



Development of Badminton Multiball Feeding Skill Tests and Norms for Student Teachers, Major in Physical Education

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Abstract

Background and Aim: Most badminton coaches use multiball feeding to train skills, movement, and physical fitness. The coach training and student teacher learning incorporated feeding skills into the program training and lesson plan; however, there were few tests to measure and evaluate these skills. The one we could find was “the research on badminton coaches’ skill test”, which tested on hand feeding, racket feeding, and rally feeding, but did not cover every skill to train players and students in badminton. So, the objective of this study was to develop a badminton feeding skills test and norm to evaluate the ability of student teachers to feed multiball for practicing badminton stroke productions to the students.

Materials and Methods: This research was a research and development project that operated with a mixed-method process. The sample was students and experts in colleges and universities in Guangzhou, People's Republic of China. There were 5 experts on interviewing, 3, 9 students for a small group tryout, 30 students for a large group tryout, and 120 male and female students were tested to collect data to form the norm of the test.

Results: 1) badminton multiball feeding test consisted 14 test which were 5 hand feedings test, 6 racket feeding test, and 3 rally feeding tests, 2) The quality of tests was: validity = 1.00, reliability = 0.87 (0.84-0.97), difficulty 0.60 (0.47-0.77), discrimination 0.60 (0.47- 0.77), and objectivity 1.00, 3) Norm based on T-Score were: Hand feeding: 61 and above = Very good, 51-60 = Good, 41-50 Moderate, 31- 40 = Poor, 30 and below = Very poor, Racket feeding: 65 and above = Very good, 55-64 = Good, 45-54 Moderate, 35-44 = Poor, 34 and below = Very poor, Rally feeding: 58 and above = Very good, 48-57 = Good, 38-47= Moderate, 28-37 = Poor, 27 and below = Very poor, Total Score: 68 and above = Very good, 58-67 = Good, 48-57= Moderate, 38-47 = Poor, 37 and below = Very poor. 4) Norm based on raw score were: Hand feeding: 41 and above = Very good, 36-40 = Good, 31-35 Moderate, 26-30 = Poor, 25 and below = Very poor,





Racket feeding: 35 and above = Very good, 31-34-64 = Good, 27-30 Moderate, 23-26 = Poor, 22 and below = Very poor, Rally feeding: 21 and above = Very good, 18-20 = Good, 15-17 = Moderate, 12-14 = Poor, 13 and below = Very poor, Total Score: 93 and above = Very good, 81-92 = Good, 69-80 = Moderate, 57- 68 = Poor, 56 and below = Very poor.

Conclusion: Badminton multiball feeding skills test could be used to evaluate the skill of feeding to gain more experience in badminton stroke production and movement for student teachers. And it could apply to evaluate teachers and coaches by adjusted norms of the test.

Keywords: Badminton Feeding Skills; Student Teachers; Badminton Tests; Badminton Teaching Skills

Introduction

Badminton is an extremely demanding sport that requires high-intensity intermittent actions and a high level of anticipatory actions within an uncertain environment. To enhance the skill acquisition of badminton players, the teachers or coaches must provide activities that allow individuals the opportunity to acquire innovative and adaptable performance behaviors by simulating competitive play. Skill acquisition in sport is traditionally centered around mass repetition with low levels of uncertainty, prioritizing movement consistency over adaptability (Krause et al, 2019). There were common badminton practice approaches that include predictable hand feedings and racket feedings that were endorsed by the Badminton World Federation (2021). To enhance badminton practice, recent research has been conducted to develop and optimize automated shuttlecock feeding machines to facilitate badminton activities in the practice environment. These machines were designed to replicate human shuttlecock feeding and allow an individual to practice technical skills and movements independently.

However, as with predictable human feeding, the use of feeding machines in other 'fast ball sports', such as cricket, has been shown to cause maladaptive learning behaviors (Pinder et al, 2011). The ecological dynamics in sport have led to considerable recent research attention towards representative learning design in the sport practice domain (Woods et al, 2020).

The feeding skills test and criteria were developed by Tasnaina and Bangthamai (2016). The result was as follows: The ability in handfeeding, most of the sample was evaluated by a cut-off at the moderate and above threshold, with 60% of the full score was 61



participants, or 58.65% passed the test. The ability in racket feeding, most of the sample was evaluated by cutting off the moderate and above, was 33 participants, or 31.73 percent, passed the test. In the ability in rally feeding, most of the sample was evaluated by cutting off the moderate and above, which was 55 participants or 48.08 percent would pass the test. The total ability of feedings. Half (50.00 %) of the sample was at a very low level, and the others were low, moderate, and good levels respectively (20.20%,14.40%), and very good mixed with good (16.40%), and only 1.90 was very good. The evaluated result by cutting off the moderate and above was 31 participants or 29.80 percent passed the test.

At present, there are many badminton feeding machines on the market. A Badminton feeding machine was a device used to automatically feed multiple balls during badminton practice sessions or training. It helped players to improve their shots and footwork without the need for another person to manually feed the multiball. The feeder usually consisted of a hopper or tube that holds the balls and a mechanical or electronic mechanism that releases them one by one to the playing area.

These showed that the multiball feeding to train badminton players and students was a very important technique to train and teach badminton. Most badminton coaches use multiball feeding to train skills, movement, and physical fitness. The coach training and student teacher learning put feeding skills in the program training and lesson plan, but there were few tests to measure and evaluate the feeding skills. The one we could find was “the research on badminton coaches’ skill test”, which tested on hand feeding, racket feeding, and rally feeding, but did not cover every skill to train players and students in badminton. Also Tasnaina & Bangthamai (2016) tested badminton skills of coaches who attended “Badminton Coach Training Program” and found that the provincial coaches had badminton feeding skills, performance was lower than the moderate criteria set by Tasnaina and Bangthamai (2016), According to those research, there were not cover all shot of basic badminton which consisted of nine shots as, net drop, jab, net lob, serve, return smash, drive, clear, drop shot, and smash. So, we could not measure and evaluate the completed skills needed for coaches and teachers.

These research products would be useful to measure and evaluate the skills to be a good teacher and a coach of student teachers in university, and could be applied to develop course descriptions for badminton coaches and evaluate the ability of those who want to be professional coaches or badminton teachers.



Objectives

1. To construct the badminton feeding skills tests to measure and evaluate the student teachers' badminton teaching performance.
2. To verify the constructed comprehensive tests according to the test construction criteria.
3. To develop norms for badminton feeding skills tests to measure and evaluate the student teachers' badminton teaching performance.

Literature Review

Badminton has soared in popularity due to its accessibility and the comprehensive benefits it offers. It's a sport that enhances physical agility, as players must react quickly to the shuttlecock's high-speed movements. This requirement for swift reflexes contributes to improved balance and flexibility, as players often find themselves reaching and lunging to keep the game in play. The social aspect of badminton is also significant, with a strong community aspect that can contribute to increased longevity. Moreover, the sport's popularity has been fueled by social media and the influence of younger generations, who are drawn to its dynamic nature and the lifestyle associated with it.

The fundamental skills in badminton were divided into five group, 1) footwork or movement which consisted of: left and right, forward and backwards, diagonal move, and combinations 2) Front court shots which consisted of: net drop, jab and defensive lob, 3) Mid-court shots which consisted of short service, long service, drive, side shot and smash return, 4) Backcourt shots which consisted of: Clear of lob (safe) smash, and drop short. (Sport Authority of Thailand 2015, Tasnaina & Bangthamai, 2016, Badminton World Federation, 2012).

1. Badminton Training

Badminton Training was developed and progressed according to the principles and knowledge of sports science, game development, and the creation of teachers and coaches.

Former Training Techniques

1. Basic Skills Drills:
 - 1.1 Footwork Drills: Emphasis on agility and movement across the court.
 - 1.2 Shadow Practice: Practicing strokes without a shuttlecock to perfect form and technique.
 - 1.3 Wall Rally: Hitting the shuttlecock against a wall to improve consistency and control.

2. Physical Conditioning:

2.1 Running and Sprinting: Building stamina and speed.

2.2 Skipping Rope: Enhancing footwork and coordination.

2.3 Strength Training: Using bodyweight exercises like push-ups and sit-ups to build muscle.

3. On-Court Practice:

3.1 Multiball Training: Coaches feed multiple shuttlecocks to players to improve reaction time and shot accuracy.

3.2 Match Play: Regular practice matches to simulate real-game scenarios.

Integration of Technology

1. Wearable Tech: Devices that track performance metrics like heart rate, movement, and shot accuracy.

2. Apps and Software: Tools for planning training sessions, tracking progress, and providing feedback.

Combining traditional methods with modern innovations allows players to develop a well-rounded skill set and stay competitive. Whether you're a beginner or an advanced player, incorporating a mix of these techniques can help you improve your game.

In badminton training and learning, the first stage of the lesson or training program for novices, the footwork and movements are usually in the first hour of training and teaching because they were very importance skills as most of coaches and teachers stated that "You can do a perfect hit if you do not move to the right position" (Tasnaina & Bangthamai, 2016, Chiu et al, 2020). The badminton game in the present time has changed completely from slow to quick moves. The fast-paced nature of the game enhances physical agility and balance, as players must often make quick, strategic movements and maintain their footing in various positions. The speed of the shuttlecock was very fast (The fastest object measured in sports is the badminton birdie).

2. Badminton Techniques

Badminton involves a variety of skills and strokes that players need to master to be effective on the court. Here are some key skills and strokes:

Key to Badminton Players' Ability

1. Footwork: Efficient movement around the court is crucial. Good footwork helps players reach the shuttle quickly and maintain balance.

2. Hand-Eye Coordination: Essential for timing shots accurately.

3. Agility and Speed: Quick reflexes and the ability to change direction rapidly are important.

4. Stamina and Endurance: Badminton matches can be physically demanding, so good cardiovascular fitness is beneficial.

Keys of Badminton strokes (Tasnaina, 2016, BWF, 2021)

1. Serve: The starting shot of a rally. There are different types of serves, including high serve, low serve, flick serve, and drive serve.

2. Clear: A high, deep shot aimed towards the back of the opponent's court. It can be played as an attacking or defensive shot.

3. Drop Shot: A soft shot that just clears the net and lands close to it, forcing the opponent to move forward.

4. Smash: A powerful, downward shot aimed at finishing the rally. It's one of the most aggressive shots in badminton.

5. Drive: A fast, flat shot that travels horizontally over the net. It's often used in doubles to keep the shuttle low.

6. Net Shot: A delicate shot played close to the net, aiming to make the shuttle tumble over the net.

7. Lift: A defensive shot played from near the net, sending the shuttle high and deep into the opponent's court

8. Return the Smash: A quick response to the smash shot, which shuttlecock flew rapidly. The return of smash must react with quickness to hit back the shuttlecock. The players' most used were backhand returns.

9. Cut shot: At the back of the court, the player hit the high ball by slicing cut, aiming to drop the shuttle cock to fall close to the net instead of smashing or clearing.

3. Badminton Training with Multiball Feeding

Multiball feeding to train badminton was successfully utilized in one-to-one situations, such as private coaching, where a coach works with a single player. Additionally, it can also be applied successfully with a ratio of one coach to two players. Multi-ball training involves delivering balls with different spins, power, speed, and placement in various combinations. The continuous hitting of balls eliminates time wasted on ball retrieval, resulting in increased training intensity. Moreover, this method aids in enhancing the execution of drills by strengthening the execution of challenging movements. (Apostu et al, 2018).

Li and Hongsaenyatham (2023) researched on “The Effects of Multiball Training Program on Badminton Skills of Male Students Aged Between 9-11 Years” The objectives of research were: (1) To study the effects of a multiball training program on badminton skills of male students aged between 9-11 years, and (2) To construct the multi-ball training program for improving badminton skills of male students aged between 9-11 years. The results showed that after the 8-week training using a multi-ball training program, it was found that the badminton skills of male students aged between 9-11 years improved in all four aspects, including the high clear shot, drop shot, smash, and serve skills. These skills showed statistically significant differences before receiving the training with the multi-ball training program, after completing the training in Week 4 and Week 8. Conclusion: It can be concluded that the multi-ball training program developed by the researcher affects the development of badminton skills in male students aged between 9-11 years, which could improve the fundamental badminton skills of male students.

Badminton Multiball Feeding Test

In 2018, the Badminton Feeding Test was developed by Tasnaina and Bangtamai (2016). They researched “Constructing the Skill Test and Norm for Badminton Coach”. The summary of the tests was as follows: 1) the shape of the targets was a sector of the circle with 30 inches for hand feeding, a radius of 48 inches for racket feeding, and rally feeding. 2) Three types of feeding were tested, 3) The spots of feeding targets were four spots for hand feedings, four spots for racket feedings, and two spots for rally feedings. The content validity was .98. Then the test manual, recording forms, and targets were developed and tried out with 36 coaches by repeated measurement method. The reliability was .94, the difficulty was .50, and the discrimination was .33, which were acceptable for normal test criteria. The tests were implemented for the 107 badminton coaches with three different experience groups by purposive sampling, they were 36 with low experience (less than one year), 37 with moderate experience (1-5 years), and 34 with high experience (6 years and more), most of them was male. The total score of the test was 36.50 ± 7.58 . The scores were transformed into T-scores to make the norm of five scales. The very good was 60 and more, the good was 53-59, the moderate was 46-52, the poor was 39-45, and the very poor was 38 and lower. For another consideration, we made the norm by raw scores convenient to the user. The very good was 45 and more, the good was 39-44, moderate was 33-38, the low was 27-33, and the very low was 26 and lower.

4. Principle of the Sport Test Construction.

The test construction techniques and principles consists of ten (10) Modules under the following topics as 1) Getting started in the virtual classroom 2) Basic terms on educational evaluation and measurement 3) Types of test and classification, 4) Characteristics of test, 5) Preparation of achievement test, 6) Methodology of Test Construction, 7) Test Planning stages, 8) Test Item Development, 9) Test Item Analysis, 10) Development of Marking Scheme.

The steps of test construction

1. Preparation: The preparation phase in test construction consisted of

1. The test items
2. The directions to test items,
3. The directions for administration,
4. The directions for scoring,
5. The question analysis chart in the table of specifications (TOS)

2. Try out the tests: This phase was the test construction and validation process. The construction of test items requires careful planning, but their effectiveness can only be confirmed through empirical testing. Initially, a preliminary version of the test, containing approximately twice the number of items needed for the final version, is created. This allows for a thorough item analysis, where many items may be discarded. A detailed scoring key is also prepared. The steps were: 1) Preliminary Try-Out, which involves administering the test to a small, diverse group of 10 to 15 students. This step aims to identify any errors or ambiguities in the test items and instructions, ensuring they are clear and functional. Necessary revisions are made based on the feedback from this stage. 2) Final Try-Out, the revised test is then administered to a larger, representative sample of 200 to 300 students, encompassing a range of abilities. This pilot study aims to identify defective items, weaknesses in test administration, and non-functional distractors in multiple-choice questions. It also provides data for evaluating item discrimination, determining the final number of items, and setting time limits. 3) The Scoring and Analysis. After the final try-out, answer sheets are scored according to the prepared key, with corrections for guessing if necessary. The resulting scores are used for item analysis and overall test evaluation.

3. Evaluation: After scoring is complete, the test must be evaluated to examine whether the test items are good and whether the test was reliable and valid. The topics to evaluate were 1) analyse the items to examine their worth of inclusion in the test or Item analysis, 2) determine the validity of the test, determine the reliability of the test, 4) assess the

discrimination, difficulty, objectivity of the test 3. the usability of the test as practical, appropriate, satisfying to the stakeholders and contents to use.

4. Development of norms or criteria: Creating norms for a test involves collecting data from a representative sample and using that data to establish reference points for interpreting individual scores by 1) defining the target population, 2) identifying the characteristics of the population for which the test is intended (e.g., age, education level, geographic location). 3) Select a representative sample for criteria setting. This sample should be large enough to provide reliable data, typically ranging from 200 to 1,000 participants, and the sample must reflect the diversity of the target population. Depending on the test's scope. 4) Administer the Test, by conducting the test under standardized conditions to ensure consistency. Provide clear instructions and maintain a controlled environment. 5) Collect Data by gathering test scores and relevant demographic information from the participants. Ensure data is anonymized to protect privacy. 6) Analyze the Data by calculating descriptive statistics such as mean, median, mode, standard deviation, and percentiles for the test scores and identify any outliers or anomalies in the data that may need to be addressed. 7) Establish Norms by creating norm tables or charts that show the distribution of scores. This could be formulated in 1) Percentile ranks: Indicating the percentage of scores below a particular score. 2) Standard scores: Such as z-scores or T-scores, which standardize the scores based on the mean and standard deviation. 3) Raw score range 4) Age or grade equivalents 5) Experience of sample group 8) Validate the Norms by conducting validity checks to ensure the norms are accurate and applicable to the target population. This may involve comparing the norms to other established benchmarks or conducting additional studies. 8) Document the Norms by preparing a detailed report that includes the methodology, sample characteristics, statistical analyses, and the final norm tables. This documentation is crucial for transparency and future reference. 9) Review and Update (DelCacho-Tena et al, 2024)

Periodically review and update the norms to ensure they remain relevant and accurate over time. This is especially important if the test was used over a long period or if the target population changes.

Conceptual Framework

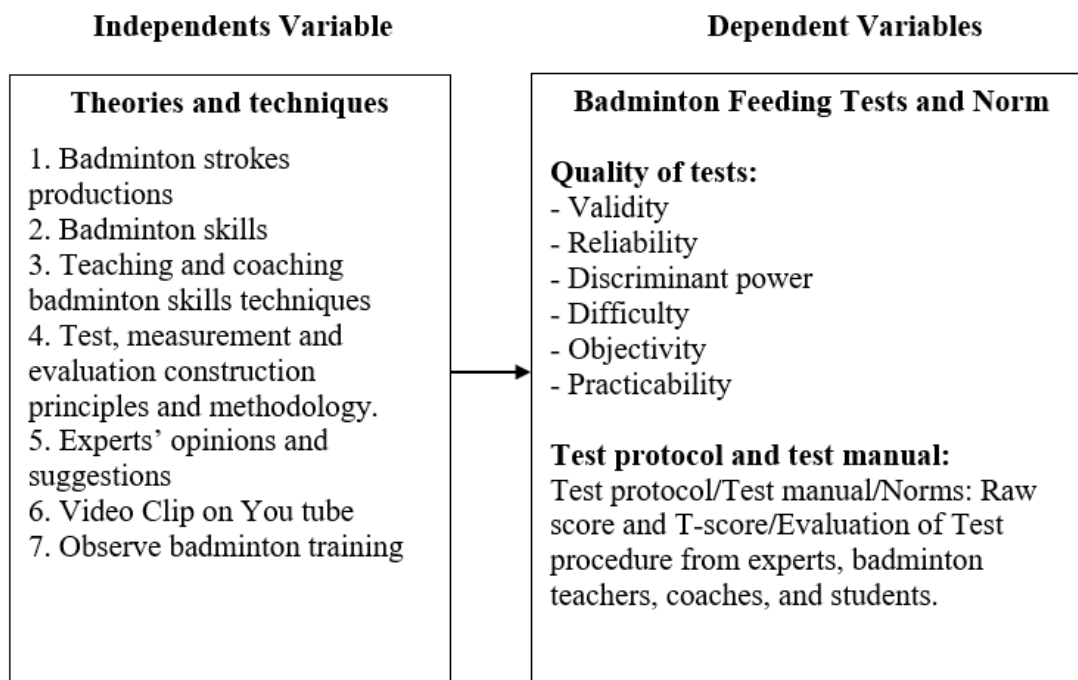


Figure 1 Conceptual Framework

Methodology

Population

The target population of this study is university students, majoring in physical education and sport training, who have studied the course of badminton teaching or badminton coaching. 7 universities and colleges in Guangzhou City offer badminton teaching and badminton coaching. The students who studied badminton teaching or badminton coaching and are still registered as present students were approximately 1200 students.

Samples were selected by purposive sampling by teachers in 4 universities, with the option of:

1. Passed the studied requirement in badminton teaching or badminton coaching in a bachelor's degree program or above.
2. In each university, select approximately 30 students into groups of high performance (10), moderate performance (10), and low performance (10)
3. The total was not less than 120 student teachers.

Sample for tests try-out

1. Select one university, then cooperate with the teacher to choose the students who passed the option of research for 12 students, 3 students for small group tryout, 9 students

for medium group tryout (3 in high performance, 3 in moderate performance, 3 in low performance)

2. A large group tryout was conducted with 30 students to assess the efficiency of the test on reliability, difficulty, power, discriminant power, practicality, and objectivity. The subjects were 10 students in high performance, 10 students in moderate performance, and 10 students in low performance.

Experts for interviewing to form the test and test protocol.

1. Nine Badminton teachers and badminton coaches.
2. They had at least 10 years' experience in badminton teaching or coaching
3. They used to teach or train their students or athletes with multiball feeding.

Experts for developing a test.

1. Experts for validating the test by the Indexes of Items Objective Congruence (IOC) were one teacher and two coaches, who had high experience in badminton teaching or coaching (15 years or more)

2. Experts to evaluate the objective of the test were one teacher and two coaches, who had experience in multiball feeding for badminton.

Research Instrument

1. The research instruments were a video clip on multiball feeding in badminton teaching or training.

2. Semi-structured interviewing form
3. Questionnaire for validating test and protocol. (IOC=1.00)
4. Multiball feeding test and equipment.
5. Recording form to record the test results.
6. Questionnaire for test operation and procedure evaluation.
7. Comprehensive test manual/forms and equipment for testing.

Data Collection

1. Consult 9 experts through face-to-face interviews, telephone interviews, and semi-structured interviews

2. Validating the test and test protocol by rating form concerns the test objective, test items, and test protocol.

3. Small group tries out 3, and 9 persons to check the understanding of communication and the process of the tests.

4. Large group tryout: 30 persons to find the reliability of the test, difficulty, power, discriminant power, practicality, and objectivity of the test.

5. Implementation of a test to collect data by a sample of at least 150 university students to formulate norms in T-score and raw score.

6. Evaluation of Test by questionnaire distribution to the sample.

Data Analysis

1. Statistics: The statistics used in this research were mean, standard deviation, percentage, Pearson's correlation analysis, Cronbach's Alpha Coefficient, and T-score.

2. Software: Exam Test Analysis with Excel developed by Narong Teeprachai, Statistic Analysis Package, and set norm by calculator.

3. Norm setting

3.1 Norm based on raw data.

3.1.1 Setting a 5 scales norm: 1 = very poor, 2= poor, 3= moderate 4 = Good 5= Very good

3.1.2 Analyzed Data to find the minimum score, maximum score, average score, and standard deviation.

3.1.3 Calculate range and interval score by maximum score – minimum score, then divide by 5 scales.

3.1.4 Defined Scale by Maximum score – interval score to be a very good scale, then each scale minus with interval scores to be Good, moderate, poor, and very poor consecutively.

3.2 Norm based on T- T-score.

3.2.1 Setting a 5 scales norm: 1 = very poor, 2= poor, 3= moderate 4 = good 5= very good

3.2.2 Analyzed Data to find the minimum T-score, maximum score, average score, and standard deviation of 10.00.

3.2.3 Calculate Scale by setting moderate at average $\pm 1/2$ standard deviation (5.00) and then using the standard deviation (10.00) as an interval to form another level up and down.

3.3 Based on hybrid (raw score with standard deviation)

3.3.1 Setting a 5 scales norm: 1 = very poor, 2= poor, 3= moderate 4 = Good 5= Very good

3.3.2 Analyzed Data to find the minimum score, the maximum score, the average score, and the standard deviation.

3.3.3 Calculate range and interval score by maximum score – minimum score, then divide by 5 scales.

3.3.4 Defined Scale by using the average $\pm 1/2$ Standard to set the moderate level (3). Then used 1 standard deviation up as an interval to define good (4) and very good (5), and down as poor (2) and very poor (1) consecutively.

4. Scale interpretation

5 = very good

4 = good

3 = moderate

2 = poor

1 = very poor

5. Index of difficulty of the test (Bob Matoba, 2020)

0.00 - 0.19 = Very difficult

0.20 - 0.39 = Difficult

0.40 - 0.60 = Moderate difficult

0.71 - 0.90 = Easy

0.91 -1.00 = Very easy

6. Index of discrimination of the test

0.09-0.19 = very poor

0.20-0.29 = fair

0.30-0.39 = good

0.40 and above = very good

Results

1. Draft badminton feeding skills tests for student teachers included protocol and manual

Summarize the reviewed data to draft a test, then drafted 7 tests on hand feeding, 6 tests on racket feeding, 5 tests on rally feeding, and 2 combined feeding.

A. Hand Feeling:

1. Hand feed-1	Clear stroke: stationary hit
2. Hand feed-2	Side stroke: Two positions
3. Hand feed-3	Net drop: Two positions
4. Hand feed-4	Over shoulder and net lob
5 Hand feed-5	Multi Position hit: 4 positions
6. Hand feed-6	Smash return: speed feeding
7. Hand feed-7	Drive: speed feedings

B. Racket Feeding

1. Racket feed-1	Backcourt clear: two positions
2. Racket feed-2	Smash and net recovery
3. Racket feed-3	Smash four positions
4. Racket feed-5	Smash return Practice
5. Racket feed-6	Drive: Speed feedings
6. Racket feed-7	Net lift and clear

C. Rally Feeding

1. Rally-1	Clear
2. Rally-2	Return the smash to the back court

3. Rally-3 Smash to practice smash return
 4. Rally-4 Net lift and clear
 5. Rally-5 Speed Drive
- D. Combined feeding Racket and Rally feeding
- 1 Combined feeding 1 Net drop and clear
 - 2 Combined feeding 2 Net lob and smash

2. Validate the test by 5 experts.

Delivered the test manual to 5 experts. The criteria were Badminton Coaches and Badminton teachers experienced in badminton competition, and teaching or coaching badminton, who were 3 Thai experts and 2 Chinese experts. The experts consider the face validity of a test or measurement tool, which refers to whether the tool seems relevant to the topic at hand. The validity was very high at 1.00.

Researchers considered the problems of time consumption, correlation between rests, reliability, difficulty, and the discrimination power of the test. Some tests should be deleted to reduce the time consumed, and some tests were not accepted by the criteria. The researcher took the evidence gathered in the tryout and summarized it, then brought it to a panel of three experts to consider and adjudicate it. Finally, they selected 14 tests as follows:

A. Hand Feeding 6 tests: Standing clear, Side strokes two positions, Multi 4 positions, Over shoulder and net drop, Smash returns, Speed drive.

B. Racket Feeding 5 tests: Clear left and right, Clear, and net play, Smash return, Smash and net play smash, Speed Drive,

C. Rally Feeding 3 tests: Clear left and right, Smash, and net recovery, Speed Drive

The researcher used the 30 students' try-out data and omitted some tests, which were suggested by the expert panel to be analyzed again, and found that 1) reliability was at .98, 2) Difficulty was at .0.47-0.77, and 3) Discrimination was at 0.47-0.73.

Table 1 Correlation and reliability of first tryout with 30 participants on original Badminton Multiball Feeding Skill Tests (14 tests)

No	Items	Hand	Racket	Rally	Total	Remark
1	The sum of hand feeding	1.00	0.92	0.84	0.98	
2	The sum of racket feeding	0.92	1.00	0.87	0.97	
3	The sum of rally feeding	0.84	0.87	1.00	0.91	



No	Items	Hand	Racket	Rally	Total	Remark
Reliability by Cronbach's alpha = 0.87						

Table 1 showed that the correlation among the sum of feeding test was very high: 1) Hand feeding and racket feeding was 0.92, hand feeding and rally feeding was 0.84, and hand feeding and total score was 0.98. 2) Racket feeding and rally feeding were 0.87, rally feeding and total score were 0.97, 3) Rally feeding and total score were 0.91. The reliability was 0.87.

Table 2 The analysis of the test on difficulty and discrimination.

Test				
Numbers	Difficulty	Meaning	Discrimination	Meaning
A	Hand Feedings Test			
1	0.77	Easy /Accepted	0.73	Very Good
2	0.73	Easy /Accepted	0.67	Very Good
3	0.77	Easy /Accepted	0.73	Very Good
4	0.60	Easy /Accepted	0.53	Very Good
5	0.53	Moderate/accepted	0.53	Very Good
6	0.77	Easy /Accepted	0.73	Very Good
B	Racket Feedings test			
1	0.60	Easy /Accepted	0.53	Very Good
2	0.47	Moderate/ accepted	0.67	Very Good
3	0.53	Moderate/ accepted	0.53	Very Good
4	0.53	Moderate/ accepted	0.53	Very Good
5	0.57	Moderate/ accepted	0.47	Very Good
C	Rally Feeding			
1	0.50	Moderate/ accepted	0.53	Very Good
2	0.50	Moderate/ accepted	0.47	Very Good
3	0.63	Easy /Accepted	0.60	Very Good
Average	0.60	Easy /Accepted	0.60	Very Good



Table 2 Analysis of the quality of the try out on adjusted badminton feeding skills tests with student teachers (30 participants) on difficulty and discrimination. The difficulty average was 0.60, which was easy but acceptable. (0.47-0.77), 7 tests were moderately difficult, and 7 tests were easy but acceptable. All of the tests had very good discrimination, the average was 0.60 (0.47 - 0.73)

3. Setting the norm of the Badminton Feeding Skill Test for Student Teachers

Researchers coordinate with teachers in 4 universities to select the students who majored in physical education and had already passed the course in badminton coaching or badminton teaching, which was a required course for students in the major of physical education teaching. The teachers selected at least 30 students and tried to equalize them into groups of 10 students each group with high performance, moderate performance, and low performance.

Table 3 The Scores of Tests on Badminton Feeding Skill Test for Student Teachers

No	Tests	Points	Min	Max	$\bar{x}$	SD
A	Hand feeling test	60	22.00	46.00	34.51	6.32
1	Standing: clear	10	4.00	9.00	6.49	1.20
2	Side strokes two positions	10	3.00	8.00	5.93	1.04
3	Multi 4-position strokes	10	3.00	9.00	5.80	1.51
4	Over shoulder and net drop	10	3.00	9.00	5.59	1.64
5	Speed smash returns	10	3.00	8.00	5.30	1.43
6	Speed drive strokes	10	3.00	8.00	5.38	1.14
B	Racket Feeding Test	50	19.00	40.00	27.93	5.34
1	Clear left and right	10	4.00	9.00	6.04	1.43
2	Clear and net play	10	3.00	9.00	6.00	1.70
3	Smash return	10	3.00	8.00	5.32	1.23
4	Smash and net plays	10	3.00	9.00	5.45	1.46
5	Speed Drive	10	3.00	8.00	5.10	0.99
C	Rally Feeding Tests	30	11.00	24.00	17.58	3.79
1	Clear left and right	10	3.00	9.00	5.94	1.34
2	Smash and net recovery	10	3.00	9.00	5.94	1.40
3	Four positions	10	2.00	9.00	5.69	1.59
D	Total score	140	48.00	104.00	73.70.	11.23
E	T-Score					
1	T score of hand feeding	100	30.22	68.15	50.00	10.00
2	T-score of racket feeding	100	30.89	74.47	50.00	10.00

No	Tests	Points	Min	Max	$\bar{x}$	SD
3	T Score of rallies feeding	100	32.65	66.91	50.00	10.00
4	T Score of total t score	100	28.99	72.28	50.00	10.00

Table 3 Showed that the large group test to collect data to set norm were 1) sum of hand feeding scores (60 points) was 35.51 ± 6.32 , the average of each hand tests (total = 10 points) was between 5.30- 6.49, 2) sum of racket feeding tests scores (50 points) was 27.93 ± 5.34 , the mean of each racket tests (total = 10 points) was between 5.10- 6.04) sum of racket feeding test scores (30 points) was 17.58 ± 3.79 , the average of each rally feedings tests (total = 10 points) was between 5.69 -5.94. These showed that all participants passed the cut-off score at 50% for each test and the total score of the tests.

4. Setting norm based on T-score

The researcher analyzed the Z-score and calculated the T-score to set the norm of the test; the result is in Table 4

Table 4 Norm of tests on Badminton Feeding Skill Test for Student Teachers based on T Score.

No	Characteristics	Hand Feeding	Racket Feeding	Rally Feeding	Total Score
A Statistic					
1	Min	27.36	30.89	32.65	27.71
2	Max	70.09	74.47	66.91	76.97
3	Everage	34.51	27.93	17.58	50.00
4	Standard Deviation	10.00	10.00	10.00	10.00
B Level of performance					
5	Very good	61 and above	65 and above	58 and above	68 and above
4	Good	51-60	55-64	48-57	58-67
3	Moderate	41-50	45-54	38-47	48-57
2	poor	31-40	35-44	28-37	38-47
1	Very poor	30 and below	34 and below	27 and below	37 and below

Table 4 showed that the norm set by the T-score of the badminton feeding skill test for student teachers was as follows:

Hand feeding: 61 and above = Very good, 51-60 = Good, 41-50 Moderate

31- 40 = Poor, 30 and below = Very poor

Racket feeding: 65 and above = Very good, 55-64 = Good, 45-54 Moderate

35-44 = Poor, 34 and below = Very poor

Rally feeding: 58 and above = Very good, 48-57 = Good, 38-47= Moderate

28-37 = Poor, 27 and below = Very poor

Total Score: 68 and above = Very good, 58-67 = Good, 48-57= Moderate

38-47 = Poor, 37 and below = Very poor

5. Set norm based on raw score

The researcher used the raw score to calculate the range and interval to set the norm of the test; the result is in Table 5.

Table 5 Norm of Badminton Feeding Skill Test for Student Teacher Based on Raw Score

No		Hand Feeding	Racket Feeding	Rally Feeding	Total Score
A	Statistic				
1	Min	22.30	19.00	11.00	48.00
2	Max	46.00	40.00	24.00	104.00
3	Everage	34.51	27.93	17.58	73.70
4	Standard Deviation	6.33	5.34	3.79	11.23
Level of performance					
5	Very good	41 and above	35 and above	21-and above	93 and above
4	good	36-40	31-34	18-20	81-92
3	Moderate	31-35	27-30	15-17	69-80
2	Poor	26-30	23-26	12-14	57- 68
1	Very poor	25 and below	22 and below	11 and below	56 and below

Table 5 showed that the norm based on the raw score of the badminton feeding skills test for student teachers was as follows:

Hand feeding: 41 and above = Very good, 36-40 = Good, 31-35 Moderate

26-30 = Poor, 25 and below = Very poor

Racket feeding: 35 and above = Very good, 31-34-64 = Good, 27-30 Moderate

23-26 = Poor, 22 and below = Very poor

Rally feeding: 21 and above = Very good, 18-20 = Good, 15-17 = Moderate

12-14 = Poor, 13 and below = Very poor

Total Score: 93 and above = Very good, 81-92 = Good, 69-80 = Moderate

57-68 = Poor, 56 and below = Very poor

Summary of research

1. The size of target plates for the target of feeding, the researcher implied 2 plates of Tasnaina and Bangthamai (2016), which were 30 inches for hand feeding the target and 48 inches for racket feeding and rally feeding

2. The tests consisted of 14 tests; they were 6 tests for hand feedings, 5 tests for racket feedings, and 3 tests for rally feedings

3. The quality of tests was: Validity = 1.00, Reliability = 0.87 (0.84-0.97), Difficulty 0.60 (0.47-0.77), Discrimination 0.60 (0.47- 0.77), and Objectivity 1.00

4. Norm based on T-Score were: Hand feeding: 61 and above = Very good, 51-60 = Good, 41-50 Moderate, 31- 40 = Poor, 30 and below = Very poor, Racket feeding: 65 and above = Very good, 55-64 = Good, 45-54 Moderate, 35-44 = Poor, 34 and below = Very poor, Rally feeding: 58 and above = Very good, 48-57 = Good, 38-47 = Moderate, 28-37 = Poor, 27 and below = Very poor, Total Score: 68 and above = Very good, 58-67 = Good, 48-57 = Moderate, 38-47 = Poor, 37 and below = Very poor.

5. Norm based on raw score were: Hand feeding: 41 and above = Very good, 36-40 = Good, 31-35 Moderate, 26-30 = Poor, 25 and below = Very poor, Racket feeding: 35 and above = Very good, 31-34-64 = Good, 27-30 Moderate, 23-26 = Poor, 22 and below = Very poor, Rally feeding: 21 and above = Very good, 18-20 = Good, 15-17 = Moderate, 12-14 = Poor, 13 and below = Very poor, Total Score: 93 and above = Very good, 81-92 = Good, 69-80 = Moderate, 57-68 = Poor, 56 and below = Very poor.

Discussion

Badminton and many sports, coaches and teachers used multiball feeding to teach and coach their athletes and students because it help them to adjust their movement and eye hand coordination to move their body and holding equipment to exactly contact point at the balls, with repeated hit their could learn the best to perform their job, Li and Hongsaenyatham (2023), researched on “The Effects of Multi-ball Training Program on Badminton Skills of Male Students Aged Between 9-11 Years old.” The result revealed that the badminton skills of male students improved in all four skills in badminton, including the high clear shot, drop shot, smash, and serve skills, which showed statistically significant differences before receiving the training with the multi-ball training program, after completing the training in week 4th and week

8th. This concluded that the multi-ball training program could develop badminton skills. The badminton skills consisted of 9 strokes production (Tasnaina, 2016), so the teachers and coaches must train them all for their clients using multiball training. Other than the 9 skills mentioned before, the footwork was also a necessary technique for elite badminton players.

Similar result of Jumarsa et al (2019) who researched “The Effect of Multiball Training Method Against Backhand Drive Stroke Accuracy in Table Tennis”, The research result showed that there was an influence of the ball training method on the accuracy of the backhand drive hit in table tennis. It could be concluded that the multiball training could improve accuracy in table tennis.

Multiball repeated hitting is a highly effective training method in badminton that significantly contributes to skill improvement. This technique involves a coach or a dedicated machine continuously feeding shuttles to a player, allowing them to perform a high volume of repetitions of a specific shot or a sequence of shots in a short amount of time. The importance of this method can be understood through several key benefits:

1. Development of Muscle Memory and Automation.
2. Improved Shot Consistency and Accuracy.
3. Enhanced Physical Conditioning and Endurance.
4. Reduced Training Plateaus.

The benefits and application of multiball training were confirmed in the book “Badminton: The Skills of the Game,” a respected coaching manual that dedicates significant sections to the importance of structured repetition and multiball feeding for skill acquisition and refinement. It provides practical applications and theoretical underpinnings for the method. (Schmidt & Lee, 2014). Motor Control and Learning: A Behavioral Emphasis. Human Kinetics. While not specific to badminton, this foundational textbook on motor learning provides the scientific basis for why repetition and spaced practice (like that found in multiball training) are so effective for developing motor skills and muscle memory. It discusses concepts like the "specificity of practice" and "transfer of learning," which are directly relevant.

Safari and Subagja (2018) presented that the multiball practice method was much more significant to the forehand technique of a table tennis game drive, with an average post-test score of 29.25, compared with the wall reflection method, with a post-test average of 24.67.

Yang (2012) systematically summarized the tactics of badminton singles, mainly including the following aspects: serve attack tactics, post court high ball tactics, tie high ball tactics, level ball tactics, net front ball tactics; reception and serve tactics: high ball tactics; front ball tactics; attack and back court tactics; forced backhand tactics; four penalty tactics; kill and hang online tactics; transition ball tactics; defensive and counter tactics.

These showed the significance of multiball feeding benefits on skills enhancement, not only in badminton but also in other sports. The student teachers who were trained to be badminton teachers in the future must practice and evaluate the skills of multiball teaching techniques. The results of research showed that the sample got a moderate score on tests because they usually had only one session during badminton teaching and coaching, and they did not have a specific test on multiball feeding. Tasnaina & Bangthamai (2016) reported that the provincial coach had a low score on the badminton feeding test. The multiball feeding tests should better apply to train students in every basic stroke production and movement, so this research responded to this concept because the tests in this set were 14 tests with three types of feeding, which covered all basic skills in badminton and all directions of movement. These could lead to the requirement that teachers must teach their students and test them.

Recommendation

Application of this research

1. This badminton feeding skill test could be used for evaluating student teachers, teachers, and coaches, but the norms must be adjusted to fit each group
2. Applying to the class, the teacher should select some tests in each type of feeding to fit the objectives and time to finish tests in one session.
3. The test scores in this research were a little low, so the teachers should add more activities and time for practicing to gain more experience in feeding skills for students.

Recommendations for Further Research

1. Develop the protocol of the test for professional teachers and coaches
2. For advanced badminton players' training, the speed and deception of feeding should be considered for inclusion in the test protocol.

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