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Traditional Educational Model vs. Educational Model of Teaching Games for Understanding for Teaching Long Badminton Service in Female Adolescents: Cross-Sectional Study

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Original Article

Abstract

Introduction: Learning is one of the important parts of life. There is not sufficient experimental evidence to support the effectiveness of different educational models. This study endeavored to compare the effect of traditional educational model and teaching games for understanding (TGFU) model on learning the long service skill in female adolescents.

Materials and Methods: For this quasi-experimental, cross-sectional study, 40 adolescent female students without experience of playing badminton were randomly divided into two groups of 20 as the traditional learning model group and TGFU model. Data were collected using the personal information questionnaire and Scott and Fox badminton long service test. The study consisted of pre-testing a set of attempts with 20 repetitions, acquisition stage (exercises in the style of traditional educational model and educational model of TGFU) for 12 sessions of 5 sets with 10 attempts according to the available manuals; the post-test (memorization) stage was one attempt with 20 repetitions. Data were analyzed by Friedman test for the intra-group comparisons and the Mann-Whitney test and the Wilcoxon test for intergroup comparisons at the significance level of 0.05.

Results: The results showed no significant difference between various categories of acquisition efforts ($P \geq 0.05$); however, the average rank of TGFU training model group was higher than that of the traditional training group. In the post-test comparison (0.75 to 1 point), the TGFU educational model group had a higher mean than the traditional educational model group ($P \leq 0.001$).

Conclusion: Based on the results obtained, it seems that the TGFU educational model can be proposed as a better educational model to replace the traditional skill-based educational model for training and coaching.

Keywords: Traditional educational model; Educational model of teaching games for understanding; Learning; Long service; Badminton

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Introduction

Learning is one of the sensitive parts of life that gives meaning to experience and practice, and improves human capabilities (1). Learning and increasing skills in a sport field and its techniques play an important role in the success of athletes and their enjoyment of the sport. Meanwhile, using the right educational approach plays a highly important role in the athlete's success (2). The use of traditional models has limitations such as poor transfer of skills to the target field and new educational models can partially solve these limitations (3). In traditional theories, skill

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acquisition is based on logical reasoning and verbalization, imitation, and internalization of informational and procedural knowledge (informative and procedural) using traditional methods or repetition of verbal instructions to understand the task. In other words, traditional methods are the type of educational model, in which the skill is first explained by the teacher. The underlying assumption of such an approach is that there is an ideal movement pattern for each task and the role of the practitioner is to help the learner to recreate that pattern (4).

Today, most of the physical education coaches and teachers are skeptical about the effectiveness of traditional models for teaching and acquiring sports skills. To know and use the optimal and efficient method in teaching different skills, many models and approaches have been presented by researchers (5). The use of models that deal with comprehensive education through the use of games provides an opportunity to create and expand cognitive, motor, and mental skills and, in general, to maintain the physical and mental health of a person (6). The teaching games for understanding (TGFU) approach has been developed based on the observations and reviews of technique-based models (7), because technique-based models (traditional) include fundamental points that can be criticized including the emphasis on performance in this approach, which leads to slight success in most people, and the techniques learned are inflexible and often not transferred to performance in the game (8). On the other hand, this method is structured both in classrooms and when teaching different skills, and it uses repetition to teach skills; thus, the learner does not widely enjoy the training when using this approach and has limited chance to participate in the game (9, 10). Although the main emphasis of this approach is on acquiring the necessary technical skills, at the same time, the cognitive skills necessary for effective participation in the game are not considered by the coaches, which causes the learners to fail in getting correct and practical skills and practice (8).

Researchers believe that technique-based approaches do not lead to achieving some important goals of training, including the implementation of the developed game and long-term participation in physical activities. Accordingly, TGFU has been introduced by researchers and coaches as a more effective model than traditional training models for teaching and coaching games (11). In the TGFU model, which is a tactic-based model, the learner learns to play the game with a priority on understanding tactics and strategies (12). This way, students are considered as active, social, and creative learners who construct their own knowledge and identify what needs improvement during the learning process (13). The basis of training in the TGFU method is that simple game techniques and methods are introduced first and, then, the main skill is practiced during the teaching process (14).

Therefore, although one of the goals of the TGFU approach is to help mastery and competence in the execution of skills (15), its main goal is to understand the game (7). From a cognitive point of view, when a person is trained in the TGFU model, s/he learns over time that s/he should make the best decision based on her/his ability and capability, as well as being aware of the task and at the right time (16). The TGFU model is a combination of appropriate variables that provide the necessary factors to improve the performance of the game (17). Considering that the learning environment in the TGFU approach is designed in a completely dynamic and enjoyable way, better performance is provided for learners via increasing the motivation and elevating the inclusive physical activity during education (7). The TGFU approach is in line with the principles of playing the game in relation to choosing the correct way of action and movement, as well as efficient and stable execution of the action during the competition (15). TGFU exposes individuals to game-like experiences earlier than usual (2, 16), which is achieved by introducing strategies and tactics through engaging in moderated games and it often includes aspects such as basic laws and other provisions (18). It is of note that this manner of teaching provides a valuable learning opportunity, in which the learner must re-evaluate the existing movement capabilities against the real needs of the environment.

While the TGFU approach improves decision-making, news and procedural knowledge (2), in general, there are very few studies on the efficiency of skill implementation in game conditions using the TGFU approach (19). It seems that with the TGFU approach, players are able to make correct decisions in the game (12, 15, 16, 18), while in the traditional approach, players have more problems in implementing their skills in game conditions (20). Game-oriented approaches focus on the simultaneous development of technical skills, tactical awareness, and decision-making through modified games (21). According to Light (22), if the conditions for learning are favorable and there is enough time for training through the TGFU approach, the TGFU approach has more potential than traditional approaches. The main goal of the TGFU approach is to develop technical skills, and thus this model emphasizes acquiring skills

first and technical skills are learned before introducing the rules and playing the game. Besides, game-based models such as TGFU increase a person's physical activity and improve cognitive and motor skills due to providing a dynamic and enjoyable environment (23). The interest and excitement of students in sports games and games are considered as a positive stimulus and as the dominant task structure in the pattern (24). In other words, students who always play the full sports game or some versions of it maintain their interest and excitement at the highest level; this way, their interest in learning activities increases (18). The main message of the TGFU model is to facilitate a deep level of understanding that can be used in sports games and playful situations and can be transferred to other similar sports games (25). The complexity of TGFU educational principles includes developing and adapting the form of sports to the student's developmental level (3). The focus is on operationally matching the tactical issues presented in these sports with the overall proficiency level. Referring to the classification of sports into four categories (8), first, it is recommended to teach goal-based sports that have the least complexity, then ball and net sports or ball catching, and, afterwards, offensive sports. This recommended process for teaching motor skills is consistent with the idea that there should be a match between task complexity and skill levels (17, 26). According to the motor development age of the students at the first secondary level, training of ball and net sports in terms of task complexity and skill level is suitable for these ages, namely, thirteen to fourteen years old (26).

Although the TGFU model has been of interest for educators (8), there is limited empirical evidence to support its effectiveness (9). Some teachers employ methods that are too hard or inappropriate for children and discourage them, instead of creating interest and learning. These methods not only reduce the attractiveness of the game, but also cause most learners to lose interest. On the other hand, beginners usually want to play, instead of learning difficult or complex techniques (5). Therefore, to learn the desired skill, it is desirable to have a greater impact on the trainees and to learn and remember more deeply and meaningfully. Considering the important and key role of badminton long serve in learning badminton and the low ability of people in this technique, this study endeavored to compare two teaching methods (traditional and TGFU) on learning badminton long serve in adolescent girls who had no history of participating in badminton. The main hypothesis was that using the TGFU method significantly improved the learning of this skill more than the traditional method.

Materials and Methods

This applied study was conducted in a cross-sectional, quasi-experimental manner after obtaining an ethics permit from Research Institute of Physical Education and Sports Sciences affiliated to the Iranian Ministry of Science, Research and Technology during May and June. The population was made up of all the female students of the first year of the seventh grade of secondary school in Qom, Iran (n = 12875). Sampling was done by convenience sampling method from the 7^{th} grade students of a school; the school officials, parents, and students declared their readiness to cooperate in this project. The data were collected in the aforementioned school. It is of note that because it seems that the learning of movement skills is different in boys and girls at this age (4), the study was designed only on female students with the aim of controlling the confounding effect of gender on the results.

Healthy female students aged 13 to 14 who had no experience playing badminton were used. If a student, based on medical documents and the report of the individual or parents, had an abnormality or underlying disease that affected her movement ability, she would be excluded from the study. Besides, if individuals did not attend more than three training sessions or did not want to continue training, they would be excluded from the research. After signing the informed consent form by the parents and participants, 40 individuals were selected after completing the personal information questionnaire and randomly divided into two groups. A lottery was used to randomly divide the participants into two groups. In this way, the names of the students were written on paper and put in a box; then, the names were taken out of the box one by one and the first person was placed in the traditional education group and the next in the TGFU education group, respectively; this process continued until the last person.

Execution method: For the traditional training group, i.e., the structured training environment, warm-up activities and skill repetition were considered as the main components, in which only the repetition of the task was emphasized, and the students had limited chance to participate in a real badminton game; therefore, cognitive skills (such as decision-making) were not considered for this group, namely, individuals were only forced to repeat a predefined pattern without having a choice to make a decision.

In the training group based on the TGFU model, a six-step process was designed. In the first stage, the game was introduced according to the level of the subjects. The second stage was the understanding of the game, in which the learners got to know the rules of the general game of badminton. In the third stage, learners developed a tactical awareness or understanding along with aspects such as knowledge of the rules of the game using previous experiences (e.g., holding a racket, catching the ball, hitting a serve, positioning to receive a serve, etc.).

The fourth stage included timely and appropriate decisions. In this stage, the learners developed the tasks that should be performed (tactical awareness) and learned how to perform them (choosing appropriate answers and implementing skills); the fifth stage was the performance of skills, focusing on how to perform special skills and movements. In the sixth stage, the performance score was recorded based on certain criteria, in the pre-test and post-test for 20 repetitions each and, on the training days, for 50 repetitions per day. To register points, certain areas on the badminton court and the score of sending the ball to that area were calculated based on the rules of the badminton game. If the ball landed on the lines, points were recorded, and balls that crossed the service line were not awarded points. Therefore, information was collected in three stages:

- Pre-test stage: In this stage, the subjects performed a set of attempts with 20 repetitions and their performance score was recorded (score range: 0 to 100).
- Acquisition stage (practice): In this stage, after the pre-test, both groups practiced the badminton long serve skill as described before for 12 sessions in four weeks. On even days, for one hour and 50 long serves in each session, in five categories with 10 attempts and according to the provided instructions, the performance and points of this stage were also recorded. The trainer was present in the training sessions and in the traditional training group, appropriate feedback was provided to the student whenever necessary to correct the movement pattern. In the TGFU group, appropriate feedback was provided regarding compliance with the rules of the badminton game (the score range of each category was 0 to 50, and the average of five set of attempts was recorded).
- Memorization test: After 48 hours of non-training, the post-test of the standard task (long serve execution) was performed as a set of 20 attempts based on Scott and Fox's long serve badminton tests (27) in two groups (score range: 0 to 100).

The validity of this test is about 54% and its reliability is reported at about 70%. To perform the test, a fully stretched and strong rope was installed at the height of 2.40 m from the ground and distance of 4.20 m from the net. Besides, the circles were drawn with chalk at the end corner of the field with the radius of 95, 75, 55, and 125 cm from the point of intersection of the longitudinal and transverse lines of the single-player field, and 20 cm lines were considered as circles. The examinee stood in the circles in the diameter of the opposite court and tried to send the ball to the circles with a long serve over the rope. If the ball lands inside the designated areas, the score of that area will be calculated; if the ball lands on the lines of the circle, it will score the smaller circle (5). Balls that do not cross the rope are not awarded points (Figure 1).

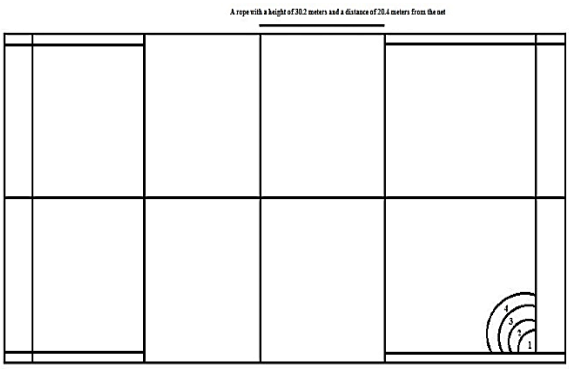

Figure 1. Arrangement of scoring circles on the playing field

Statistical method: Inferential statistics methods such as repeated measures analysis of variance (ANOVA), one-way ANOVA, MANOVA, and Bonferroni's post-hoc test were used to test the research hypotheses. A significance level of 0.05 was considered. The distribution of the data was checked with the Shapiro-Wilk test and the homogeneity of variances was checked with the Levene's test. Due to the non-normality of the data distribution, the Friedman test was used for intra-group comparisons and the Mann-Whitney U test for inter-group comparisons during the acquisition period. Moreover, in the pre-test and post-test stages, Wilcoxon signed-rank test was used for intra-group comparison and Mann-Whitney U test was employed for inter-group comparison. Data analysis was done with SPSS statistical software (version 26, IBM Corporation, Armonk, NY, USA) and the graphs were drawn with Excel software (version 2013, Microsoft Corporation, Redmond, WA, USA).

Results

All the individuals who volunteered to participate in the study completed all the stages of the study. In view of this, in this study, there was no attrition in any of the two groups (attrition rate = 0%). The general characteristics of the subjects by group are presented in table 1.

Table 1. Demographic information of participants in different groups

Variables	TGFU (n = 20)	Traditional education group (n = 20)	P value
Age (year)	13	13	> 0.999
Weight (kg) (mean ± SD)	56.55 ± 3.11	59.55 ± 3.74	0.624
Height (cm) (mean ± SD)	156.35 ± 3.68	155.70 ± 2.65	0.097
BMI (kg/m^2) (mean ± SD)	23.00 ± 0.20	25.00 ± 0.16	0.473

Multivariate analysis of variance (MANOVA) test to check the difference between groups in age, height, and weight variables; $P \geq 0.05$, there was no significant difference between the groups.
BMI: Body mass index; TGFU: Teaching game for understanding; SD: Standard deviation

As can be seen, there was no significant difference between the subjects of the two groups in terms of demographic variables. It is of note that age was only checked in terms of years and a more precise number (details of meter per year) was not collected.

The distribution of data for the category of pre-test efforts, acquisition on days 1, 4, 7, and 12 of the TGFU group, and for the category of acquisition efforts on days 4, 8, and 12 of the control group followed a normal distribution. Accordingly, all the intra-group and inter-group comparisons were performed using non-parametric statistics. Descriptive statistics of badminton long serve score in different time stages between the two groups of traditional training model and TGFU model are shown in table 2 and figure 2.

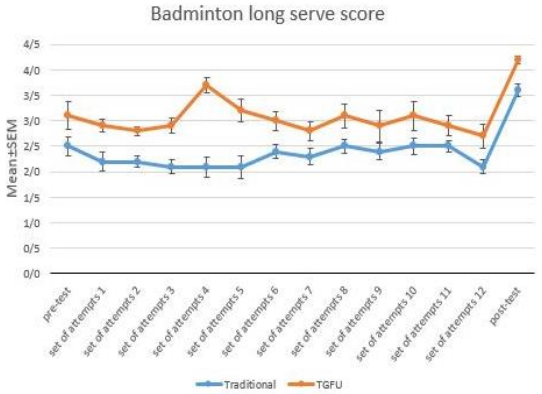

Figure 2. Average score of badminton long serve of groups in different stages

Table 2. Mean and standard deviation (SD) of groups in different stages

Steps	Group	Mean ± SD	P value (Intergroup)
Pre-test	Traditional education	2.50 ± 0.88	0.070
	TGFU	3.15 ± 1.22	
Acquisition - Day 1 set of attempts	Traditional education	2.20 ± 0.81	0.001
	TGFU	2.97 ± 0.54	
Acquisition - Day 2 set of attempts	Traditional education	2.25 ± 0.52	0.001
	TGFU	2.82 ± 0.40	
Acquisition - Day 3 set of attempts	Traditional education	2.15 ± 0.65	0.001
	TGFU	2.95 ± 0.70	
Acquisition - Day 4 set of attempts	Traditional education	2.10 ± 0.91	0.001
	TGFU	3.57 ± 0.67	
Acquisition - Day 5 set of attempts	Traditional education	2.15 ± 0.01	0.001
	TGFU	3.25 ± 0.99	
Acquisition - Day 6 set of attempts	Traditional education	2.40 ± 0.59	0.004
	TGFU	3.02 ± 0.88	
Acquisition - Day 7 set of attempts	Traditional education	2.35 ± 0.67	0.020
	TGFU	2.84 ± 0.80	
Acquisition - Day 8 set of attempts	Traditional education	2.55 ± 0.62	0.003
	TGFU	3.18 ± 1.04	
Acquisition - Day 9 set of attempts	Traditional education	2.42 ± 0.67	0.002
	TGFU	2.95 ± 1.42	
Acquisition - Day 10 set of attempts	Traditional education	2.52 ± 0.80	0.001
	TGFU	3.17 ± 1.26	
Acquisition - Day 11 set of attempts	Traditional education	2.50 ± 0.51	0.009
	TGFU	2.92 ± 0.93	
Acquisition - Day 12 set of attempts	Traditional education	2.15 ± 0.58	0.010
	TGFU	2.70 ± 1.10	
Post-test	Traditional education	3.57 ± 0.54	0.001
	TGFU	4.18 ± 0.36	

SD: Standard deviation; TGFU: Teaching game for understanding

As regards the examination of the badminton long serve score in the acquisition stage, due to the non-normality of the data distribution, two Friedman tests and twelve Mann-Whitney U tests were used. Therefore, the significance level was adjusted [Bonferroni adjustment: ($\alpha = 0.004 \frac{0.05}{14}$)]. Besides, in the examination of the badminton long serve score in the pre-test and post-test stages, due to the non-normality of the data distribution, two Mann-Whitney U tests and two Wilcoxon tests were used. Therefore, the significance level was adjusted [Bonferroni adjustment: ($\alpha = \frac{0.05}{4} = 0.013$)]. Friedman's test was used to examine the set of acquisition attempts (inter-group) in the traditional education group. The results showed that the main effect of the set of attempts was not significant [$\chi^2_{(11\ \&\ n\ =\ 20)} = 12.03$, P = 0.4]. As a result, no significant difference was seen between any of the acquisition set of attempts. In addition, comparing the pre-test and post-test scores of the traditional education group, the results of the Wilcoxon test showed a significant difference (P = 0.004, n = 20, Z = 2.9). The mean rank in the post-test phase (mean rank = 8) was higher than that in the pre-test (mean rank = 0) (Table 3), namely, the performance of people in the traditional education group was better in the post-test than the pre-test.

In examining the set of acquisition attempts (inter-group) of the TGFU group, the results of the Friedman test showed the main effect of the test was significant [$\chi^2_{(11\ \&\ n\ =\ 20)} = 25.5$, P = 0.008]. However, in pairwise comparisons, no significant difference was observed between the set of attempts. Comparing the pre-test and post-test scores of the TGFU group, the results of the Wilcoxon test showed a significant difference (P = 0.001, n = 20, Z = -3.2) and mean rank in the post-test stage (mean rank = 7.9) was higher than the pre-test stage (mean rank = 2) (Table 3), namely, the performance of people in the TGFU group was better in the post-test than the pre-test.

In examining the inter-group effects in the set of attempts, the results showed that in the first (P = 0.001), second (P = 0.001), third (P = 0.001), fourth (P = 0.001), fifth (P = 0.001), sixth (P = 0.004), eighth (P = 0.002), ninth (P = 0.004), and tenth (P = 0.001) sets of attempts, the mean rank of the TGFU training group was significantly higher than the traditional training group, that is, the TGFU group performed better than the traditional training group in this set of attempts. However, there was no significant difference between the two groups in the 7^{th} (P = 0.02), 11^{th} (P = 0.009), and 12^{th} (P = 0.01) sets of attempts (Table 4).

Moreover, in comparing the pre-test and post-test scores between the traditional and TGFU groups, the Mann-Whitney U test was used and the results in the pre-test stage showed no significant difference between the two groups (U = 264.5, n = 40, P = 0.07), but a significant difference was observed in the post-test stage (U = 329, n = 40, P = 0.001); the TGFU group had a higher mean rank (mean rank = 27) than the traditional education group (mean rank = 14.5) (Table 4). Accordingly, in the post-test, the performance of the TGFU group was better than the traditional training group.

Discussion

The study was conducted with the aim of comparing the traditional educational model with educational model of TGFU on teaching badminton long service in first secondary female students of Qom Province. According to the hypotheses related to badminton, the results revealed that in the acquisition phase, none of the traditional methods and TGFU had a significant effect on the performance, that is, the performance of the participants in different sessions was not significantly different from each other. But in the discussion of learning and comparison between the pre-test and post-test, the results showed that the participants in both groups made more progress than the pre-test. These results demonstrated the positive effect of physical activity on learning, which has been shown in different studies. The movement skills of the participants are improved by being placed in the training environment; this improvement can be due to the improvement of the degrees of freedom or the facilitation of the motor nerves, which leads the individual to perform the desired movement with better skill compared to the initial beginner state.

Learning and teaching in physical education is a complex field that must be examined from different perspectives.

Table 3. Results of the Wilcoxon test in examining the badminton long serve score between two stages in each of the groups

Variable	Group	Test	Z	P value	Mean rank
Badminton long serve score	Traditional	Pretest-posttest	2.9	0.004	Pre-test: 0 Post-test: 8
	TGFU	Pretest-posttest	3.2	0.001	Pre-test: 2 Post-test: 7.9

TGFU: Teaching game for understanding

Table 4. Results of the Mann-Whitney U test in examining the score of badminton long serve in different stages between two groups

Variable	Test	Group	U	P value	Mean rank
Badminton long serve score	Acquisition - set of attempt 1	Traditional-TGFU	91.0	0.001	Traditional: 15.5 TGFU: 26.0
	Acquisition - set of attempt 2	Traditional-TGFU	75.0	0.001	Traditional: 14.3 TGFU: 26.8
	Acquisition - set of attempt 3	Traditional-TGFU	86.0	0.001	Traditional: 14.7 TGFU: 26.3
	Acquisition - set of attempt 4	Traditional-TGFU	41.5	0.001	Traditional: 12.6 TGFU: 28.4
	Acquisition - set of attempt 5	Traditional-TGFU	84.0	0.001	Traditional: 14.7 TGFU: 26.3
	Acquisition - set of attempt 6	Traditional-TGFU	109.0	0.004	Traditional: 16.0 TGFU: 25.0
	Acquisition - set of attempt 7	Traditional-TGFU	122.0	0.020	Traditional: 16.6 TGFU: 23.6
	Acquisition - set of attempt 8	Traditional-TGFU	92.0	0.003	Traditional: 15.0 TGFU: 25.3
	Acquisition - set of attempt 9	Traditional-TGFU	90.0	0.002	Traditional: 15.9 TGFU: 25.8
	Acquisition - set of attempt 10	Traditional-TGFU	94.0	0.001	Traditional: 15.2 TGFU: 25.8
	Acquisition - set of attempt 11	Traditional-TGFU	115.0	0.009	Traditional: 16.3 TGFU: 24.8
	Acquisition - set of attempt 12	Traditional-TGFU	116.5	0.010	Traditional: 16.3 TGFU: 24.7
	Pre-test	Traditional-TGFU	264.5	0.070	Traditional: 17.3 TGFU: 23.7
	Post-test	Traditional-TGFU	329.0	0.001	Traditional: 14.5 TGFU: 27.0

TGFU: Teaching game for understanding

Athletes need physical, technical, tactical, and psychological skills to succeed in sports like badminton. Becoming an expert in tactical skills requires a better understanding of sports and training, which makes athletes more involved in training and increases their motivation to train (29, 30). The purpose of this research was to compare the traditional educational model and the TGFU educational model on learning the badminton long serve in adolescent girls. The results of the present study showed a difference between set of the acquisition attempts. Besides, the average post-test score of the traditional educational group was higher than the pre-test. In the TGFU training model, higher performance was observed than the traditional training model, which is a sign of the technical value of the TGFU training model compared to the traditional training model.

In other studies, the superiority of using the TGFU approach in improving the students' skills in the physical education course of the first secondary school (28), volleyball service (2), basketball tactics (31), and decision-making in soccer (35) was confirmed. In the TGFU group, the process of changes and gradual improvement of decision-making skills in the field of sports, choosing the right answer, or making the right decision is not necessarily related to successful performance (33). In different situations of the game, the target may be selected correctly, but assigning the right parameters for the selected movement program is the basic problem of the beginners. The two processes "what" and "how" are probably specific to complex motor skills such as games (34). Another important issue related to the improvement of TGFU group decision-making is the use of the educational principle of questions and answers, which in the context of moderated games improves decision-making (30). Questioning is a tool that can cause success in very complex situations because it directs the athlete's attention to important aspects of the game and obtains positive results (32).

There is a relationship between the duration of the game-based intervention and the performance of the skill (35). In the present study, the groups practiced for 12 sessions and each session was for one hour. It

seems this volume of training was effective and made progress. However, it is interesting to note that the differences between groups were not significant in terms of skill execution. Due to the appropriate number of practice sessions, the nature of the traditional group exercises changed gradually in the last sessions. In the first sessions, this group reviewed the important techniques, but at the end of the intervention period, the techniques were practiced practically, that is to say, they were practiced in increasingly challenging situations and in the form of moderated games. However, the questioning process was not used for this group and the coach used direct instructions when necessary to facilitate the flow of the training game in order to maintain the coach-centered nature of the traditional model; possibly, the practical practice of skills in the traditional group has caused the proper progress of this group in applying the taught techniques and the difference between the groups is not significant. As in accordance with Miller's conclusion (32), support in the game can be developed in short-term training courses (eight sessions) based on tactics (35).

In the transfer test, the TGFU group performed better than the traditional group, which is consistent with the findings of the study by Holt et al. (36). It seems that the exercises of this group, which were based on questions and moderated games, have led to the development of cognitive and decision-making skills. This development in decision-making is so deep that one can benefit from it even in the relatively more complex conditions of the full game. What is interesting is the superiority of the TGFU group's decision-making. If we consider the process of questioning in the form of modified games as a factor affecting the development of decision-making, the TGFU group has been involved in this type of learning process for a longer period of time.

On the other hand, some of the previous studies have not reported a significant difference between these two educational approaches (31, 37). Turner and Martinek (38) and Gómez-Criado and Valverde-Esteve (39) have used a tactical model and a technical model in two middle school field hockey lessons (the duration of these two lessons was different). In the shorter course, which was six weeks, no significant difference was observed between the effectiveness of the two approaches (tactical students showed greater improvement in two of the sports game performance variables). In the longer course, nine-week unit, tactical students showed greater improvement in practical knowledge and decision-making in the sports game.

The results showed that the mean rank of the TGFU training group was higher than the traditional training group in the category of efforts 1-2-3-4-5-6-8-9-10 and in the post-test stage. The findings of the study that used the TGFU model indicated that the players were able to make correct decisions in the game, and their procedural and news knowledge increased (2). The results of the study were probably due to the direct effect (17) of the TGFU approach on cognitive and motor skills. On the other hand, although traditional or technique-oriented teaching methods are mostly used in teaching specific sports skills, in this method, technique training in closed environments constitutes a large part of the course and there is not enough time for playing (40). What is clear is that learning a sports skill is a complex process that includes several components and there is a complex interaction between them (39). Among the factors affecting the process of acquisition and learning are the nature of the task, the experiences of people's motor intelligence, physical structure, and psychological conditions (41).

In the approach of dynamic systems and movement control, which seeks to respond to the existence of degrees of freedom, movement coordination is considered as a self-adjustment characteristic (42). In human movement systems, the interaction between the performer and the environment contributes to the formation of self-adjustment and self-organization behaviors (43). However, individuals use different coordination patterns to achieve task goals (44) and this issue has not been considered in traditional education approaches (45). On the other hand, the main slogan in the new approach to education is to provide the possibility of the emergence of these patterns of coordination and to pay attention to the dynamics of learning and the learner (4). In effect, encouraging the learner to explore is done to achieve the goals of the task while taking advantage of individuals' desires (4). In general, according to the results obtained from the study, the game-based education approach has the capacity to make students perform better than the traditional educational model.

Limitations

The psychological conditions of subjects during exercise, the type of nutrition of subjects before exercise, and the time interval between nutrition and exercise are factors that affect the results of such studies (4); however, it was not possible to check and control them in this study.

Recommendations

According to the results of this study, it is recommended to design studies to compare the effect of this educational model in both sexes. Based on similar research, the condition of functional mastery and movement diversity of the participants plays a role in the effect of the TGFU pattern (46). Due to the point that beginners were used in this study, it is suggested to compare the effect of this educational model on skilled individuals with beginners. Besides, it is desirable to investigate the kinematic model of badminton long serve with the presence of an opponent for a more detailed investigation of the best type of training model in real game conditions.

Conclusion

The results of this study showed that, in the acquisition stage, the performance of the participants in the traditional training group and the TGFU training group was not different. However, in the discussion of learning and comparison between pre-test and post-test, the results showed that the participants in both groups had progressed. These results represented the positive effect of physical activity on learning, which has been confirmed in various studies.

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Authors' Contribution

Study design and ideation: Tahereh Ghaffari
Getting financial resources for the study: Tahereh Ghaffari
Scientific and executive support to the study: Tahereh Ghaffari
Providing equipment and study samples: Tahereh Ghaffari, Marzieh Bilali
Data collection: Tahereh Ghafari, Mehdi Namazizadeh
Analysis and interpretation of results: Tahereh Ghafari, Mehdi Namazizadeh, Ismail Nasiri, Marzieh Bilali
Specialized statistics services: Tahereh Ghaffari, Ismail Nasiri
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Specialized scientific evaluation of the manuscript: Mehdi Namazizadeh, Marzieh Bilali, Ismail Nasiri, Tahereh Ghafari
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Maintaining the integrity of the study process from the beginning to the publication, and responding to the referees' comments: Mehdi Namazizadeh, Marzieh Bilali, Ismail Nasiri, Tahereh Ghafari

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Conflict of Interest

The authors have no conflict of interest. Tahereh Ghaffari is a PhD student in motor behavior, Islamic Azad University, Central Tehran Branch, Tehran, Iran. Dr. Mehdi Namazizadeh, is associate professor of motor behavior at Islamic Azad University, Khorasgan Branch, Isfahan, Iran. Dr. Marzia Balali is associate professor of motor behavior at Islamic Azad University, Central Tehran Branch, and Dr. Ismail Nasiri is associate professor of motor behavior at Shahed University, Tehran.

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