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Validity and reliability of a futsal performance test based on multiple intelligences

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ABSTRACT

This study aimed to develop a futsal performance test instrument based on the theory of multiple intelligences for futsal athletes, and to assess its feasibility and effectiveness. The research used the ADDIE model, which includes Analysis, Design, Development, Implementation, and Evaluation phases. The sample consisted of students enrolled in the Sports Coaching Education Study Program at the University of Jambi who were registered in the futsal course. Two trial groups were involved: a limited-scale trial with 30 students and a large-scale trial with 90 students, selected through simple random sampling. Sampling criteria were based on enrollment in the futsal course, as per the curriculum of the Sports Coaching Education (PORKES) Study Program. Data collection techniques included questionnaires and performance tests. Analysis methods involved content validity testing (Aiken's V), construct validity testing (Confirmatory Factor Analysis), and product effectiveness evaluation using descriptive statistics. The development process produced an instrument consisting of 18 components, each with a factor loading above 0.3, indicating strong construct validity. Content validity, assessed by three experts using the Delphi method, yielded a total Aiken's V value of 1.141. The reliability coefficient was 0.807, indicating high internal consistency. These results demonstrate that the developed futsal test instrument is both valid and reliable for evaluating futsal performance based on multiple intelligences.

KEYWORDS

Sport; Development; Physical Education; ADDIE

1. INTRODUCTION

Sports have become part of the lives of people around the world and become a culture, as well as a profession (Alnedral et al., 2024; Darajat et al., 2024; Fatahilah et al., 2024; Saputra et al., 2025). Sports training is considered as one of the main tools for developing life skills among the younger generation who participate in sports (L. M. Id et al., 2022). Futsal is a popular sport that continues to gain recognition and develop at various levels, including amateur, semi-professional, and professional (González-Víllora et al., 2022; Sanmiguel-rodr et al., 2021). Despite its popularity and competitive status, there are only a few scientific studies examining Futsal in professional players. Therefore, further research is needed to understand the physiological responses, activity patterns, and skill requirements of Futsal (Sánchez-sánchez et al., 2018; Spyrou et al., 2020). This understanding will aid in the development of the sport and allow practitioners to design appropriate training programs for Futsal players. By examining key aspects of Futsal such as match analysis, physiological needs, energy needs, fitness measurements, and skill requirements, researchers can gain insight into the specific physical and technical demands of Futsal match play (Illa et al., 2021; Sekulic et al., 2021; Spyrou et al., 2020). This knowledge can then be used to improve skill transfer and aid the development of soccer players who also participate in Futsal (Ribeiro et al., 2021). However, additional scientific research is needed to improve the understanding of the technical and physical demands of futsal and the potential benefits for soccer player development.

A futsal player must have a high capacity for intermittent endurance, repeated sprinting ability, and leg strength (Iedynak et al., 2019; Vilar et al., 2013). In addition, technical aspects such as shooting and passing skills, agility, and coordination are also very important for success in Futsal (Fitrian et al., 2023). In order for the development of futsal athletes to be achieved optimally in terms of technical, physical, and psychological aspects, a comprehensive evaluation tool is needed. So that the coach can control and see the development and progress of athletes during the training process. Thus, the training process can be controlled so that the athlete's potential can be optimal. Evaluation tools such as test instruments can help athletes understand the dynamics, techniques, tactics and physiological factors in futsal (Fitrian et al., 2023). In the Department of Sports Education and Coaching, University of Jambi, especially in the futsal course, the evaluation conducted is limited to looking at basic futsal technical skills and ignoring other intelligence or abilities possessed by students. Playing futsal does not only involve kinesthetic intelligence but also includes various intelligences.

Futsal, a fast-paced indoor soccer game, requires players to possess a variety of cognitive skills and abilities, including not only physical agility and technical prowess, but also the ability to make quick decisions, strategize, communicate effectively with teammates, and adapt to changing game situations (González-víllora et al., 2022). By combining multiple intelligences, futsal players can excel both individually and as a team, leveraging their strengths to contribute to the overall success of the game. Furthermore, the role of cognitive performance is critical in futsal, as the fast-paced nature of the game requires quick thinking and decision-making (Jakiwa et al., 2023). Futsal requires good cognitive performance in making quick decisions and adapting to changing game situations, by engaging in futsal, players have the opportunity to develop and improve their cognitive abilities, especially in areas such as problem solving, critical thinking (Fitrian et al., 2023). Therefore, a comprehensive test instrument is needed to evaluate the technical, physical, and psychological aspects of futsal athletes.

In this study, a futsal playing test instrument based on multiple intelligence will be developed so that the evaluation carried out can measure the multiple intelligence aspects possessed by futsal athletes when playing futsal. The development of futsal playing test instruments based on Multiple Intelligences will improve the evaluation process by providing a comprehensive assessment of the technical, physical, and psychological abilities of futsal players. This instrument is expected to help coaches understand the multifaceted abilities needed to succeed in futsal, so that it can improve player development and performance.

2. METHODS

2.1. Design and Participants

The development method used in the research on the development of futsal playing test instruments based on Multiple Intelligence is the ADDIE model. The stages are; (1) Analyze, (2) design, (3) develop, (4) implementation, and (5) evaluation (Sugiyono, 2022). Research and Development is a research method that aims to produce a particular product and test its effectiveness. Development is the process of changing design specifications into physical form. This process includes variations applied in learning and is inseparable from evaluation, management, and use. In general, development involves: (1) content-driven delivery, (2) a learning approach based on theory, and (3) application of technology in the form of learning materials, hardware, and software.

The sample in this study consisted of students of the Sports Coaching Education Study Program at the University of Jambi who were registered in the Futsal course. This study involved two

test groups, namely a limited-scale trial and a large-scale trial. The limited-scale trial involved 30 students, while the large-scale trial involved 90 students selected using a simple random sampling technique. The sample selection criteria are based on students who take Futsal courses in accordance with the curriculum of the PORKES Study Program. Participants' participation in this study was voluntary, and all participants gave consent to participate after being explained about the purpose and procedures of the study.

2.2. Procedures

The selection of this model is based on several reasons, namely (1) the ADDIE model is specifically designed for the development of technology-based learning designs, making it easier for researchers to carry out research (2) this model has systematic and specific steps, starting from analysis, planning, development, application, implementation to evaluation, so that it is hoped that product development can achieve the desired goals (3) this model also includes the stages of needs analysis and initial and final front-end analysis which are very important in development research.

The following is the design and development procedure with the ADDIE model:

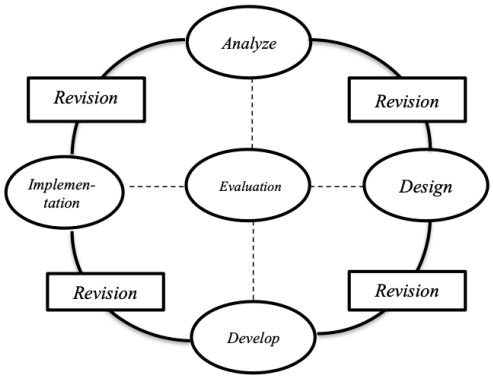

Figure 1. ADDIE Model Design on product development

1. **Analysis Stage:** At this stage, the following are carried out: covering the analysis of needs related to futsal playing test instruments based on multiple intelligence integrated with mobile applications for futsal athletes. This is done by reviewing the problems that exist during the futsal playing test which currently only measures technical aspects, thus ignoring other intelligences possessed by humans, then identifying aspects and indicators of the futsal playing test through theoretical studies, then compiling and constructing specifications and forms of questionnaires with the assistance of judgment

(experts/measurement experts).

2. **Design Stage:** At this stage, the product design is designed by first creating a grid of futsal playing test instruments based on multiple intelligence. Based on the grid of the test instrument, a futsal playing test instrument will be developed that covers nine aspects of intelligence according to Gardner's theory. Which will be poured into a mobile application so that users can use the test instrument more practically.
3. **Development stage:** At this stage, the product is revised by removing items that do not meet the development criteria. Conduct testing and measurement with the IRT approach and interpret it.
4. **Implementation stage:** Namely the instrument that has been validated is then tested. At this stage. The trial is carried out to determine the validity and reliability of the instrument. Instruments that are already valid and reliable are also refined on the android application. The application of the instrument that is already valid and reliable is then entered into the play store. To make it easier for users to download the "FUTSAL MI TES" application.
5. **Evaluation stage:** At this stage, evaluation is carried out and user satisfaction of the product produced is analyzed.

2.3. Product Trial Design

The product trial design was conducted to collect data used as a basis for determining the feasibility of the MI-based futsal playing test instrument product for futsal athletes. To determine the quality of the test instrument, an analysis was carried out both qualitatively with expert judgment validation in terms of content, construction, and language aspects, as well as quantitatively through a trial process to determine the validity and reliability of the instrument. The subjects of the limited-scale trial were 30 students of the Sports Coaching Education study program. A large-scale trial or measurement test was conducted to prove the reliability of the instrument and the effectiveness of the instrument. By adding subjects, the validity and reliability of the instrument can be increased. The subjects of the large-scale trial were 90 students of the Sports and Health Education study program, JPOK UNJA. Using a simple random sampling technique. The sample selection criteria were based on students who contracted the Futsal MK in accordance with the PORKES Study Program curriculum.

2.4. Data Collection Techniques and Instruments

The instrument used in this study is a futsal playing test instrument based on multiple intelligence integrated with a mobile application for futsal athletes. In data collection, the instrument used must meet the criteria, so that the instrument has consistency in measurement and can be used in accordance with the measurement objectives. The criteria in question are validity and reliability. An instrument is considered valid if it can measure in accordance with the measurement objectives, or in other words, the measurement results can measure what the researcher wants to measure. While reliability is a criterion that can prove the level of trust in the instrument. An instrument is said to be reliable if the instrument has been used repeatedly in measurements involving the same subjects and gets the same results. In addition, data is obtained from input and suggestions from sports test and measurement experts, sports coaching experts, and experts in the field of futsal. The input and suggestions can be in the form of oral (input in meetings) or questionnaires (written input). This discussion method is recorded and implemented in an MI-based futsal playing test instrument that has been refined to be transformed into an MI-based futsal playing test instrument integrated with a mobile application.

2.5. Data Analysis Techniques

The process of instrument preparation begins with creating a grid to assess the variables to be measured. This grid is then developed into test items, which are compiled into a standard instrument and reviewed by experts via the Delphi method. Experts in measurement, futsal, and sports education/ coaching provide input. The instrument, based on Howard Gardner's theory of Multiple Intelligences (MI), is validated to ensure it measures what it is intended to. Content validity is assessed using the Aiken formula, where a validity coefficient of 0.7 is acceptable (Aiken, 1980).

The futsal test instrument is analyzed using Item Response Theory (IRT), starting with an assessment of unidimensionality through fit analysis or exploratory factor analysis. The Rasch model is used to check if the items fit, using the Infit Mean-Square (IMS) and Outfit Mean-Square (OMS) statistics, with acceptable values between 0.5 and 1.5. Item difficulty levels are categorized from very easy to very difficult based on these values. The reliability index of the test is calculated using the test information function (Hambleton & Swaminathan, 1985), which estimates the standard error of measurement. The test results are analyzed to assess futsal playing ability based on MI, and results are presented as a frequency distribution and a percentage chart, categorizing ability levels based on ideal mean and standard deviation values (Azwar, 2015).

Table 1. Ability Interval

Ability Interval	Level
X<M-1.SD	Low
M-1.SD<M+1.SD	Currently
M+1.SD<X	High

3. RESULTS

The product developed is a futsal playing test instrument based on multiple intelligence integrated with a mobile application consisting of 18 statement items, namely knowledge items about futsal games that cover nine aspects of intelligence, namely: (1) linguistic, (2) mathematical logic, (3) visual spatial, (4) kinesthetic, (5) music, (6) interpersonal, (7) intrapersonal, (8) naturalist, (9) existence. The test instrument consists of four criteria for each observation item (using a Likert scale).

3.1. Validity of the Instrument

The analysis was carried out using the Aiken formulating the Aiken's V formula to calculate the content-validity coefficient which is based on the assessment results of a panel of experts of n people on an item in terms of how far the item represents the measured construct.

Table 2. Validity of the content of the Aiken Index

No	Rater 1	Rater 2	Rater 3	Io1	Io2	Io3	Sum	Indeks Aiken
1	3	4	3	2	3	2	10	1,111
2	3	4	4	3	3	2	11	1,222
3	3	4	3	2	3	3	10	1,111
4	4	4	3	3	3	2	11	1,222
5	3	3	3	2	2	2	9	1
6	4	4	3	3	2	2	11	1,222
7	4	4	4	3	3	3	12	1,333
8	4	4	3	3	3	2	11	1,222
9	3	3	3	2	2	2	9	1
10	3	3	3	2	2	2	9	1
11	3	4	3	2	3	2	10	1,111
12	3	4	3	3	3	2	10	1,111
13	3	3	3	2	2	2	9	1
14	3	3	4	2	2	3	10	1,111
15	4	3	4	3	2	3	11	1,222
16	4	3	4	3	3	3	12	1,333
17	4	4	4	2	3	3	11	1,222
18	3	3	3	2	2	2	9	1
Average								**1,141**

The average Aiken validity of the instrument as a whole is 1.141, meaning that the V-Aiken coefficient on the observation instrument is classified as Valid. From the results of the instrument trial conducted on 18 statement items with a sample of 30, the unidimensional test was carried out with factor analysis using the SPSS 25 program. Before conducting the factor analysis, a feasibility analysis test was carried out using the KMO-MSA test and the Barlett's test on each instrument. The requirements for factor analysis are Kaiser-Meyer Olkin (KMO) - MSAU> 0.5 and the significant unidimensional barlet test means that each test item only measures one ability. To test unidimensionality with factor analysis. The results of the KMO and Barlett's analysis are less than 0.05. The KMO-MSA test is used to see the adequacy of the sample, while the Barlett's test is for the normality of the data used. The results of the trial can be explained in Table 3.

Table 3. KMO and Bartlett's Test

KMO and Bartlett's Test	**Value**
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0,807
Bartlett's Test of Sphericity - Approx. Chi-Square	342.761
df	153
Sig.	0.000

Table 3 explains the results of the empirical analysis with a KMO-MSA value of 0.807 or more than 0.5 and a Barlett's sig test of 0.000. Based on these data, it can be concluded that all data analysis results are significant. This can be interpreted as an instrument that is suitable for factor analysis. To obtain items that measure the same dimensions, an extraction process is carried out to produce several factors. Each factor formed has an eigenvalue, and factors that have an eigenvalue above 1.00 are retained (Santoso, 2010). According to Swaminathan et al. (2006), the unidimensional assumption is considered fulfilled if the test contains one dominant component that measures a person's ability. The same statement was put forward by Sihombing (2019) who stated that if the measurement finds one dominant dimension, the dominant dimension becomes a single dimension or unidimensionality in the response or characteristics of the item. Furthermore, if the eigenvalue of the first factor has a value several times the eigenvalue of the second factor and so on is almost the same, it is said that the unidimensional requirement is met.

Table 4. Total variance explained

Component	Total	% of Variance	Cumulative %
1	8.800	48.891	48.891
2	1.737	9.648	58.539
3	1.119	6.217	64.756
4	1.042	5.787	70.542
5	0.672	5.382	75.924
6	0.549	4.397	80.321
7	0.505	4.042	84.363
8	0.383	3.067	87.430
9	0.343	2.743	90.173
10	0.244	1.956	92.128
11	0.208	1.668	93.796
12	0.199	1.593	95.389
13	0.186	1.493	96.882
14	0.137	1.099	97.981
15	0.102	0.566	98.797
16	0.069	0.386	99.353
17	0.078	0.301	99.786
18	0.039	0.148	100.000

After knowing the total variance in Table 4 of 70.542% in the first component, which can be interpreted that this instrument measures one aspect with a dominant eigenvalue of 27.100, meaning that the instrument developed only measures one dimension of ability. The results can be seen in the Scree Plot of the exploratory factor analysis explained in Figure 2 below.

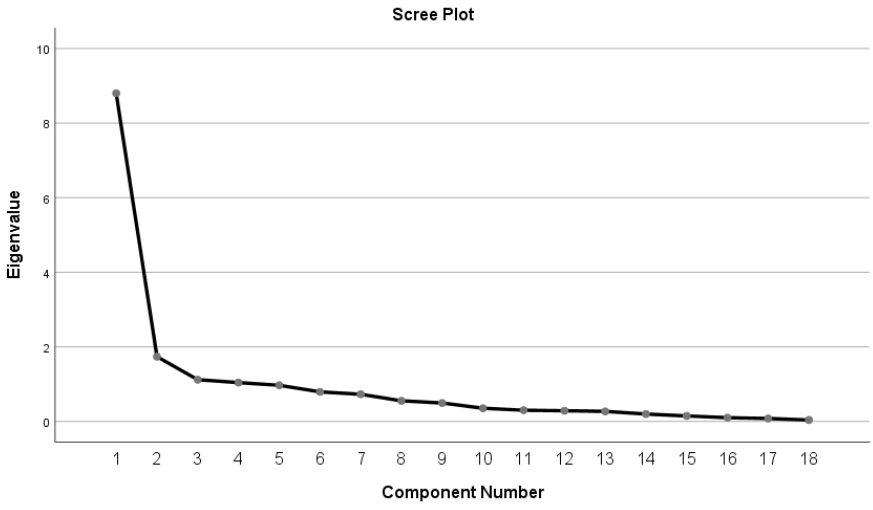

Figure 2. Scree Plot

3.2. Instrument Reliability

The next step is to analyze the items using SPSS to see the reliability of the developed instrument. The parameters used to determine reliability are by looking at the Cronbach Alpha value in each output table obtained, with the provision that if the Alpha index is greater than 0.7 ($\alpha > 0.7$), the instrument is reliable (Taber, 2018). The results of the Alpha coefficient in the limited scale trial showed a value of 0.936 (> 0.7), meaning that the instrument built has met the requirements for high reliability. Table 5 below shows the results of the reliability coefficient of the observation instrument.

Table 5. Cronbach's Alpha

Cronbach's Alpha	Number of Items
0,65	22

4. DISCUSSION

The results of the research and development obtained are similar to the results of study Mashkoor & Hameed (2022), namely looking for the influence of the strategy of using multiple intelligence theory on the development of basketball skills. The results showed that the learning program applied to the control group can increase multiple intelligences. Likewise, the active learning method can be applied to improve MI in basketball games in high school.

Meanwhile, Jes (2024) studied the relationship between physical body-kinesthetic movement abilities and student learning outcomes. The results obtained were that there was no significant difference between the control and experimental classes that affected students' MI abilities. This implies that increasing MI abilities needs to be based on a habituation program according to each person's potential and talents.

The relevance to this study is in the MI aspects studied, there are nine intelligences that will be observed in this development research. With instruments developed in accordance with the procedure, the assessment results obtained will also be optimal in developing MI abilities in students in high school. Meanwhile, also developed an instrument to assess different intelligences, namely musical, interpersonal, intrapersonal, kinesthetic-bodily, social, naturalistic, spiritual, spatial, and mathematical (Pocinho & Mendes, 2021). The results obtained from the nine aspects of intelligence developed showed valid and reliable trial results, although in this study there was one test item whose results were invalid. This study provides suggestions that the aspects of multiple intelligences developed can be adjusted between indicators and learning objectives. With learning objectives that are in accordance with the abilities and interests of students, these MI aspects can develop. The

results can be seen that there is a real influence of the meta-analytic process that shows the relationship between MI and student academic achievement. The results of research and development conducted by on the development of MI-based basketball game assessments (Id et al., 2024). The relevance to this study is using Howard Gardner's theory of multiple intelligence as the basis for the instrument. What distinguishes this study is the different sports between basketball and futsal. In addition, this study also produces test instruments that are integrated into mobile applications.

5. CONCLUSIONS

This study aimed to develop a futsal playing test instrument based on Howard Gardner's Multiple Intelligences (MI) theory for futsal athletes and to assess its feasibility. The results showed that the developed instrument consists of 18 items covering nine aspects of intelligence: linguistic, logical-mathematical, visual-spatial, kinesthetic, musical, interpersonal, intrapersonal, naturalistic, and existential. This instrument was designed to evaluate various intelligence aspects relevant to futsal, going beyond just kinesthetic intelligence to include cognitive and social dimensions. Content validity analysis, using Aiken's V formula, yielded an average validity coefficient of 1.141, indicating that the instrument is valid for measuring the intended constructs. Additionally, factor analysis confirmed the instrument's unidimensionality, meaning it successfully measures a dominant ability related to playing futsal. The instrument's reliability, tested with Cronbach's Alpha, resulted in a high coefficient of 0.936, confirming its consistency and reliability for repeated use. Moreover, the instrument was integrated into a mobile application, "FUTSAL MI TES," which enhances user accessibility and practicality. The developed instrument contributes significantly to futsal training by providing a comprehensive evaluation tool that assesses not only technical skills but also cognitive and social abilities. Overall, the MI-based futsal playing test instrument has proven to be valid, reliable, and practical for use, offering a valuable tool for coaches and athletes to assess and develop various intelligence aspects critical to futsal performance.

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All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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