

Developing an Achievement Test for Selected Defensive and Offensive Basketball Skills Based on the Rasch Model

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Abstract

Objectives of the Study:

- Develop an achievement test to measure selected defensive and offensive basketball skills using the Rasch model.
- Examine the scientific properties (validity and reliability) of the achievement test designed based on the Rasch model.

Methodology:

The study employed a descriptive comparative approach due to its suitability for the research objectives. Data collection methods included content analysis, interviews, and questionnaires designed according to the Rasch model. The test development process involved the following steps:

- Designing test items based on the Rasch model.
- Analyzing data using statistical software (Microsoft Excel, WINSTEPS, Bilog-MG3).

Population and Sample:

- **Research Population:** Second-year students from the College of Physical Education at the University of Duhok and the Department of Physical Education and Sports Sciences at the University of Zakho, totaling 213 students.
- **Research Sample:**
 - **Construction Sample:** A total of 149 students (69.95% of the population) were purposively selected, distributed between the University of Duhok (109 students) and the University of Zakho (40 students).
 - **Application Sample:** A total of 64 students (30.05% of the population) were purposively selected to test the final version of the achievement test.

Key Findings:

- The Rasch model demonstrated high accuracy and objectivity in constructing cognitive tests, excluding inappropriate items to achieve reliable results.
- The model relies on sample-independent measurements, ensuring precise and unbiased estimates.
- The Rasch model provided accurate estimates of validity and reliability coefficients, enhancing measurement quality and result accuracy.
- The model showed strong capabilities in distinguishing individual differences, reflecting high sensitivity to performance variations.
- Excluding a larger number of items in the Rasch model indicates its strict adherence to rigorous standards, leading to greater precision in skill measurement.
- Statistical analyses revealed significant differences in estimates derived from the Rasch model, underscoring its superiority in delivering precise and objective measurements.

Conclusion and Recommendations:

The study concluded that the Rasch model is an effective tool for data analysis and cognitive test design in the sports field. It is recommended to adopt the Rasch model more widely in test design, train researchers and practitioners on its application, and develop user-friendly software to expand its use in other domains.

Keywords: Rasch Model, Achievement Tests, Basketball, Objective Measurement, Physical Education.

1. Introduction to the Study:

1.1 Introduction and Research Importance:

Measurement and evaluation are fundamental pillars across various scientific and applied fields, as they provide tools to scientifically and accurately understand and interpret phenomena. In sports, assessing technical and physical skills is a critical factor for improving performance and achieving success. Basketball, as one of the most popular team sports, is characterized by a wide range of technical skills, both defensive and offensive, necessitating the development of precise measurement tools that account for the diversity of these skills. Achievement tests are the primary tools in sports measurement, used to evaluate players' performance and identify their strengths and weaknesses. However, these tests require meticulous design based on clear scientific principles to ensure objectivity and fairness in measurement. This study focuses on developing an achievement test for selected defensive and offensive basketball skills based on the Rasch model. The Rasch model is an advanced methodology that enables the development of tests capable of providing accurate results, which can enhance the quality of sports training and elevate performance levels (Al-Shawawreh, 2013, p. 41).

Applying the Rasch model in constructing achievement tests represents a paradigm shift in understanding and analyzing player performance. It emphasizes analyzing individuals' responses to precisely estimate their abilities, independent of test or sample characteristics. Hence, this study represents a significant contribution to the development of sports measurement, aiming to provide an objective and reliable tool for analyzing basketball performance.

Theoretical Significance:

The current research seeks to enhance the theoretical understanding of measurement mechanisms and data analysis by employing the Rasch model in constructing achievement tests. This model is a modern tool proven effective in designing accurate tests that reflect individuals' actual performance. Through this study, the scientific knowledge base regarding the development of achievement tests in sports can be expanded, particularly in evaluating defensive and offensive basketball skills.

The study provides a comprehensive theoretical framework enabling researchers and specialists to understand advanced measurement principles and use them to develop more precise and effective tests. Furthermore, applying the Rasch model demonstrates how measurement quality can be significantly improved compared to traditional methods, enhancing the credibility of results and enriching the research literature in this field.

Practical Significance:

Practically, this research holds considerable importance due to its direct relevance to developing effective measurement tools for evaluating basketball players' performance. The tests designed using the Rasch model serve as reliable measurement tools that allow coaches and specialists to analyze performance more accurately, enabling them to devise more efficient training plans.

This study contributes to improving the quality of training and educational processes by providing accurate data on players' abilities in defensive and offensive skills. Such data help identify strengths and weaknesses, allowing coaches to implement appropriate interventions to enhance performance. Additionally, the study's findings could aid in developing training and educational curricula related to basketball, contributing to raising the game's standard at both individual and team levels.

Moreover, the study's results could be beneficial to decision-makers in sports, offering effective measurement tools for selecting and scientifically evaluating players. The use of the Rasch model ensures fairness in measurement, making the test results more objective and applicable across various contexts.

By focusing on developing an achievement test based on the Rasch model, this research addresses many challenges associated with measuring sports skills. It also enhances coaches'

and specialists' ability to evaluate players' performance more accurately, positively impacting the quality of training and sports development overall.

1.2 Research Problem

Despite the significant role of measurement methods in ensuring accuracy and objectivity in sports performance evaluation, many achievement tests currently used in physical education lack updates and development. These tests are often designed without reliance on advanced scientific principles that ensure precise measurement of athletes' technical and skill performance. This results in several challenges, including unfair evaluation and difficulty in scientifically interpreting results to reflect field realities.

Defensive and offensive basketball skills require precise measurement tools capable of analyzing players' performance and reliably determining their actual skill levels. However, traditional tests often provide only aggregated performance results, overlooking individual differences among players or the unique characteristics of each test item. This limitation restricts achievement tests from presenting a comprehensive and accurate depiction of sports performance, negatively affecting the effectiveness of training processes and developmental decision-making.

Given these challenges, there is a pressing need to design tests based on advanced scientific methodologies, such as the Rasch model, which is one of the most effective models for providing accurate and objective measurements. The Rasch model surpasses the limitations of traditional measurement methods by analyzing individual responses at the level of each test item, thereby improving result quality and offering fairer and more transparent evaluations.

Thus, the current research problem is defined as the need to develop an objective achievement test to measure defensive and offensive basketball skills using the Rasch model. The study aims to design a measurement tool capable of accurately analyzing sports performance while ensuring reliable data that can improve the quality of training and evaluation in the sports field. This research addresses the urgent need for more precise and objective measurement tools that enhance training efficiency and better achieve educational and sports goals.

The study seeks to answer the following questions:

1. What are the psychometric properties of the test items when constructed using the Rasch model?
2. How can the new test contribute to improving the evaluation of defensive and offensive basketball skills?
3. To what extent is the new test effective in providing objective and fair measurements of sports performance?

- **1.3 Research aims:**

- To develop an achievement test for selected defensive and offensive basketball skills based on the Rasch model.
- To identify the scientific foundations (validity and reliability) of the achievement test for selected defensive and offensive basketball skills using the Rasch model.

- **1.4 Research Scope:**

- **Temporal Scope:** From October 1, 2021, to November 25, 2024.

- **Human Scope:** Students of the College of Physical Education and Sports Sciences at the University of Duhok and students of the Department of Physical Education and Sports Sciences at the College of Education, University of Zakho.
- **Spatial Scope:** The College of Physical Education and Sports Sciences at the University of Duhok and the Department of Physical Education and Sports Sciences at the College of Education, University of Zakho.

1.5 Definition of Terms:

- **Achievement Test:** An achievement test is a structured tool designed to measure the level of knowledge and skills acquired by a sample from a specific population in relation to a particular subject or sport (game) they have formally studied. This is achieved through their responses to a selected set of questions (items) that represent the content of the theoretical or academic material. (Bharadway, 2024, 135)
- **Defensive Basketball Skills:** Defensive basketball skills refer to a set of abilities possessed and executed by a basketball player during a game when in a defensive position, adhering to the legal framework of the game. These skills are performed individually, collectively, or as a team to prevent the opposing team from successfully scoring (a point or multiple points) in their basket. Key defensive skills in basketball include:
 - **(Defensive Stance:** Preparing the player to react effectively.
 - **Foot Movement:** Ensuring agility and proper positioning.
 - **Intercepting Passes:** Disrupting the opposing team's ball movement.
 - **Defending Against the Shooter:** Contesting shots to reduce scoring chances.
 - **Defending Against the Dribbler:** Applying pressure on the ball-handler.
 - **Defending the Pivot Player:** Containing the central player in offensive plays.
 - **Rebounding:** Securing missed shots or rebounds to regain possession. (Crudeli, 2023, 26)
- **Offensive Basketball Skills:** Offensive basketball skills refer to a set of abilities possessed and performed by a basketball player during a game while in an offensive position, i.e., when their team has possession of the ball. These skills aim to score the maximum possible points in the opponent's basket to secure a victory for their team. Key offensive skills include:
 - **(Shooting:** Executing shots accurately to score points.
 - **Passing:** Delivering the ball effectively to teammates to maintain possession and create scoring opportunities. **Dribbling:** Controlling the ball while moving to navigate through the defense.) (Oliver, 2024, 53)
- **Rasch Model:** The Rasch model is a branch of modern measurement theory, specifically part of Item Response Theory (IRT), developed by Georg Rasch. It is defined as a one-parameter logistic model that estimates the probability of an individual correctly answering a specific test item based on their ability and the difficulty parameter of the item. This estimation is independent of the total number of test items or the sample size of the examinees. The Rasch model is commonly used for analyzing test items in assessments where each correct response is awarded a raw score of 1 and each incorrect response a raw score of 0. It ensures objective measurement by focusing on the interaction between item difficulty and individual ability. (Lampriano,2024, 106).

2. Research Procedures

2.1 Research Methodology

The researchers adopted the descriptive comparative approach, as it is suitable for the current study.

2.2 Research Population and Sample

The research population was defined as students enrolled in the College of Physical Education and Sports Sciences at the University of Duhok and students in the Department

of Physical Education and Sports Sciences at the College of Education, University of Zakho, for the academic year 2023–2024, totaling **213 students**.

• **Population Description:**

The population included second-year students from the College of Physical Education and Sports Sciences at the University of Duhok and the Department of Physical Education and Sports Sciences at the College of Education, University of Zakho, totaling 213 students for the academic year 2023–2024. Detailed population data are presented in **Table 1**.

Table 1: Details of the Research Population

#	College/Department	Number of Students
1	College of Physical Education and Sports Sciences, University of Duhok	109
2	Department of Physical Education and Sports Sciences, College of Education, University of Zakho	104
Total		213

- **Research Sample:** The research sample was divided into two sub-samples: a construction sample and an application sample. The construction sample included 149 students, while the application sample comprised 64 students.
- **Construction Sample:** The construction sample was purposively selected to represent the research population. It included 109 students from the College of Physical Education and Sports Sciences at the University of Duhok and 40 students from the Department of Physical Education and Sports Sciences at the College of Education, University of Zakho, totaling 149 students. This sample represents 69.95% of the total research population, ensuring a comprehensive and accurate representation of the target population's characteristics.
 - **Statistical Analysis Sample:** 106 students were selected from the College of Physical Education and Sports Sciences at the University of Duhok for statistical analysis.
 - **Pilot Study Sample:** 10 students were randomly selected from the Department of Physical Education and Sports Sciences at the College of Education, University of Zakho, to perform the pilot study.
 - **Reliability Sample:** 30 students were randomly selected from the Department of Physical Education and Sports Sciences at the College of Education, University of Zakho, for reliability testing.

Table 2: Details of the Construction Sample Representing 69.95% of the Research Population

#	College/Department	Statistical Analysis	Pilot Study	Reliability	Excluded
1	College of Physical Education and Sports Sciences, University of Duhok	106	-	-	3
2	Department of Physical Education and Sports Sciences, College of Education, University of Zakho	-	10	30	-
Total		106	10	30	3

- **Application Sample:** The application sample consisted of **64 students**, purposively selected from the Department of Physical Education and Sports Sciences at the College of Education, University of Zakho. This sample represents **30.05%** of the total research population and was selected to implement the final version of the scale: the Defensive and Offensive Basketball Skills Scale based on the Rasch model.

Table 3: Details of the Application Sample Representing 30.05% of the Research Population

#	College/Department	Application Sample	Excluded	Total
1	Department of Physical Education and Sports Sciences, College of Education, University of Zakho	63	1	64

2.3 Methods and Tools for Data Collection (Scientific Research Tools):

- Content Analysis.
- Personal Interview.
- Questionnaire:
 - A questionnaire form was designed to identify educational objectives and evaluate the validity of the items related to defensive and offensive basketball skills.
 - The questionnaire was distributed to a panel of experts and specialists in measurement, evaluation, teaching methods, and basketball.
 - The initial version of the Rasch model-based test was distributed to the construction sample.
 - A finalized questionnaire (Appendix 1) was distributed to the pilot study sample, the reliability sample, and the application sample to assess the Rasch model-based scale in its final form.
- **Achievement Test Development**
 - Planning: A detailed plan for developing the achievement test was established.
 - Content Areas: The test covers two main content areas: defensive basketball skills and offensive basketball skills.
 - Behavioral Objectives: To ensure the validity and coverage of the behavioral objectives, they were presented to a panel of nine experts. The experts reviewed and validated the clarity and relevance of the objectives, ensuring comprehensive coverage of the educational content. A total of 43 objectives were derived, all of which achieved an agreement rate exceeding 75%. This threshold, as recommended by research standards (Suleiman, 2021, p. 39), guarantees the validity of the items. Consequently, all objectives were adopted without modification.

Preparation of a Specification Table for the Research Sample:

A specification table was prepared to outline the distribution and weight of the test items across the content areas of defensive and offensive basketball skills.

Table 4: Specifications Table for the Achievement Test on Defensive and Offensive Basketball Skills

Content Areas	Relative Importance	Relative importance	Behavioral Objectives			Behavioral Objectives Summary
			Knowledge (Recall) Objectives (30%)	Understanding Objectives (30%)	Application Objectives (40%)	
Defensive Skills	Defensive Stance	%9	1	1	2	4
	Defense Against the Dribbler	%7	1	1	1	3
	Defense Against the Key Player	%7	1	1	1	3
	Defense Against the Shooter	%5	0	1	1	2
	Defense Against the Pivot Player	%7	1	1	1	3
	Defensive Follow-Up (Rebounding)	%7	1	1	1	3
Offensive Skills	Ball Handling	%7	1	1	1	3
	Passing	%14	2	2	2	6
	Dribbling	%11	2	1	2	5
	Shooting	%16	2	2	3	7
	Foot Movement	%5	0	1	1	2
	Offensive Follow-Up (Rebounding)	%5	1	0	1	2
Summary of Behavioral Objectives		%100				43

The True-False type was used, which is considered one of the common evaluation methods in educational tests.

- Defining the style and drafting the items of the achievement test.
- Preparing and compiling the test items.
- Determining the validity of the test items.
- Developing test instructions.
- Implementing the conditions for conducting the test.
- Administering the achievement test to the construction sample.
- Scoring the achievement test.
- Statistical analysis of the test items.

1. **Unidimensionality:** Item Response Theory (IRT) emphasizes the fulfillment of several assumptions for the performance of individuals assessed by the study tool. One of these assumptions is the assumption of unidimensionality, which means the existence of a single ability that explains the performance of the targeted individuals. For this reason, this theory is referred to as a unidimensional model.

To verify this assumption, the researchers employed factor analysis using the Principal Component Analysis (PCA) method, which is one of the most commonly used methods for verifying the unidimensionality assumption in IRT. To extract the factor analysis for the achievement test, the Statistical Package for the Social Sciences (SPSS) was used.

Table 5 presents the results of the factor analysis for the achievement test.

Factor	Eigenvalue	Variance Explained (%)	Cumulative Variance Explained (%)
1	2.57	24.09	24.09
2	1.76	16.48	40.57
3	1.42	13.33	53.90
4	1.08	10.15	64.05
5	0.56	5.27	69.33
6	0.55	5.14	74.47

Through the Principal Component Analysis of the data, we find that the first component explains approximately 24.09% of the variance in the data, while the second component explains about 16.48%. Typically, to claim that the data follow the unidimensionality assumption of the Rasch model, the first component must explain a significant portion of the variance, usually greater than 20%. Based on these results, we can conclude that the unidimensionality assumption has been met acceptably, as the first component explains a large portion of the variance (24.09%). This means that this component is the dominant factor in explaining the total variance in the test scores. Therefore, the test is considered unidimensional, indicating that there is a single latent trait measured by the test, which is responsible for explaining the variance in test scores. This is illustrated in Figure 1.

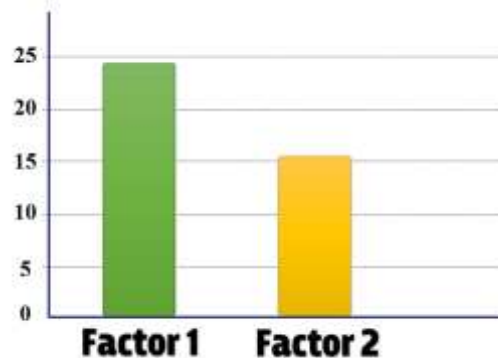


Figure 1 illustrates the percentage of the first and second factors for the scale as a whole. When examining the variance distribution across the different components, it is evident that the first component clearly dominates in explaining the variance compared to the other components. This result is a strong indicator that a single fundamental dimension underlies and explains the overall performance of individuals on the test. With the proportion of variance explained by the first component exceeding 20%, the evidence for the data reasonably adhering to the unidimensionality assumption is reinforced.

Moreover, the proportion of variance explained by subsequent components is significantly lower, supporting the idea that the first component represents the primary and fundamental dimension influencing performance. This aligns with the Rasch model's assumption, which posits that a single ability explains test performance.

In summary, the Principal Component Analysis strongly supports the unidimensionality assumption of the Rasch model for this data, enhancing the validity of the model and the continued use of this tool for evaluating individuals' performance on the test. This is illustrated in Figure 2.

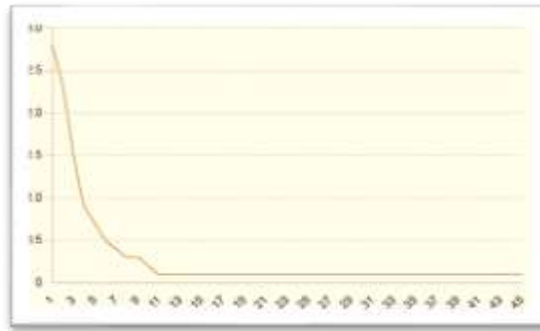


Figure 2 illustrates the principal components of the analysis.

In this figure, the **horizontal axis** represents the **component number**. Each number corresponds to a specific component (Principal Components). The **vertical axis** represents the **eigenvalue**, which indicates the amount of variance in the data explained by each component. In Principal Component Analysis, eigenvalues are typically examined to determine how many components to retain. Components with higher eigenvalues explain more variance in the data.

In this chart, we observe that eigenvalues decrease sharply after the first few components. This indicates that the first components explain the majority of the variance in the data, while the subsequent components account for very little variance.

In the presented chart, the first eigenvalue (first component) is significantly larger compared to the others, which drop off rapidly to smaller values. This pattern suggests that most of the variance in the data is explained by the first dimension, supporting the unidimensionality assumption.

We can conclude that the unidimensionality assumption in the Rasch model appears to be supported when the eigenvalues of subsequent components are much smaller compared to the first. This implies that the data is concentrated in a single dominant dimension, making the Rasch model suitable for analysis. (*Brentani and Golia, 2007, 42*)

2. Local Independence

- **Item-Free Person Measurement:** To identify indicators of the fit of the study sample individuals, the ability of each individual in the sample was determined. The standard deviation and standard error in measuring the abilities of the sample individuals were also calculated.

Additionally, the Infit Mean Square Statistic (INFIT) was calculated, which serves as a statistical indicator of unexpected behavior by individuals that affects their responses to items close to a specific ability level. Similarly, the Outfit Mean Square Statistic (OUTFIT) was computed to identify unexpected external behaviors by individuals, which is more sensitive to responses on items far from their ability level but carries a similar interpretation to the INFIT statistic.

These calculations are presented in Table 6, which shows the mean, standard deviation, and standard error for each estimation of the sample individuals' abilities. The table also provides the mean square values for both the Infit and Outfit statistics, along with the fit statistics (ZSTD) for both internal (Infit) and external (Outfit) fit indices.

Table 6: Statistical indicators of the study sample's ability estimates

Ability	Infit Statistics	Outfit Statistics
	Mean Square (MNSQ)	ZSTD Value
Mean	1.07	0.31
Standard Deviation	0.10	0.46
Standard Error	0.01	0.05

Table 6 indicates that the mean ability of the individuals is **0.09**, reflecting a balanced distribution of abilities around the average level. This suggests that the study sample includes individuals with ability levels that align well with the difficulty of the items included in the test. Considering the **standard deviation of ability (0.88)**, it shows significant dispersion in ability levels among the individuals in the sample. This dispersion indicates diversity in abilities, with some individuals possessing very high abilities, while others have lower abilities.

The **standard error (0.09)** signifies high accuracy in estimating the mean, which enhances the reliability of the results obtained. This suggests that the sample contains individuals with diverse and balanced ability levels, without significant bias toward a particular ability value. The standard deviations of the **mean squares (MNSQ)** for internal and external fit statistics indicate good homogeneity of values around the means. Conversely, the standard deviations of the **ZSTD values** show greater dispersion, reflecting diversity in the degree to which individuals conform to the model.

These analyses provide a comprehensive understanding of data variance and distribution around the mean, helping to evaluate the model's quality and ensure data conformity with it. The data suggest that all sample individuals exhibited responses that align closely with the model's expectations, enhancing the reliability of the results. There is no need to exclude any individual from the analysis, as all data provided by the sample can be utilized fully. This reflects consistent performance across all participants, strengthening the validity of the analysis.

Table 7 shows the internal and external fit of the individuals with the Rasch model.

Sample	Ability	Infit Statistics		Outfit Statistics	
		Mean Square (MNSQ)	ZSTD Value	Mean Square (MNSQ)	ZSTD Value
1	0.23	1.12	0.53	1.06	0.27
2	-0.14	1.05	0.24	1.01	0.06
3	0.23	1.08	0.38	1.03	0.13
4	-0.95	1.01	0.05	1.02	0.07
5	-1.64	1.07	0.33	1.03	0.13
6	-0.42	0.98	-0.08	0.96	-0.16
7	-0.42	1.04	0.21	1.03	0.13
8	0.62	1.01	0.05	0.97	-0.16
9	-0.23	0.95	-0.24	0.92	-0.35
10	0.62	1.01	0.03	0.96	-0.18
11	0.52	1.17	0.76	1.09	0.40
12	-1.07	1.01	0.03	1.01	0.06
13	-0.23	0.98	-0.08	0.96	-0.20
14	0.33	0.97	-0.16	0.93	-0.33
15	-0.05	1.04	0.16	0.99	-0.03
16	-0.84	1.06	0.27	1.05	0.21
17	0.73	1.13	0.60	1.04	0.19
18	-0.14	1.08	0.38	1.04	0.20
19	-0.95	0.90	-0.47	0.92	-0.39
20	0.14	1.08	0.38	1.04	0.17

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21	0.14	1.00	-0.02	0.95	-0.23
22	-2.03	0.97	-0.12	0.99	-0.02
23	2.03	1.16	0.73	1.01	0.03
24	0.84	0.99	-0.05	0.95	-0.22
25	-1.64	1.02	0.11	1.01	0.04
26	-0.73	0.96	-0.20	0.95	-0.23
27	1.07	0.85	-0.71	0.85	-0.70
28	0.52	0.92	-0.36	0.88	-0.55
29	-0.42	0.97	-0.15	0.95	-0.21
30	0.73	1.16	0.72	1.06	0.30
31	-0.52	1.19	0.85	1.14	0.64
32	-0.23	1.07	0.30	1.03	0.12
33	-0.95	1.22	1.00	1.12	0.57
34	-0.33	1.08	0.37	1.04	0.19
35	-0.84	1.20	0.91	1.12	0.57
36	-0.84	1.04	0.16	1.03	0.15
37	0.52	1.14	0.66	1.06	0.28
38	0.14	1.14	0.64	1.09	0.41
39	-0.62	1.05	0.23	1.01	0.05
40	-0.05	1.01	0.05	0.98	-0.11
41	-0.52	1.20	0.92	1.15	0.68
42	-0.73	0.91	-0.41	0.92	-0.37
43	-0.23	1.10	0.47	1.07	0.34
44	1.33	1.02	0.08	0.97	-0.14
45	-1.33	1.09	0.42	1.05	0.22
46	-1.48	1.00	0.01	1.01	0.03
47	-0.84	1.08	0.39	1.06	0.29
48	0.23	0.89	-0.52	0.85	-0.68
49	-0.14	1.00	-0.02	0.97	-0.16
50	0.14	1.12	0.56	1.07	0.34
51	0.33	1.11	0.53	1.05	0.24
52	0.42	1.13	0.61	1.06	0.29
53	0.42	1.04	0.19	0.98	-0.09
54	0.42	0.96	-0.17	0.93	-0.34
55	0.52	0.88	-0.55	0.85	-0.71
56	0.05	1.23	1.07	1.18	0.82
57	-2.59	0.99	-0.06	0.99	-0.05
58	0.23	0.98	-0.10	0.93	-0.34
59	-0.52	1.19	0.88	1.14	0.65
60	0.14	1.00	0.01	0.95	-0.21
61	1.19	1.00	0.01	0.97	-0.16
62	-0.42	1.19	0.87	1.14	0.66
63	0.84	1.18	0.81	1.06	0.29
64	-0.23	1.19	0.86	1.15	0.67
65	-0.05	1.11	0.48	1.06	0.28
66	-0.42	1.18	0.82	1.14	0.63
67	1.19	0.85	-0.70	0.86	-0.65
68	-1.33	1.24	1.08	1.10	0.46
69	-0.73	1.20	0.89	1.13	0.60
70	-0.62	1.09	0.43	1.07	0.33
71	0.52	1.03	0.12	0.98	-0.10
72	0.33	0.84	-0.72	0.81	-0.86

73	0.23	1.04	0.16	0.99	-0.07
74	-1.82	1.12	0.54	1.04	0.17
75	0.84	0.98	-0.07	0.95	-0.23
76	-0.23	1.18	0.82	1.14	0.63
77	-1.07	1.03	0.12	1.02	0.11
78	0.33	1.10	0.47	1.05	0.22
79	-0.42	0.93	-0.32	0.92	-0.37
80	-1.07	1.28	1.26	1.15	0.69
81	-0.84	1.16	0.72	1.10	0.45
82	-0.52	1.08	0.36	1.04	0.17
83	0.14	1.09	0.42	1.04	0.20
84	-1.19	1.01	0.04	1.01	0.04
85	0.84	0.97	-0.12	0.94	-0.28
86	-0.23	1.22	1.01	1.18	0.81
87	-0.23	1.20	0.92	1.16	0.72
88	1.64	1.05	0.23	0.98	-0.07
89	0.14	0.99	-0.04	0.94	-0.26
90	0.62	1.15	0.67	1.06	0.27
91	-0.73	1.08	0.39	1.06	0.29
92	0.73	1.20	0.91	1.09	0.40
93	0.42	1.10	0.47	1.03	0.16
94	2.03	0.99	-0.05	0.97	-0.16
95	-0.52	1.04	0.19	1.01	0.03
96	0.62	1.19	0.89	1.10	0.46
97	2.03	0.95	-0.24	0.95	-0.22
98	-1.82	1.09	0.42	1.03	0.12
99	0.95	1.23	1.07	1.09	0.40
100	-0.23	0.93	-0.33	0.91	-0.43
101	0.23	1.10	0.45	1.04	0.19
102	-1.48	1.27	1.25	1.10	0.46
103	0.62	1.17	0.78	1.08	0.38
104	1.82	1.12	0.54	1.00	0.00
105	-0.52	1.19	0.86	1.14	0.63
106	-0.33	0.96	-0.17	0.94	-0.26

Table 7 shows that the mean square (MNSQ) values for internal fit and external fit were 0.81 and 1.28, respectively. These values fall within the ideal range expected by the model. Mean square (MNSQ) values for internal and external fit that fall within the range of 0.7 - 1.3 are considered ideal and consistent with the model (*Bond & Fox, 2015, 49*).

Additionally, the data in Table 7 indicate that the mean values of the internal and external fit statistics (ZSTD) range between -0.72 and 1.26, which are also close to the ideal values assumed by the model, typically within ± 2 . ZSTD values for internal and external fit within the range of ± 2 are considered ideal and consistent with the model (*Wright & Stone, 1999, 163*).

- **Sample-Free Item Calibration:** The statistical analysis was re-conducted to determine the extent to which the items of the scale align with the **Item-Fit model**. The difficulty parameter for each item and the standard error for measuring this parameter were estimated. Additionally, the internal fit statistic (Infit) and the external fit statistic (Outfit) were calculated.

Table 8 presents the mean, standard deviation, and standard error for each item estimate (items of the scale). It also shows the mean square values for both internal and external fit statistics, along with the fit statistics (ZSTD) values for internal and external fit.

Table 8: Statistical Indicators for Item Calibration (Difficulty Estimates)

Difficulty	Infit Statistics		Outfit Statistics	
	Mean Square (MNSQ)	ZSTD Value	Mean Square (MNSQ)	ZSTD Value
Mean	1.16	0.81		
Standard Deviation	0.26	1.80		
Standard Error	0.04	0.28		

Table 8 shows the mean and standard deviation of the item parameter estimates and the standard error in achievement, as well as the mean square values (MNSQ) for internal (Infit) and external (Outfit) fit statistics, along with the ZSTD values for each.

The mean of Infit MNSQ was 1.16, indicating that the data fit well with the assumed model at the individual level. This value suggests that individual responses align largely with the theoretical expectations of the model, enhancing the accuracy of individual results.

The mean of Infit ZSTD was 0.81, which is close to zero, indicating a good fit of the data to the model. Values close to zero in this context mean that deviations from theoretical expectations are minimal, reflecting a high degree of internal fit.

The mean of Outfit MNSQ was 0.33, which is within the acceptable range. This suggests that the data fit well with the model at the group level. This indicates that the variation in responses among individuals does not deviate significantly from theoretical expectations.

The Outfit ZSTD value was -1.40, a negative value indicating a lower-than-average fit with the model. Negative values may suggest the presence of data points or individuals that deviate from the assumed model, indicating that some items may need further review (e.g., items requiring modification or removal).

The mean value of item difficulty estimates was 0.21, providing an overview of the central tendency of values within the sample. This reflects the discriminative ability of the test or scale. This value demonstrates the scale's effectiveness in distinguishing between individuals with different levels of ability or achievement.

The standard deviation was 0.46, indicating the extent of dispersion or variation in the data around the mean. The standard deviation helps to understand how spread out the values are. The standard error was 0.01, reflecting stability and precision in the estimates.

This analysis demonstrates the validity and reliability of the scale while identifying areas for potential improvement. Table 9 provides details on the internal and external fit of the items with the Rasch model.

Table 9: Internal and External Fit of Items with the Rasch Model

Item	Ability	Infit Statistics		Outfit Statistics	
		Mean Square (MNSQ)	ZSTD Value	Mean Square (MNSQ)	ZSTD Value
1	-0.47	0.93	0.52	1.12	-1.73
2	0.51	0.80	-0.44	1.10	-1.90
3	0.33	1.27	1.96	1.18	-1.27
4	0.15	1.45	4.27	1.21	-1.10
5	0.37	0.79	-0.49	1.10	-1.89
6	-0.47	0.96	0.52	1.15	-1.70
7	0.19	1.12	1.90	1.16	-1.46
8	0.11	1.32	3.30	1.18	-1.27
9	0.37	0.81	-0.49	1.12	-1.87
10	-0.47	0.91	0.52	1.10	-1.75
11	-0.34	1.30	1.87	1.18	-1.29
12	0.37	0.90	-0.49	1.09	-1.76
13	0.37	0.87	-0.49	1.18	-1.81
14	-0.47	0.94	0.52	1.13	-1.72
15	0.19	1.12	1.90	1.16	-1.46

16	0.11	1.32	3.30	1.18	-1.27
17	0.37	0.98	-0.49	1.17	-1.68
18	-0.47	0.99	0.52	1.18	-1.67
19	-0.34	1.30	1.82	1.18	-1.29
20	0.37	1.05	-0.49	1.36	-1.63
21	0.06	1.22	1.94	1.13	-1.32
22	-0.20	1.24	1.75	1.17	-1.36
23	-0.25	1.25	1.85	1.16	-1.41
24	-0.11	1.39	3.86	1.19	-1.22
25	-0.07	1.23	1.67	1.18	-1.31
26	0.19	1.43	4.13	1.18	-1.31
27	0.11	1.52	4.82	1.20	-1.15
28	-0.16	1.41	3.95	1.20	-1.17
29	0.28	0.69	-2.24	1.08	-2.03
30	-0.07	0.96	0.74	1.14	-1.60
31	0.52	0.81	-1.24	1.07	-1.92
32	1.28	1.69	-0.24	2.08	-0.52
33	0.16	1.19	0.74	1.29	-1.37
34	0.41	0.82	-1.24	1.21	-1.39
35	0.74	1.15	-1.24	2.07	-1.06
36	0.36	1.39	0.74	2.13	-1.17
37	1.22	1.63	-1.24	2.02	-0.58
38	1.17	1.58	-1.24	2.01	-0.63
39	-0.24	0.78	0.74	1.08	-1.90
40	0.83	1.36	-1.24	2.04	-0.97
41	1.04	1.45	-1.24	2.13	-0.76
42	0.23	1.26	0.74	1.25	-1.30
43	0.69	1.10	-1.24	2.07	-1.11

Table 9 highlights the exclusion of items whose values deviate significantly from the ideal values compatible with the Rasch model. Ideal values are those that align perfectly with the model's standards and contribute to the accuracy and reliability of the final results.

Mean square (MNSQ) values for internal and external fit that fall within the range of 0.7 - 1.3 are considered ideal and consistent with the model (*Bond & Fox, 2015, p. 49*).

Similarly, ZSTD values for internal and external fit within the range of ± 2 are considered ideal and consistent with the model (*Wright & Stone, 1999, p 163*).

The items that were excluded are detailed in Table 10.

Item Number	Reason for Exclusion
4	Internal Fit Statistic (Infit MNSQ)
8	Internal Fit Statistic (Infit MNSQ)
13	Internal Fit Statistic (Infit MNSQ)
16	Internal Fit Statistic (Infit MNSQ)
24	Internal Fit Statistic (Infit MNSQ)
27	Internal Fit Statistic (Infit MNSQ)
28	Internal Fit Statistic (Infit MNSQ)
29	Internal Fit Statistic (Infit MNSQ)
32	External Fit Statistic (Outfit MNSQ)
33	External Fit Statistic (Outfit MNSQ)
35	External Fit Statistic (Outfit MNSQ)
36	External Fit Statistic (Outfit MNSQ)
40	External Fit Statistic (Outfit MNSQ)
41	External Fit Statistic (Outfit MNSQ)
42	External Fit Statistic (Outfit MNSQ)
43	External Fit Statistic (Outfit MNSQ)

3. **Parallelism of Item Characteristic Curves:** To verify the assumption of parallelism in Item Characteristic Curves (ICCs), the data was reanalyzed after removing items that did not align with the Rasch model during the verification stage of Sample-Free Item Calibration. This procedure ensures that the remaining items conform to the model's requirements, thereby enhancing the accuracy of the results.

The full details are presented in Table 11.

Table 11: Parallelism of Item Characteristic Curves

Item	Item Parameter (b)	Log-Likelihood
1	0.25	0.80
2	0.27	0.86
3	0.01	0.58
5	0.31	0.89
6	0.26	0.81
7	0.11	0.62
9	0.32	0.90
10	0.22	0.78
11	0.10	0.61
12	0.30	0.88
13	0.32	0.90
14	0.25	0.80
15	0.11	0.62
17	0.28	0.86
18	0.25	0.80

19	0.10	0.61
20	0.26	0.84
21	0.05	0.56
22	0.04	0.57
23	0.09	0.60
25	0.06	0.55
30	0.24	0.81
31	0.12	0.63
33	0.26	0.84
34	0.05	0.57
39	0.07	0.53
42	0.11	0.57

A comprehensive analysis of item difficulties was conducted using the Rasch model to verify the parallelism of Item Characteristic Curves (ICCs). The results of the analysis indicate that the item parameters are distributed in a way that reflects a variety of difficulties, with item parameters ranging from low values indicating easier items (e.g., Item 3 with a parameter $b = 0.01$) to higher values indicating more difficult items (e.g., Item 9 with a parameter $b = 0.32$).

Additionally, the high log-likelihood values for most items suggest a good fit of the model to the data, further reinforcing the use of the Rasch model as an effective analytical tool in this context. Furthermore, the graphical representations of the item characteristic curves demonstrate clear parallelism, supporting the fundamental assumption of the model that items differ only in difficulty and not in the slopes of their curves.

This is illustrated in Figure 3.

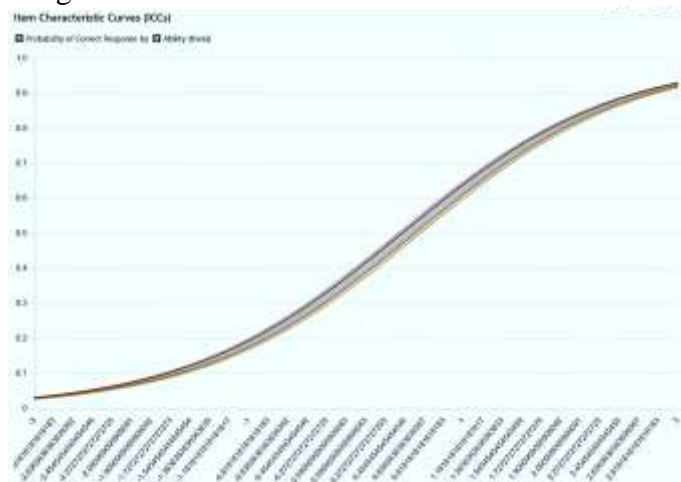


Figure 3 illustrates the graphical representations of the Item Characteristic Curves (ICCs).

The item parameter (b) represents the difficulty of an item in the Rasch model. The higher the value of b , the more difficult the item. For instance, an item with a higher b value requires a higher level of ability (θ) to answer correctly. The log-likelihood displays the logistic model's log-likelihood value for each item, reflecting the model's fit with the data for each item. Higher values indicate a better fit of the model to the data (He and Min, 2024, 95).

Item Characteristic Curves (ICCs) are visual tools used in Item Response Theory (IRT) models, such as the Rasch model, to represent the relationship between individuals' latent ability (θ) and the probability of correctly answering the items. ICCs provide insights into how different items perform across a wide range of abilities, helping to understand item difficulties and their ability to differentiate between individuals with varying abilities (William and John, 2020, 153).

The Rasch model assumes that the probability of an individual's response to a given item depends only on their ability and the difficulty of the item.

In Figure 3, the horizontal axis (theta) spans negative to positive values, representing the range of individuals' abilities. Individuals with negative abilities have lower capabilities, while those with positive abilities have higher capabilities. The vertical axis (probability) represents the probability of a correct response to the item, ranging between 0 and 1.

The horizontal shift of curves corresponds to the difficulty of the items. Items with different difficulties appear as horizontal shifts of their curves along the horizontal axis. Difficult items, such as Item 9 with a high difficulty parameter ($b = 0.32$), appear further to the right on the horizontal axis compared to easier items like Item 3 with a very low difficulty parameter ($b = 0.01$).

All curves in the Rasch model have the same shape and slope, consistent with the assumption that items differ only in difficulty, not in their ability to discriminate between individuals with different abilities. The parallelism of the ICCs indicates that all items have the same discriminatory power, meaning that they equally contribute to differentiating between individuals with different abilities.

At a $\theta = 0$ (average ability), the probability of a correct response to items with $b = 0$ (average difficulty) is 0.5. Items with higher difficulty require higher abilities to achieve the same probability, while easier items require lower abilities. For instance, if $b = 1$, an individual needs a latent ability (θ) higher than 0 to have a 50% chance of answering correctly. Conversely, if $b = -1$, the individual requires a θ lower than 0 to achieve the same probability (Katz et al., 2021, 142).

These relationships between θ (latent ability), b (difficulty), and the probability of a correct response are illustrated by ICCs, which show how the probability values change based on individuals' abilities. Easier items tend to shift leftward on the ICC, while harder items shift rightward (William and John, 2020, 168).

Figure 3 of the ICCs demonstrates general parallelism among the curves, supporting the Rasch model's assumption that items differ only in difficulty. This parallelism indicates that the model is suitable for analyzing this data, as the items maintain their discriminatory ability across a wide range of abilities. These findings support the Rasch model's use as an effective analytical tool in this context.

4. **Speededness:** Sufficient time was provided for participants to complete the questionnaire, as all students finished answering before the allocated time ended, which was one and a half hours. This duration was set as it aligns with the time allocated for each lecture for the students, confirming that the time provided was appropriate and sufficient for completion without any negative impact of time constraints on performance.

2-4 Scientific Foundations of the Scale

1. Test Validity:

- **Content Validity:** This type of validity is achieved through a rational analysis of the scale content and its determination based on subjective judgments. Two methods are commonly used to achieve this: logical reasoning and the review and analysis of previous studies. The researchers followed the logical reasoning method through the following steps:
 - Analyzing the curriculum and identifying the skills.
 - Developing items for each skill.
 - Consulting a group of experts and specialists to provide their opinions on the skills and the development of the items.
- 2. **Face Validity:** The validity of the study tool was confirmed by presenting it to nine experts and specialists in the fields of measurement and evaluation, teaching methods, and basketball. These experts were asked to provide their opinions on the appropriateness of the questionnaire items for the purposes they were designed for, in terms of clarity, content, wording, language, and the relevance of the items. They were also invited to suggest any modifications, additions, or deletions of items as they deemed necessary.

2. **Reliability:**

- **Person-Item Reliability:** The person-item reliability index was calculated, representing the ratio of person variance to error variance. A high value of this index indicates that the model estimates abilities accurately. The reliability value for the person-item reliability was approximately 0.71. This value suggests that the model estimates abilities with relatively good accuracy, reflecting a good variance among individuals and error variance. This is illustrated in Figure 4.

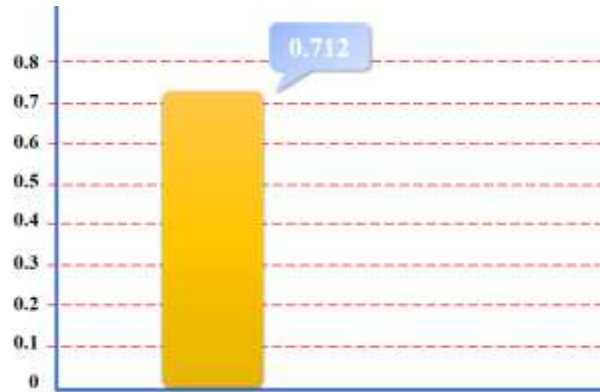


Figure 4 illustrates the Person-Item Reliability coefficient.

- **Reliability Coefficient Using Item Fit Statistics:** The Item Fit Statistics for Infit and Outfit metrics of various items in the model show values ranging between 0.71 - 0.84 for Outfit Statistics and 0.72 - 0.87 for Infit Statistics. These values are illustrated in Table 12 and Figure 5.

Table 12: Reliability Coefficient Using Item Fit Statistics (Item Fit Statistics)

Item	Infit Statistics (Internal Fit)	Outfit Statistics (External Fit)
1	0.86	0.72
2	0.80	0.72
3	0.78	0.74
4	0.86	0.72
5	0.83	0.83
6	0.83	0.74
7	0.80	0.84
8	0.76	0.80
9	0.77	0.82
10	0.82	0.82
11	0.73	0.77
12	0.83	0.77
13	0.84	0.77
14	0.77	0.78
15	0.85	0.82
16	0.81	0.78
17	0.80	0.78
18	0.85	0.75
19	0.85	0.82
20	0.83	0.73
21	0.87	0.80
22	0.84	0.80
23	0.86	0.71
24	0.84	0.81
25	0.86	0.78
26	0.77	0.73
27	0.81	0.80

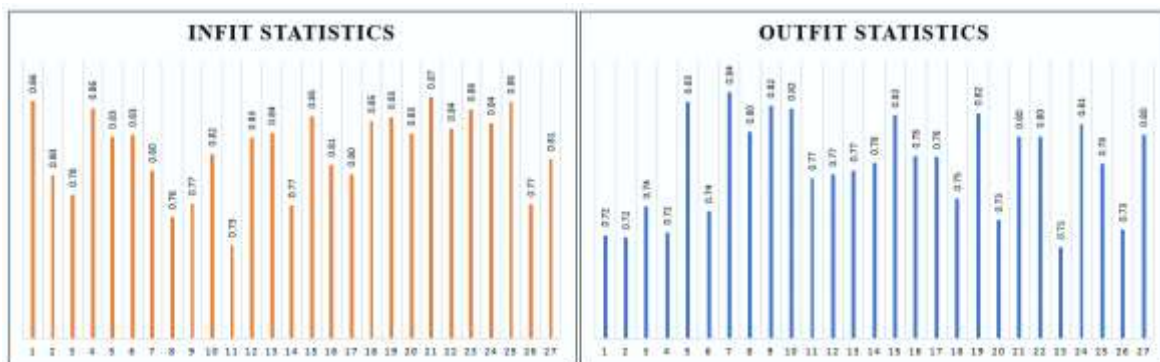


Figure 5 illustrates the Reliability Coefficient calculated using Item Fit Statistics. The left side represents Infitem Statistics, which reflect the extent to which items fit the model by focusing on items of moderate difficulty. Ideal values for Infitem are close to 1. The values shown in the chart range between 0.71 and 0.87, indicating good item fit with some variation. The right side represents Random Adjusted Outfit Statistics, which reflect the extent to which items fit the model for very high or very low difficulty items. Ideal values for Outfit are also close to 1, and the values shown in the chart range between 0.71 and 0.87, indicating good item fit with some variation.

The values illustrated in the chart provide a positive impression of the items' fit to the model, as most values are close to the ideal range. This reinforces confidence in the stability and accuracy of the data in interpreting performance.

3. Objectivity: The current study relies on data collection methods that ensure objectivity and eliminate personal bias from the researchers. Instead of relying on self-assessments by the researchers, the data are recorded based on the participants' responses to the questionnaire items.

This approach enhances objectivity by relying entirely on the direct and explicit feedback of the individuals who constitute the study sample. This ensures that the extracted data accurately reflect their opinions and actual experiences. Through this systematic and independent method, the study achieves objectivity, as the data are collected without subjective influence from the researchers, thereby strengthening the reliability and scientific validity of the results.

2-5 Research Trials:

- **Pilot Study:** The pilot study is one of the most essential steps for accurately implementing the requirements of scientific work. This experiment aims to overcome difficulties and save both physical and financial effort by testing the measure before its final preparation. After completing all scientific and administrative procedures, the researchers conducted a pilot study on March 25, 2024, on a sample of 10 students. The objectives of this study were as follows:

1. To assess the sample's ability to comprehend the concept of the scale.
2. To evaluate the clarity of the items.
3. To ensure the clarity of the test instructions.
4. To determine the time required to implement the scale.
5. To identify potential challenges and drawbacks that the researchers might face.
6. To address any questions or inquiries, if present.
7. To evaluate the responsiveness of the sample to the researchers.
8. To observe the response of the study sample in performing the tests.
9. To organize the supporting team.\

The results of this pilot study indicated that the scale is ready for application in the main experiment. No issues or obstacles emerged during the execution of this study, which encouraged the researchers to move to the next step in developing the scale.

- **Main Experiment:** On April 14, 2024, the Defensive and Offensive Basketball Skills Scale based on the Rasch model was distributed to the application sample. This scale

provides a detailed analysis of each test element based on the participants' abilities, enhancing the accuracy of the evaluation and its suitability for individual differences among players.

- Distribution and Testing Procedures:
- The scale was presented to the application sample, and participants were given sufficient time to answer the questions, set at one and a half hours. To ensure the quality of responses, a detailed and comprehensive explanation of how to answer the questions was provided. This explanation included clarifying how to determine correct and required answers in both traditional and modern scales, ensuring all participants understood the required answering method.
- All answer sheets were collected meticulously to ensure no data was lost. The completeness and accuracy of the responses were verified before beginning the data analysis process.
- Advanced statistical methods were used to analyze the data collected from the scale. The analysis aimed to compare the results derived from the scale, focusing on the impact of the Rasch model in evaluating the skills.

2-5 **Statistical Tools Used:** (Microsoft Excel, WINSTEPS, Bilog-MG3)

3. Presentation, Analysis, and Discussion of Results

3-1 Presentation and Analysis of Results

- Comparison of Standard Scores for the Achievement Test of Defensive and Offensive Basketball Skills Using the Rasch Model.

Table 13 presents the means, standard deviations, skewness coefficients, and standard errors for the scores of the application sample according to the modern theory using the Rasch model.

No.	Axis	Mean	Standard Deviation	Skewness Coefficient	Standard Error
1	Defensive Skills	7.71	2.23	0.22	0.29
2	Offensive Skills	9.74	2.82	0.39	0.36
3	Total (Combined)	17.54	4.67	-0.49	0.58

Table 13 shows that the mean score for defensive skills is 7.71, which is lower than the mean scores for offensive skills and the overall total. This reflects relatively lower performance in defensive skills compared to offensive skills. The standard deviation for defensive skills is 2.23, indicating moderate variation among individuals in their defensive performance. The skewness coefficient is 0.22, which is positive, meaning that the distribution of scores slightly skews toward the higher end, with more individuals scoring below the mean. Additionally, the standard error of 0.29 reflects moderate accuracy in estimating the mean for these skills.

On the other hand, the offensive skills have a higher mean of 9.74. The standard deviation is 2.82, slightly higher than that of defensive skills, indicating greater variation in individuals' performance. The skewness coefficient is 0.39, which is also positive, suggesting a concentration of scores at the lower end, but with a distribution less symmetrical compared to defensive skills. The standard error of 0.36 is slightly higher, indicating relatively less accuracy in estimating the mean.

For the overall total (combined), the mean score of 17.54 represents the general performance level, reflecting the sum of individuals' performance in both skills. The standard deviation of 4.76 indicates significant variation in overall performance, highlighting noticeable individual differences within the sample. The skewness coefficient of -0.49 indicates a skew toward the lower end, meaning that a larger number of individuals performed below the overall mean. Finally, the standard error of 0.58 suggests relatively lower accuracy in estimating the total mean compared to individual skill axes.

- **Comparison of Standard Levels for the Achievement Test of Defensive and Offensive Basketball Skills Using the Rasch Model.**

Table 14 illustrates the scores and standard levels for the achievement test of defensive and offensive basketball skills based on the modern theory using the Rasch model.

Scores	Levels	Frequency
26-27	Very Good	None
25-22	Good	13
21-12	Average	40
11-8	Acceptable	11
7-3	Poor	None

Table 14 illustrates the distribution of scores and performance levels for the study sample according to a detailed categorization of levels, ranging from "Poor" to "Very Good," with a focus on the number of individuals within each level. From analyzing this data, it becomes clear that the overall performance of the sample is largely concentrated in the "Average" and "Acceptable" levels, with a notable absence of individuals in both the "Very Good" and "Poor" levels.

In the "Very Good" level, which corresponds to scores ranging from 27 to 31, no individuals were recorded in this category, indicating an absence of outstanding high performance in the sample. The "Good" level, ranging from 22 to 25, included only 13 individuals, meaning a limited proportion of individuals exhibited performance that exceeds average but does not reach excellence.

On the other hand, the "Average" level, spanning scores between 12 and 21, was the most prevalent among the sample, comprising 40 individuals. This suggests that the majority of individuals demonstrate relatively acceptable performance, though it does not reflect exceptional or outstanding achievement. The "Acceptable" level, with scores between 8 and 11, included 11 individuals. Lastly, the "Poor" level, corresponding to scores from 3 to 7, recorded no individuals, indicating a minimum level of competence among all participants in the sample.

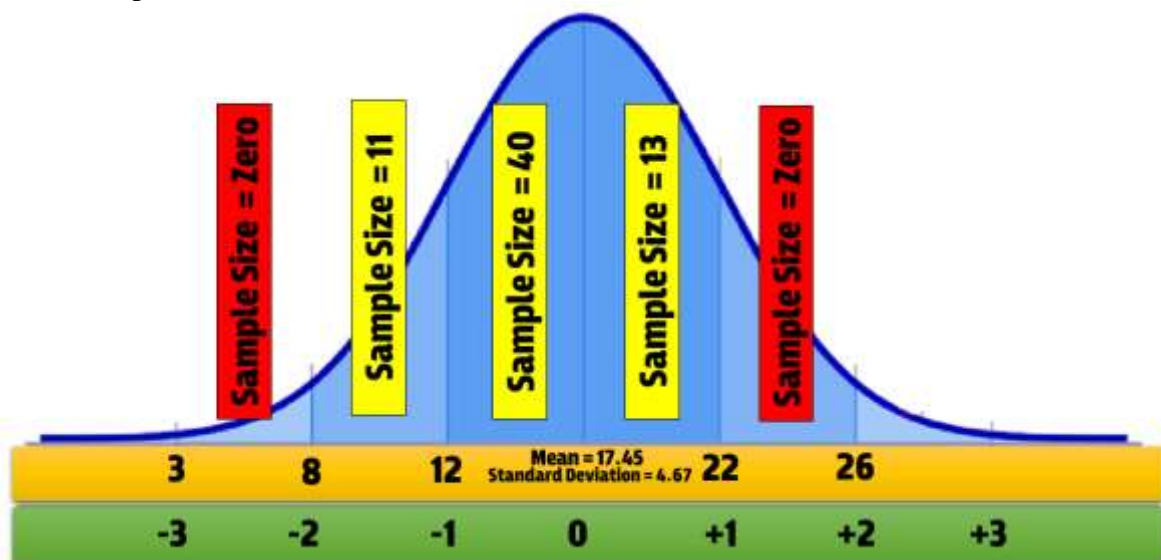


Figure 6 illustrates the scores and standard levels for the achievement test of defensive and offensive basketball skills based on the modern theory using the Rasch model.

The graphical representation displays the distribution of the research sample's scores in defensive and offensive skills according to the Rasch model, with values concentrated around the mean of 17.54 and a standard deviation of 4.17. This distribution reflects a normal spread of performance among the sample, with a significant concentration at the average

levels and a notable absence of individuals in the higher levels ("Excellent" and "Very Good") as well as the lowest level ("Poor").

The normal curve shows that most individuals are centered around average performance, with the "Average" level (scores ranging from 12-21) encompassing 40 individuals, making it the most prevalent level. This indicates that the overall performance of the sample is characterized by moderation, with a large proportion of individuals demonstrating acceptable skills that lack excellence.

On the other hand, the "Acceptable" level, which includes individuals scoring between 8-11, consists of 11 individuals. These participants exhibit below-average performance but still exceed the minimum threshold, suggesting a foundation upon which their abilities can be improved.

Conversely, the absence of individuals in the higher levels, such as "Excellent" and "Very Good," highlights a clear shortfall in achieving outstanding performance. At the same time, the lack of individuals in the "Poor" level (scores ranging from 3-7) is a positive indicator, showing that all sample participants possess at least a minimum level of proficiency in defensive and offensive skills.

The chart reflects this distribution clearly, with the normal curve appearing balanced but tilted toward the central region. The extremities at the higher and lower levels are nearly empty, reinforcing the notion that the sample's overall performance leans toward average, with a noticeable decline in the proportion of individuals demonstrating either exceptional or weak performance.

3-2 Discussion of Results

Discussion of Results from the Construction Sample: Through the presentation and analysis of the results obtained during the construction stages of the cognitive test for some defensive and offensive basketball skills, it was found that the Rasch model provides an accurate and objective measurement tool. This enhances the understanding of students' individual abilities and provides precise estimates of their performance. The model is based on fundamental principles that allow for data interpretation independently of the sample characteristics, making the resulting measurements more reliable and consistent.

The Rasch model demonstrated the independence of item parameters from the examined students, where a student's score is determined by their ability to answer a specific number of items based on their difficulty. This approach ensures objective measurement of a student's abilities and enables performance comparisons across different groups based on specific traits. (*Hambleton and Swaminathan, 1989*) noted that the Rasch model makes item parameters independent of the sample used in estimation, enabling more accurate and broadly applicable results.

Item Difficulty According to the Rasch Model: The Rasch model provides precise estimates of item difficulty based on a continuous scale reflecting the probability that a student with a specific ability will correctly answer an item. The difficulty is estimated using mathematical equations ensuring that this property remains constant regardless of the sample used. This approach allows for direct and accurate comparison of items, contributing to an objective interpretation of performance. (*Allam, 2000*) emphasized that the Rasch model focuses on positioning test items on a difficulty scale for all items comprising the test.

Item Fit and Analysis: The results showed that 16 items were deleted when verifying the assumptions of the Rasch model. This is attributed to the Rasch model's assumption of unidimensionality, which requires all items to measure a single trait. Items showing unexpected fluctuations in students' responses are considered misfitting and are excluded. (*Sharifi et al., 2018*) confirmed that the Rasch model excludes more items than other theories due to its strict requirements for fit.

Validity According to the Rasch Model: The Rasch model relies on the concept of unidimensional validity, requiring all items to measure only one trait, thereby enhancing measurement accuracy. Factor analysis played a crucial role in verifying construct validity, ensuring that items adhered strictly to the model's requirements. (*Mustafa, 2018*) noted that

the Rasch model excels in providing precise estimates of individual abilities and item difficulties, thereby enhancing the validity and reliability of the test.

Reliability According to the Rasch Model: In terms of reliability, it was verified using several statistical indicators that consider the fit of items and individuals to the model. The results showed that the reliability coefficient for items ranged between 0.72 and 0.87, while the reliability coefficient for individuals was 0.71. The standard error was also used as an indicator of estimate precision. (*Magno, 2009*) pointed out that the Rasch model estimates reliability based on individual estimates accompanied by a standard error that reflects measurement precision, sometimes leading to lower but more conservative and accurate values.

The results showed that the Rasch model is one of the most efficient models for designing and constructing cognitive tests, ensuring measurement accuracy and independence of results from the sample used. These characteristics make the Rasch model an effective tool for performance analysis and test development in sports and educational fields, contributing to improved evaluation quality and the accuracy of decisions derived from its results.

Discussion of Application Samples: The results of analyzing the achievement tests for some defensive and offensive basketball skills using the Rasch model showed that this model provides more accurate and objective estimates compared to other methods. The Rasch model relies on excluding items that do not fit the individual characteristics of each player, making it an effective tool for measuring individual performance and providing precise estimates that reflect the true variation between individuals.

It was found that the average performance according to the Rasch model was lower than the higher estimates generated by other measurement methods. This is due to the fact that the Rasch model relies on a precise analysis of individuals' responses, focusing on the difficulty level of items and the individual's ability to answer them, resulting in more conservative yet more reliable estimates. The results showed that the standard error for the model could be relatively higher, indicating its high sensitivity to data variation and the accuracy of individual estimates for each player. This supports what **Bond and Fox (2015)** stated, where the Rasch model is considered more accurate in detecting individual variations compared to traditional methods.

Discriminating Performance Between Individuals: The Rasch model demonstrated its ability to differentiate performance between individuals more accurately than other methods. The model stands out by accounting for the variation in individuals' responses and providing precise estimates of individual abilities based on the analysis of each item separately. This feature makes the model an effective tool for identifying subtle differences in performance between players. **Wright and Stone (1999)** emphasized that the Rasch model is designed to be sensitive to fine variations in individuals' responses, leading to more detailed and comprehensive estimates.

Data Variation and Accuracy in Measuring Individual Abilities: The results revealed that data dispersion was greater when using the Rasch model, reflecting higher accuracy in measuring the variation between individual abilities. The model calculates the standard error for each estimate, allowing for more accurate and clear results that truly reflect individual differences. These characteristics make the Rasch model more suitable for analyzing individual abilities and exploring differences between levels of performance.

The results confirmed that the Rasch model represents an important development in measurement methods, as it provides precise and objective analysis tools for performance evaluation. Its ability to handle individual data in detail and exclude misfitting items makes it an ideal choice for analyzing individuals' responses. Thanks to these advantages, the Rasch model can significantly contribute to the development of achievement tests in sports and improve the accuracy of evaluations in basketball.

4. Conclusions, Recommendations, and Suggestions

4-1 Conclusions:

- The results showed that the Rasch model provides high accuracy and objectivity in building cognitive tests, thanks to its reliance on advanced analytical principles that focus on individuals' responses and item difficulty separately.
- The Rasch model relies on the independence of measurements from samples, ensuring accurate performance estimates without being affected by the characteristics of the sample used in the test.
- The Rasch model demonstrated high accuracy in measuring individual abilities by excluding items that do not fit the assumptions of the model, ensuring reliable results.
- The Rasch model is distinguished by accurately estimating validity and reliability coefficients, where these estimates are based on factor analysis and item fit with the model assumptions, enhancing the quality and accuracy of the measurements.
- The Rasch model reflects high sensitivity to individual changes in performance, making it an effective tool for measuring subtle differences between individuals and analyzing their responses accurately.
- The Rasch model showed clear superiority in measuring individual variations, providing estimates that reflect the actual performance of each individual, making its results more accurate and objective.
- The exclusion of a greater number of items in the Rasch model is attributed to its strict assumptions regarding item fit, ensuring high accuracy in the estimates.
- The Rasch model showed significant differences in estimates compared to other methods, reflecting its superiority in providing precise measurements that accurately and objectively reflect individuals' actual performance.

4-2 Recommendations and Suggestions

- Utilize the Rasch model in designing and constructing cognitive tests in the sports field to improve the accuracy and reliability of measurements and reduce errors in estimates.
- Train researchers and specialists in the sports field on how to use the Rasch model to benefit from its advanced capabilities in data analysis and interpretation.
- Focus on using advanced statistical methods that enhance the validity and reliability of cognitive tests in the sports field.
- Adopt multiple statistical methods during the test construction process to ensure accurate and objective evaluation of results and to improve test quality.
- Use modern statistical software for data analysis to ensure the accuracy of test construction according to the Rasch model requirements.
- Pay attention to methods for building cognitive tests in the sports field based on latent trait theory, with a focus on the Rasch model as one of the most efficient models.
- Mainly use the Rasch model when designing tests and analyzing data to ensure accurate estimates and objective results, contributing to a true representation of performance.
- Conduct applied studies to evaluate the effectiveness of the Rasch model in other sports and educational fields, to explore its potential and expand its use.
- Develop user-friendly software based on the Rasch model to facilitate its application by researchers and practitioners in the sports field.
- Enhance the use of evaluation tools entirely based on the Rasch model to improve the quality of measurements and results in the sports field comprehensively.
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(Appendix 1) The Final Version of the Scale (Rasch Model)

Item No.	Statement
1	The defensive position is important as it allows the player to move freely and efficiently.
2	The defensive stance should be aligned with the player's intended movement.
3	The player's body position should be balanced and ready for quick movements.
4	The player should keep their arms wide apart while in the defensive stance.
5	The player should maintain proper spacing and control of the ball.
6	The player's defensive stance should be flexible for adjusting to offensive plays.
7	The defensive player should focus on maintaining the balance and flexibility required for successful defense.
8	The defensive position should be dynamic, allowing for rapid transitions and quick movements in any direction.
9	The defensive stance should ensure the ability to block or intercept passes from the opponent.
10	The player should apply defensive pressure to prevent easy shots from the opponent.
11	The player should be aware of the opponent's positioning and anticipate their movements.
12	The defensive player should force the opponent into making mistakes by limiting their options.
13	The player should be prepared to move quickly and adjust to changes in the game dynamics.
14	The defensive player must be ready to switch positions and adapt quickly when the situation demands.
15	The player should remain calm and focused under pressure, maintaining their defensive responsibility.
16	The player should be able to react quickly and efficiently to the offensive player's moves.
17	The defensive stance must be solid enough to prevent the opponent from easily advancing.
18	The player should be ready to challenge the opponent's attack and be proactive in stopping their progress.
19	The defensive player should be quick to adapt to changes in offensive strategy.
20	The player should be able to effectively control the ball in defensive situations.
21	The defensive player should adjust their movements based on the offensive player's actions.
22	The player should be able to cut off the opponent's path and force them into unfavorable positions.
23	The player should anticipate and block any potential threats posed by the opponent.
24	The defensive player should have the ability to outmaneuver their opponent during critical moments.
25	The player should possess the agility needed to respond to offensive strategies.
26	The player should be able to remain in control of their movements and decisions.
27	The defensive strategy should always align with the team's overall approach and objectives.

(Appendix 2) Scoring Keys for the Scale According to the Rasch Model

Correct Answer	Item Number	Correct Answer	Item Number	Correct Answer	Item Number
✓	19	✗	10	✓	1
✗	20	✓	11	✗	2
✓	21	✗	12	✓	3
✗	22	✓	13	✗	4
✓	23	✗	14	✓	5
✗	24	✓	15	✓	6
✓	25	✗	16	✓	7
✗	26	✓	17	✓	8
✗	27	✓	18	✓	9