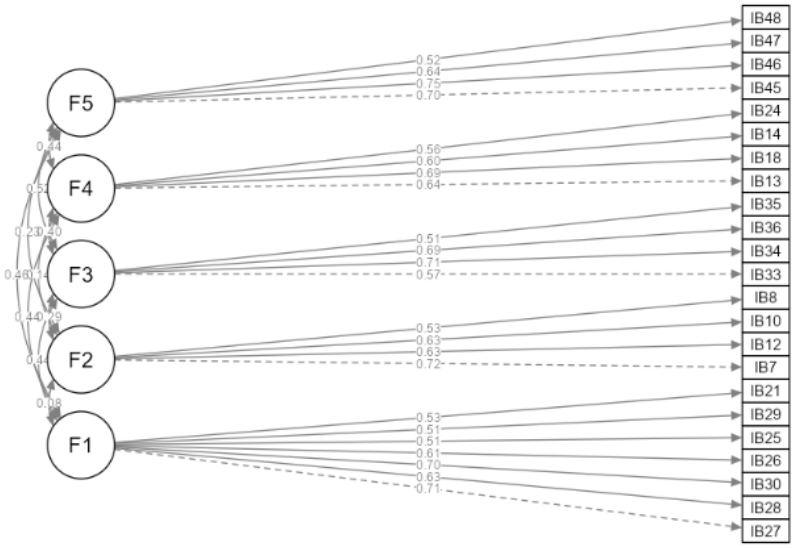

Figure 1. Multiple Intelligences Model Based on CFA

The HTMT (Heterotrait-Monotrait Ratio) values between all constructs were below the recommended threshold of 0.90. This indicates adequate discriminant validity among the factors. Based on the correlation matrix presented in Table 8, the HTMT values between constructs confirm the presence of discriminant validity.

Table 8. HTMT Results of the Interest Blank Scale

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Factor 1					
Factor 2	0,095				
Factor 3	0,353	0,214			
Factor 4	0,371	0,118	0,298		
Factor 5	0,386	0,203	0,378	0,339	

Based on the analyses conducted, the instrument still requires further refinement to achieve satisfactory construct validity. The empirical structure obtained from the data differs from Gardner's theoretical conceptualization regarding the number of factors underlying multiple intelligences. This indicates that several types of intelligence appear to overlap within this population.

These findings suggest that the boundaries between certain intelligence domains are not yet clearly differentiated in the present instrument. As a result, some constructs may be empirically indistinguishable, reflecting conceptual overlap as perceived by respondents.

DISCUSSION

The psychometric evaluation of the Interest Blank scale indicates that the instrument is still in an early stage of development and requires further refinement. Overall, the findings from reliability testing, item analysis, and construct validity assessment suggest that some dimensions function adequately; however, the expected multidimensional structure based on Multiple Intelligences theory has not yet been fully supported empirically.

In terms of reliability, only three dimensions met the acceptable internal consistency criterion ($\alpha > 0.70$), namely Musical, Interpersonal, and Naturalistic intelligence. This finding suggests that the items within these dimensions are relatively homogeneous in measuring the same construct. In contrast, the remaining five dimensions fell below the recommended threshold. In instrument development, low alpha values may be attributed to several factors, such as a limited number of items, heterogeneous content, or insufficiently specific item formulation. Taber (2018) emphasized that Cronbach's alpha is highly influenced by construct homogeneity and item quality; therefore, values below 0.70 in early-stage development may still be acceptable but require revision. Accordingly, the indicators representing Linguistic, Logical-Mathematical, Spatial, Kinesthetic, and Intrapersonal intelligence are not yet sufficiently robust to form coherent constructs.

Item discrimination analysis revealed that several dimensions (Musical, Interpersonal, Intrapersonal, and Naturalistic) had items that fully met the criterion of corrected item–total correlation ≥ 0.30. This indicates that the items were able to discriminate between respondents at the individual level. However, the Intrapersonal dimension still showed suboptimal reliability despite acceptable item discrimination. This phenomenon may occur when items are sufficiently discriminative but not homogeneous in content, resulting in weak inter-item correlations that fail to increase Cronbach's alpha (Taber, 2018). Therefore, decisions regarding item elimination should consider content relevance in addition to statistical indicators.

The implications of suboptimal reliability in several dimensions are particularly important in the context of using this instrument with elementary school students. Low reliability suggests inconsistent scores, which may lead to unstable interpretations of students' interest and aptitude profiles. In educational practice, this may result in inaccurate identification of students' tendencies, where a child may be classified as having a specific interest that is not yet adequately represented by the measurement results (DeVellis & Thorpe, 2022).

Although the analyses indicate that several dimensions exhibit suboptimal reliability (e.g., Cronbach's alpha below 0.70), this has important implications for application in elementary school populations. Low reliability may reflect response inconsistency due to children's limited cognitive ability to comprehend items or the relatively undeveloped and unstable nature of interests at this developmental stage (Podsakoff et al., 2003).

The factorability test results indicated that the data were highly suitable for factor analysis (KMO = 0.833; Bartlett's Test significant), confirming that the correlation matrix was appropriate for further analysis. However, when extracting eight factors based on the theoretical framework of Multiple Intelligences, the total variance explained was approximately 35%. This value is below the recommended range for multidimensional psychological constructs (approximately 40–60%), as suggested by Hair et al. (2019). The relatively low explained variance suggests that the eight-factor structure is not yet clearly defined in the empirical data.

The findings related to factor loadings further strengthen this indication. Several items exhibited loadings below 0.40, and some even showed negative values. Low factor loadings indicate that the items do not adequately represent the intended latent factor (Field, 2013). This condition suggests potential issues related to item wording clarity, overlap in content across dimensions, or differences in respondents' interpretation of the constructs. Boateng et al. (2018) emphasized that such issues are common in early-stage scale development and typically require iterative processes involving item revision and re-testing.

Exploratory analysis without a fixed number of factors indicated that the empirical structure tended to form between four and six factors, with the five-factor model emerging as the most optimal solution. In this model, several

of Gardner's domains began to appear more consistently, particularly Naturalistic and Logical-Mathematical intelligence, which formed relatively clean factors. This suggests that these constructs have clearer conceptual boundaries for respondents. In contrast, other dimensions showed considerable overlap. The Musical factor still contained Kinesthetic items, while Interpersonal and Intrapersonal intelligences showed interrelated patterns. Conceptually, this can be understood because musical activities often involve motor and rhythmic components (Hodges & McPherson, 2025). Similarly, Interpersonal and Intrapersonal intelligences both fall within the broader domain of socio-emotional intelligence (Gardner, 2011). This is consistent with recent studies indicating that several domains within Multiple Intelligences theory demonstrate moderate to high empirical correlations in self-report-based assessments (Shearer, 2019). Therefore, the observed overlap may reflect both conceptual proximity and limitations in item specificity.

The dimensions requiring the most attention are Linguistic, Kinesthetic, and Intrapersonal intelligence, as their items were dispersed across multiple factors. This indicates weak discriminant validity in these domains. Clark and Watson (2019) emphasized that in psychological scale development, behavioral indicators must be specific and unambiguous in order to clearly differentiate closely related constructs. Accordingly, item refinement and indicator clarification are essential steps for improvement.

Overall, the results of this study indicate that the empirical structure of Multiple Intelligences in this sample does not fully replicate the theoretical eight-factor model. This finding is consistent with previous literature suggesting that Multiple Intelligences models often yield more parsimonious factor structures in empirical applications, particularly in self-report instruments (Visser et al., 2006; Shearer, 2019). Therefore, instrument development should carefully balance theoretical fidelity with empirical support.

This study has several limitations in terms of instrument development. The Interest Blank scale, developed based on Howard Gardner's theory of Multiple Intelligences, demonstrates varying psychometric quality across dimensions. Some dimensions show adequate reliability, while others require item revision to ensure clearer and more developmentally appropriate indicators for elementary school students. Item wording quality significantly influences both reliability and construct validity (DeVellis & Thorpe, 2022). Items with factor loadings below 0.40 should be reviewed, revised, or removed to improve internal consistency (Hair et al., 2019).

Although the sample size was relatively large, the study was conducted in only one school, limiting the generalizability of the findings. Moreover, the use of self-report methods among elementary school students may introduce bias due to limited metacognitive ability and difficulties in understanding abstract items (Podsakoff et al., 2003). Therefore, future studies are recommended to adopt a multi-method approach, such as combining self-reports, teacher observations, and parent reports. This multi-informant approach can provide cross-contextual information and reduce single-method bias in psychological assessment of children (De Los Reyes et al., 2015). In addition, combining multiple informants can strengthen the evaluation of construct validity and convergence across measurement methods (Geiser et al., 2015).

In conclusion, the Interest Blank scale in its current form does not yet fully meet psychometric quality standards for widespread use in elementary school populations. Nevertheless, the instrument shows potential as an initial screening tool that requires further refinement, particularly through item revision and re-examination of its factor structure, to better align with respondent developmental characteristics and the intended constructs.

CONCLUSION

Based on the objective of this study to examine the psychometric quality of the Interest Blank scale grounded in the Multiple Intelligences theory for identifying elementary school students' interests and talents, it can be concluded that the instrument has not yet demonstrated fully optimal psychometric properties. In terms of reliability, only three dimensions met the criteria for good internal consistency, while the remaining five dimensions still require further improvement. Regarding item discrimination, most items were able to adequately differentiate respondents; however, several items still need additional evaluation. Construct validity analysis using Exploratory Factor Analysis (EFA) indicated that although the data were suitable for analysis, the empirical factor structure did not fully support the theoretical model of eight multiple intelligences and instead tended to form a more concise structure. Therefore, the Interest Blank scale shows potential as an instrument for identifying elementary school students' interests and talents, but it still requires item revision, strengthening of internal consistency, and further validation studies to achieve stronger and more stable psychometric standards.

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DECLARATION OF INTEREST

The authors of this article declared no conflict of interest.

ETHICAL CONSIDERATIONS

This study has obtained ethical approval from the Research Ethics Committee, and all research procedures were carried out in accordance with applicable moral principles.

AUTHORS' CONTRIBUTIONS

All authors equally contribute to this study.

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