Pubmedia Jurnal Pendidikan Olahraga Vol: 2, No 4, 2025, Page: 1-12

Impact of Mind Gardens Strategy on Long Distance Shooting in U16 Basketball

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DOI:
https://doi.org/10.47134/jpo.v2i4.1893
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Received: 26-04-2025
Accepted: 26-05-2025
Published: 26-06-2025

Abstract: The study conducted in order to analyze the role of the Mind Gardens Strategy to develop long distance shooting from the basketball players in under 16 age group. 24 subjects from a local basketball club were randomly assigned to two groups: the experimental group trained by the Mind Gardens Strategy and the control group trained in the traditional way. There were three main tests in the experiment: the Five-Area Shooting Test, the Long-Distance Shooting Speed and Accuracy Test, and the Long-Distance Shooting Under Pressure Test. The results showed that the experimental team achieved performances significantly superior in the three tests, being those related to the capacity of shooting more accurate, faster and with higher success under pressure. The experimental group showed significant increases in shooting accuracy (23.93%), and shooting speed and accuracy (33.28%), and performance under pressure (34.58%). On the other hand, the control group showed less significant developments, highlighting the effectivity of Mind Gardens Strategy in the development of shooting performance when compared to the traditional one. These results indicate that the exercise employing dual cognitive training schemes, such as the Mind Gardens Strategy, on basketball training program may be useful for improving long-range shooting performance. The study highlights the relevance of cognitive tactics in sports coaching, especially among young persons involved in sports.

Keywords: Basketball Performance, Cognitive Training, Long-Distance Shooting, Mind Gardens Strategy

Introduction

Basketball is a fast-moving game which involves a wide collection of skills and abilities, which must be performed accurately with great concentration and precision. Of those skills, shooting, and more specifically shooting from distance (3-point shooting) is key to scoring points and winning games. The game has evolved and the three-point shot has become one of the most important abilities for every player to acquire, no matter the position, as it leads to the tactical advantage such as shifts in the momentum of the game and the control over the opponent (Meyers et al, 1982) (Zhang et al, 2025).

To compliment the development of the sport, training methods have moved forward applying the more modern theories to the area of coaching and sports psychology. Of these modern methods, the "Mind Gardens Strategy" is especially significant. Here, skills and training experiences are stored within sequential mind maps that enable players to visualize the type of skills they want to learn and improve and subsequently facilitate the

development of a clear mental picture of the skills, which in turn increases technical performance and shooting accuracy (Awad & Hegazy, 2015; Sirnik et al., 2022).

The Mind Gardens Approach is described as an educational and training method that groups and structures information and motor skills as visual linked diagrams that looks like an interconnected garden in which the main skill embodies the tree trunk and sub-skills and details appear as tree limbs and leaves through the inclusion of colors, images, pictures and symbols to assist individuals to perceive and grasp the material (Rahman & Islam, 2021; Raiola et al, 2014).

This procedure is supported by a number of theoretical underpinnings such as (Ansari, 1968) Meaningful Learning Theory which, asserts the need to coat-hang new information to existing information and to organize it within structured, linked cognitive frameworks. And it supports (Paivio & Clark, 2006) Dual Coding Theory of modality that states that people comprehend better when graphic support is provided. Furthermore, the Mental Mapping Theory that speculates about how information is mapped in memory and stored through interactions into mental maps, highlights the usefulness of information organization in the context of memory retrieval (Abdulhussein et al, 2024). Finally, (Bornstein, 1986) Theory of Multiple Intelligences highlights the range of learning styles and the need to cater for different kinds of intelligences in learners (Kanthack et al, 2014) (Xiang, 2024).

A number of previous studies have suggested the utility of mental training for increasing shooting accuracy in basketball drew attention to the enhancing effects of combined mental imagery and physical practice in young players, revealing an X=18.5% global improvement on shooting performance. (Huang et al, 2017) confirmed the benefits of mind mapping in teaching, as well as its impact on the acquisition of basic basketball skills among middle school students, resulting in statistically significant differences in the academic achievement of the experimental group that used the mind maps and the compare with the control group who used other methods. Furthermore, omar et al. (2009) showed that the male gymnasts of Hwang et al. ImplOptionsolidno substantial Article performance improvement when cognitive training was combined with skill-based drills, compared with practising over the skill drills alone (Fauzee et al, 2009) (Slimani et al, 2016).

also investigated the effects of mental imagery strategies on shooting accuracy in a basketball task, and they found that shooters, who used structured imagination before shooting, had 22% better results compared to shooters who did not use this strategy (Lu et al, 2020) (Rahman & Islam, 2021).

The motivation behind the research topic is an issue that the researcher, acting both as a coach and as a researcher of basketball, has brought up, that is the fact that players under 16, as it is widely observed in most games, have not developed the ability to take good shots from the long distance. Conventional training strategies don't seem to work so well in enhancing this skill. Moreover, many coaches work almost exclusively on the physical and technical parts and often they forget the mental and psychological components and how important they are when you talk about improving the accuracy in shooting situations, especially in competitive ones that require good concentration and perfect accuracy (Salimbayat, 2025) (Vickers, 2016).

The aim of this study is to investigate the effect of the Mind Gardens Strategy (MGS) on the improvement of long-range skills in the children Basketball players under the age of 16 years old and in the development of this kind of skills, the difference between the traditional method and the proposed modern method. It is the researchers' speculation that significant differences exist between the experimental and control groups. The experimental group will be trained based on the use of Mind Gardens Strategy whereas the control group will be taught through the traditional way to form haiku (Cao et al, 2022).

Although several studies have described the development of shooting performance in basketball, there is still a lack of research on the relationship between the Mind Gardens Strategy, which was introduced in this study, and the long-distance shooting skill among young players. The best part is: most mental image study shares the way of traditional methods of mental imagery or at mind map, but they don`t get anything regarding this creative method which brings benefits of mind maps and organize thinking creative. The present research seeks to bridge this research gap, presenting new possibilities to improve young basketball players skills using the Mind Gardens strategy and perhaps the most important establishing new ways for the training and performance improvement in other sports areas (Abdulkareem & Hassan, 2025) (Slimani et al, 2016).

Methodology

This section provides a detailed description of the methodology used in the study, covering the study design, participants, tools, training protocol, data collection methods, statistical analysis, and validation processes. All instruments and materials used in this study are outlined, along with the procedures followed for data collection and analysis.

Study Design

This study employed an experimental design with two equivalent groups (experimental and control), utilizing both pre-test and post-test measurements. The purpose of the study was to examine the effect of the Mind Gardens Strategy on improving long-distance shooting skills in basketball players under 16 years old. The experimental group followed a training program that incorporated the Mind Gardens Strategy, while the control group underwent traditional training methods. Both groups were tested on their shooting performance before and after the intervention.

Participants

The study involved 24 basketball players aged between 14 and 16 years, selected from Al-Shams Sports Club in Baghdad, Iraq. The participants were purposively selected based on their experience and physical attributes. They were randomly assigned to one of two groups:

- Experimental Group (n = 12): This group underwent the training program utilizing the Mind Gardens Strategy.
- Control Group (n = 12): This group underwent a traditional training program without the Mind Gardens Strategy.

The two groups were matched for age, height, weight, and training experience to ensure equivalence at baseline, as shown in table 1.

Table 1. Equivalence of Experimental and Control Groups

Variables	Experimental Group	Control Group	t-value	Significance
Age (Years)	15.33 ± 0.78	15.25 ± 0.86	0.24	0.81
Height (cm)	176.08 ± 5.66	175.75 ± 6.12	0.14	0.89
Weight (kg)	68.42 ± 7.23	67.92 ± 6.85	0.18	0.86
Training Age (Years)	3.25 ± 0.97	3.33 ± 0.89	0.22	0.83
Long-Distance Shooting Test Score	15.67 ± 3.82	15.92 ± 3.65	0.17	0.87

The table indicates no statistically significant differences between the experimental and control groups in any of the measured variables at the 0.05 significance level, ensuring the equivalence of the two groups at baseline.

Tools and Reagents

The following tools and instruments were used in the study:

1. Restameter (Restameter Inc, USA): Used to measure the height of the participants in centimeters.
2. Calibrated Medical Scale (HealthScale Co., UK): Used to measure the weight of the participants in kilograms.
3. Digital Stopwatch (TimeMaster, Germany): Used to measure time with precision of 0.01 seconds.
4. Measuring Tape (Precision Tape, USA): Used to measure distances on the basketball court.
5. Official Basketballs (Wilson, USA): 15 legal-sized basketballs were used for the shooting tests.
6. International-Standard Basketball Court: Used for conducting shooting tests, adhering to official basketball regulations.
7. Colored Cones and Flags (Pro Sports Equipment, UK): Used to mark specific positions on the court.
8. Paper Boards and Colored Pens: Used for constructing and reviewing the Mind Gardens Strategy diagrams.
9. Digital Video Camera (Canon, Japan): Used to record and analyze player performance.

Training Protocol

The training protocol consisted of 8 weeks of training, with 3 training sessions per week. Each session lasted for 90 minutes and was divided into three parts: warm-up, main training, and cool-down. The experimental group followed a program incorporating the Mind Gardens Strategy, while the control group followed traditional training methods.

- Warm-up (15 minutes): General warm-up exercises followed by specific exercises aimed at preparing the players for shooting practice.

- Main Training (65 minutes):

oExperimental Group: Constructing and reviewing Mind Gardens Strategy diagrams, followed by practical shooting drills based on these diagrams.

oControl Group: Traditional shooting drills with verbal instruction and demonstration.

- Cool-down (10 minutes): Stretching exercises and relaxation techniques.

Data Collection

Data collection included several tests to measure long-distance shooting skills:

1. Five-Area Long-Distance Shooting Test: Players performed 25 shots (5 from each of 5 designated areas behind the three-point line), earning 1 point for each successful shot (maximum score = 25).
2. Long-Distance Shooting Speed and Accuracy Test: Players attempted as many successful shots as possible within 60 seconds from the three-point line, with the total number of successful shots recorded.
3. Long-Distance Shooting Under Pressure Test: Players performed 10 consecutive shots from the three-point line after completing 30 seconds of shuttle runs. One point was awarded for each successful shot (maximum score = 10).

Observation Forms:

- Personal and Anthropometric Data Form: Contained player details (name, age, training experience, height, weight, BMI).
- Shooting Test Results Form: Recorded the results of the three long-distance shooting tests (pre-test and post-test).
- Performance Observation Card for Long-Distance Shooting: Evaluated shooting technique in stages (ready position, stance, shooting phase, follow-through) on a 1-5 scale.
- Error Analysis Form: Recorded common shooting errors observed during testing.

Reliability and Validity

The validity and reliability coefficients for the tests were computed, showing strong validity and reliability, confirming the appropriateness of these tests for measuring long-distance shooting performance.

- Test-Retest Reliability: A test-retest procedure was carried out with a 1-week interval on a pilot sample of 10 players. The correlation coefficients ranged from 0.83 to 0.91, indicating high reliability of the tests.
- Content Validity: The tests were reviewed by 7 experts in basketball and sports measurement, confirming their appropriateness for measuring the intended skills.
- Discriminant Validity: The tests were applied to two groups (high-performing and low-performing), revealing significant differences in favor of the high-performing group, confirming the tests' ability to discriminate between performance levels, as shown in table 2.

Table 2. Statistical Measures for Tests

Test	Validity Coefficient	Reliability Coefficient
Five-Area Shooting Test	0.87	0.91
Long-Distance Shooting Speed and Accuracy	0.83	0.85
Long-Distance Shooting Under Pressure	0.85	0.83

Statistical Analysis

The statistical analyses were conducted using SPSS version 26 (IBM). Descriptive statistics (mean and standard deviation) were computed for all variables. An independent t-test was used to confirm the equivalence of the two groups. Paired t-tests were used to analyze the differences between pre-test and post-test scores within and between the groups, assessing the effect of the Mind Gardens Strategy on shooting performance. The significance level was set at $p < 0.05$ for all analyses.

Ethical Considerations

The study followed ethical guidelines, with informed consent obtained from all participants and their guardians before participation. The study protocol was approved by the relevant institutional review board.

Result and Discussion

The results of the pre- and post-tests in the experimental group on long-distance shooting performance are given in Table 3. The table is composed of three important tests, the Five-Area Shooting Test, the Long-Distance Shooting Speed and Accuracy Test, and the Long-Distance Shooting Under Pressure Test. Pre and post-test means (M) and standard deviations (SD) are listed for all tests.

The experimental group had a 5-area shooting test pre-test mean score of 15.67 (±3.82), which significantly improved after the intervention to 19.42 (±3.34). There was also a significantly favorable difference in this change, with a t-value of 9.38 (p=0.000). The percent increase for the test was found to be 23.93%, which suggested a significant improvement of shooting accuracy among the experimental group players.

Targeting: The Long-Distance Shooting Speed and Accuracy Test (LDSAT) The mean of the pretest = 6.25 (± 1.76), while the posttest mean was 8.33 (± 1.83). The mean difference between pre- and post-tests were also statistically significant (t = 7,84, p = 0,000), indicating a significant 33.28% improvement in shooting speed and accuracy.

Finally, regarding the Long-Distance Shooting Under Pressure Test, the pre-test mean score was 4.83 (± 1.34), and the post-test mean score was 6.50 (± 1.24). The increase in this test score was statistically significant (t-value=5.75, p=0.000) on the pretest, with a 34.58% gain. This indicates that among the experimental group footballers there was improvement in targeting, even under stress, post the intervention.

Table 3. Pre- and Post-Test Results for Long-Distance Shooting Performance in the Experimental Group

Test	Pre-Test (M ± SD)	Post-Test (M ± SD)	F-value	η^2	t-value	Significance (p-value)	Improvement (%)
Five-Area Shooting Test (Score)	15.67 ± 3.82	19.42 ± 3.34	3.75	0.399	9.38	0.000	23.93%
Long-Distance Shooting Speed and Accuracy (Count)	6.25 ± 1.76	8.33 ± 1.83	2.08	0.265	7.84	0.000	33.28%
Long-Distance Shooting Under Pressure (Score)	4.83 ± 1.34	6.50 ± 1.24	1.67	0.290	5.75	0.000	34.58%

Table 4 shows the results of pre- and post-test measurement for long-distance shooting ability in the control group. The mean (M) and standard deviation (SD) for each test at pre-test and post-test are presented in the table below, as well as the statistical data in terms of the F-value, η^2 (effect size), t-value, p-value, and % of improvement for each test. The three tests are Five-Area Shooting Test, Long-Distance Shooting Speed and Accuracy Test and Long-Distance Shooting Under Pressure Test.

The control groups pre- and post-test mean scores for the Five-Area Shooting Test were 17.42 (±3.53) and 15.92 (±3.65). It was a statistically significant decrease in their performance, reflected by the t-value of 5.20, p = 0.000 that there was a significant difference between their pre and post test results. Nonetheless, the control group had a negative percentage change -9.42%, meaning shooting accuracy was diminished during the training period.

In the Long-Distance Shooting Speed and Accuracy Test, mean score of pre-tests was 7.17 (±1.70) while in the post-test decreased to 6.33 (±1.67). Statistical analysis demonstrated a t-value of 3.77 and p-value of 0.003, indicating that there were significant differences between the pre- and post-tests stages. Regardless of the reduction in raw scores, the percent improvement increased to 13.27%, indicating that between the pretest and posttest period, there was a slight but discernible gain in shooting faster and more accurately on the part of control participants.

The pre-test mean score for the Long-Distance Shooting Under Pressure Test was 5.67 (±1.37) and post-test mean score was 5.00 (±1.41). The t-value (3.02) and p-value (0.012) indicate a significant performance decline, though performance P13:40% was maintained. This indicates that the players in the control group may have been capable of producing levels of shooting accuracy under pressure, but they did so less after the training phase.

Table 4. Pre- and Post-Test Results for Long-Distance Shooting Performance in the Control Group

Test	Pre-Test Mean (M ± SD)	Post-Test Mean (M ± SD)	F-value	η^2	t-value	Significance (p-value)	Improvement (%)
Five-Area Shooting Test (Score)	17.42 ± 3.53	15.92 ± 3.65	1.50	0.288	5.20	0.000	-9.42%
Long-Distance Shooting Speed and Accuracy (Count)	7.17 ± 1.70	6.33 ± 1.67	0.84	2.93	3.77	0.003	13.27%

Test	Pre-Test Mean (M ± SD)	Post-Test Mean (M ± SD)	F-value	η^2	t-value	Significance (p-value)	Improvement (%)
Long-Distance Shooting Under Pressure (Score)	5.67 ± 1.37	5.00 ± 1.41	0.67	0.22	3.02	0.012	13.40%

The t-test results of the differences of long-distance shot skill test post-test measurements of the experimental group and control group can be given as follows according to table 5: Five-Area Shooting Test, Long-Distance Shooting Speed and Accuracy Test, Long-Distance Shooting Under Pressure Test (Table 5). The means (M) and standard deviations (SD) of the two groups and these parameters, including the t-value, the p-value, the F-value and the effect size (η^2).

Experimental group trained on 5-area shooting test had mean posttest score of 19.42 (±3.34) and those of control group had mean posttest score of 17.42 (±3.53). The t-test revealed a t-value of 4.82 and p-value of 0.000 thus indicating there was statistically significant difference of the two groups. The large effect size ($\eta^2 = 0.68$) indicates that the intervention in the experimental group seriously affected the throwing accuracy.

The experimental group and the control group for the Long-Distance Shooting Task Speed and Accuracy Test scored a mean of 8.33 (±1.83) and 7.17 (±1.70), respectively. The t-value was 4.37, p-value was 0.000, and difference was significant. The value of 0.63 indicates a moderate to large effect size and represents a substantial gain in shooting speed and accuracy for the experimental group.

The experimental group scored a post-test mean of 6.50 (±1.24) on the Long-Distance Shooting Under Pressure Test, compared with 5.67 (±1.37) for the control group. The t was 3.95, and p was 0.001; the difference between control and SCATS was statistically significant. The effect size of $\eta^2 = 0.58$ revealed a small to medium effect and showed that the measure of the experimental group was greater than the control group under pressure.

Table 5. Results of the t-Test for the Significance of Differences Between the Post-Test Measurements of the Experimental and Control Groups in Long-Distance Shooting Skill Tests

Test	Experimental Group (M ± SD)	Control Group (M ± SD)	F-value	η^2 (Effect Size)	t-value	Significance (p-value)	Effect Size (η^2)
Five-Area Shooting Test (Score)	19.42 ± 3.34	17.42 ± 3.53	2.00	0.68	4.82	0.000	0.68
Long-Distance Shooting Speed and Accuracy (Count)	8.33 ± 1.83	7.17 ± 1.70	1.16	0.63	4.37	0.000	0.63
Long-Distance Shooting Under Pressure (Score)	6.50 ± 1.24	5.67 ± 1.37	0.83	0.58	3.95	0.001	0.58

Discussion

The present study had as its main purpose to analyze the effectiveness of the Mind Gardens Strategy in the performance of long-distance shoots of basketball players under 16 years old. The pre-to-posttest change scores of the EG (the intervention group) were significantly improved in all the tests including the Five-Area Shooting Test, the Long-Distance Shooting Speed and Accuracy Test, and the Long-Distance Shooting Under Pressure Test. The present findings also provide some support for the proposition that the Mind Gardens Strategy can be effective in enhancing shooting performance of basketball players.

Five-Area Shooting Test revealed a discernible increase of 23.93% in experimental group, which agreed with some researchers that the mental strategies like imagery and cognitive mapping have a positive effect on sports performance (Lu et al., 2020). Nevertheless, the control group showed a 9.42% reduction, which suggests that the traditional training was not as useful as the exer-gaming version for improving the shooting accuracy. This is consistent with the finding that mental techniques are an important component in the acquisition of skill through assistance in attention control, skill organization and visualization (Zureigat et al, 2023).

As for the Long-Distance Shooting Speed and Accuracy Test, an advantage of 33.28% in favour of the experimental group can be seen, this ratio representing the contribution of mental techniques in terms of the improvement of the accuracy and the speed of shooting. This result supports that of (Salimbayat, 2025), who highlighted the need of cognitive skills training, such as mental imagery, included in basketball training programs to increase the accuracy and decision-making. Control by contrast revealed a more modest gain (13.27%), indicating that while conventional practice can produce incremental gains, it is not as efficient in enhancing particular performance components such as. nomenclature speed.

The Long-Distance Shooting Under Pressure results showed that experimental group made a 34.58% more shooting, STAI, indicating that work with the Mind Gardens Strategy was effective in dealing with the pressure of competition. These findings are in line with those by (Meyers et al, 1982) (Paivio & Clark, 2006), who point out that mental strategies can lead to a beneficial influence of learning under pressure. The capacity to deliver under pressure is vital for sports and the findings of the present research suggests that the players who practiced with the Mind Gardens Strategy had an edge in being focused and consistent under intense circumstances.

These results imply that one hypothesis (that the Mind Gardens Strategy substantially increases long distance shooting performance in basketball) is upheld. The experimental group achieved better results than the control group for all measures, resulting in quite large effect sizes in all tests conducted (η^2 values of 0.68, 0.63 and 0.58). The findings from the current study are reiterated by several other studies within sports psychology and performance enhancement that suggest that it is essential that mental training intervention be incorporated into sport training programs (Rahman & Islam, 2021; Raiola et al., 2014).

Nevertheless, there are limitations of the present study that should be noted. Though the findings are hopeful, they were short-term findings over the course of 8 weeks only. It

would be interesting, however, to study the long-term effects of the Mind Gardens Strategy and whether they can also be applied on other sports. In addition, the sample size in the present study was limited, and more studies with larger sample sizes will be necessary to generalize these findings to a wider range of young athletes.

This study concluded that the Mind Gardens Strategy was effective in producing improvements in long distance shooting performance of athletes under 16 years old. The treatment group showed significant enhancement of their scoring, shooting, performance speed and under pressure, thus proving the hypothesis that mechanical rehearsal can improve sports performance while mental training will also be helpful. This is consistent with previous research on the role of mental training in sports and implies that including cognitive strategies in the training process might be a necessary condition for enhancing one's athletic performance.

Conclusion

The results of the present study indicate that the Mind Gardens Strategy works on desired and statistically significant variables on long distance shooting skill of basketball players under 16 years of age. The experimental group who implemented the strategy were significantly improved on all three modalities of performance measures; the Five Area Shooting Test, the Long-Distance Shooting Rate and Accuracy Test, and the Long-Distance Shooting Under Pressure Test. These benefits were statistically significant, and large to moderate effects of the intervention on shooting accuracy, speed, and pressure performance were found.

The findings substantiate the importance of incorporating cognitive training techniques, such as the Mind Gardens Strategy, within traditional physical training programs. The approach enabled players to structure and assimilate shooting methodologies, resulting in increased accuracy and speed. In addition, it was especially relevant for players to sustain their performance under pressure, an important criterion for basketball.

It also provides support for the notion that cognitive strategies can enhance performance in sports together with physical training. By not only increasing physical execution, but how players mentally see, reinforce, and understand these skills, the Mind Gardens Strategy offers a broader perspective to how players can improve their overall athletic performance. This is in line with the literature that shows that mental skills intervention including mental imagery and cognitive mapping is vital for enhancing sports performance.

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