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## Benefits of exposing pre-service physical education teachers to the mini-volleyball format

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### Abstract

Several students have less contact time in class. Physical Education Teachers Education programs have the responsibility to prepare pre-service teachers (PSTs) with effective educational approaches that address this issue. Modified games have emerged as a pedagogical framework that promotes participation and physical activity. Mini-volleyball is a modified game of the sport of volleyball. The purpose of this mixed-method study was to compare the mini-volleyball approach to traditional volleyball in three areas: (a) amount of contact with the ball per rally, (b) amount of moderate and vigorous physical activity levels (MVPA), and (c) perceptions of PSTs regarding which format is more appropriate for teaching in PE classes. A purposive sample of 24 Physical Education PSTs participated in the study. A mixed method was selected for this study. The mixed method allowed the use of quantitative methods to compare the mini-volley format (4 vs. 4) with the traditional format (6 vs. 6) in relation to the amount of contact with the ball per rally and their levels of physical activity. In addition, it permitted the implementation of qualitative techniques to collect information about how participants perceived both formats from a curricular viewpoint. Skills rubrics, written reflections, accelerometer, and video analysis served as data collection techniques. The Wilcoxon signed-ranked test ( $p < .05$ ) and a priori coding were used to analyze the results. Findings of the study showed a significant difference ( $p < .0001$ ) between mini-volleyball ( $M = 8.91$ ) and traditional ( $M = 5.56$ ) in total contact per rally. However, there was no significant difference ( $p = .271$ ) between mini volleyball ( $M = 2.60$ ) and traditional ( $M = 3.03$ ) regarding MVPA levels. PSTs perceived that the mini-volleyball format was a more appropriate approach than traditional for beginners.

**Keywords:** Mini-volleyball, physical education teacher education programs, physical education pre-service teachers, modified games, physical activity

### Introduction

Physical education (PE) teachers are facing many challenges to teaching PE than ever before (Hodge *et al.* 2017) [17]. Several studies have reported that students have less contact time because of larger class sizes (Barroso *et al.*, 2005; Mckenzie & Lounsbery, 2009) [1, 4, 24]. The participation or contact time is essential for the development of physical literacy in individuals (Magill, 2011) [21]. Therefore, it is very important for Physical Education Teacher Education programs (PETE) to prepare pre-service teachers (PSTs) with effective educational approaches that address current issues. PETE should provide structured learning experiences for PSTs to develop their own identities as teachers (Lee & Jo, 2016). Research on pre-service PE indicates that PSTs identity can be influenced by their previous experiences with PE during their school years and by their experiences in PETE (Lee & Jo, 2016; Hyndman, 2014; Fletcher, Mandigo, & Kosnik, 2012) [13, 20]. Thus, the perceptions of PSTs regarding modified games, in terms of contact time, participation, and physical activity, can influence PSTs' teaching style.

Modified games have emerged as a pedagogical framework to teach different sports in the PE field (Nathan 2015; Arias, Argudo, & Alonso, 2011) [2, 26]. Simplifying, adapting, and modifying PE activities and games can be beneficial for student learning (Griffin & Butler, 2005) [16]. Moreover, various studies have reported that modified games increase participation during playing time, improve decision making, and physical activity (Bélka *et al.*, 2016; Clemente *et al.*, 2015 Mahedero *et al.*, 2015; Danielle *et al.*, 2014; Van Acker *et al.*, 2010;

Arias, Argudo & Alonso, 2009; Gray & Sproule, 2009; Piñar *et al.*, 2009; Martens, Rivkin, & Bump, 1984) [5, 6, 9, 15, 23, 27].

Hence, this alternative approach is viable to promote more participation and physical activity in PE classes.

To expose students to a wide variety of sports and movement activities, many PE curricula recommend a series of units across an academic year (EACEA, 2013). The sport of volleyball has been implemented as an educational unit to enhance student's skill development and promote physical activity (D'isanto, Altavilla, & Raiola, 2017; Galamandjuk *et al.*, 2017) [10, 14]. However, because of the complexity of the learning and teaching process, various methods are required to initiate volleyball practitioners (da Silva *et al.*, 2007) [8]. For that reason, the modified version of the context of volleyball (mini-volleyball) could play a vital role in increasing student participation and physical activity levels. The concept of mini-volleyball is a modified game from the sport that has been used worldwide as a framework for teaching (Vôlei, 2016; Sample & Waitl, 2012; Kessel, 2009) [19, 28, 32]. The main purpose of the mini-volleyball approach emphasizes adapting the sport of volleyball to the learner's developmental level (mini-volleyball, 2016). To achieve this, the size of the court, the number of players, and height of the net are reduced. A lighter ball made of a softer material is also used. Therefore, this alternative approach could provide an opportunity to address student less contact time, participation, and physical activity issues.

## Methods

### Participants

The participants were selected from a purposive sample (Etikan, Abubakar, & Sunusi, 2015) [11, 28]. A total of 24 PSTs between the ages of 18 and 24 and consisting of 10 women and 14 men participated in the study. To be eligible to take part in the study, participants had to be undergraduate students in the PETE and be enrolled in the Fundamentals of Teaching Volleyball course. The investigation was approved by the University of Puerto Rico in Rio Piedra's Institutional Investigation Committee for the Protection of Human Rights.

### Data collection

#### Analytical Check-list Rubrics

The analytical rubrics allowed the identification and measurement of specific criteria (Shaw, 2014) [29]. In this study, three analytical check-list rubrics were used for evaluating participants' performance in underarm serve, forearm pass, and overhead pass. The rubrics were validated by a panel of 3 experts in the field of volleyball. The experts were PE teachers who have coaching experience in professional leagues and have coached Puerto Rico volleyball national teams. The rubrics were utilized to evaluate the skills levels of the participants.

#### Participant Classification Rubric

The participant classification rubric was implemented after the three fundamental skills were evaluated. The purpose of this rubric was to classify the participants into three categories according to volleyball skills: (a) beginners, (b) intermediate, and (c) advanced. To be classified as advanced, the participants had to have demonstrated mastery domain of the three basic skills that were evaluated, while to be classified as intermediate only 2 of the 3 skills had to be mastered. The participants who only mastered one skill or none of the skills were classified as beginners. The classification of the participants was used to balance the ability levels of the

teams.

### Table to Number of Contacts per Rally

A special checklist to count the number of contacts made with the ball during rallies was utilized. The three researchers used the checklist to count the number of contacts that participants had with the ball. Video-recording was used to validate the contacts reported by the investigators.

### Accelerometer

The accelerometer is a monitor that measures the acceleration of the person when they move. This is one of the most reliable instruments used to measure a person's physical activity (Aguilar Cordero *et al.*, 2014) [1]. This study utilized accelerometer technology to objectively measure the time that participants spent in moderate and vigorous physical activity levels (MVPA) during intervals of play. To measure MVPA during the intervals, an accelerometer attached to the waist with an elastic band was used.

### Reflexive questions

Reflexive questions help to evaluate the phenomena in question. Reflecting on their experiences is a fundamental process that helps PSTs shape their identities (Coulson & Harvey, 2013) [7]. After the intervention, three open-ended reflexive questions were used to obtain information about the participant's perceptions of the traditional game of volleyball and mini-volleyball. The first one was to obtain PSTs perceptions on which format provides players more opportunities to contact the ball. The second question was to acquire PSTs perceptions of which format promotes more physical activity. Finally, the third question addressed the phenomenon of which format PSTs would use in their futures to teach the game of volleyball.

### Research design and procedure

A mixed method was selected for this study. The mixed method research allowed the investigator to capitalize on the strengths of the different methods (Wiersma & Jurs, 2009). The mixed method allowed the use of quantitative methods to compare the mini-volley format (4 vs. 4) with the traditional format (6 vs. 6) in relation to the amount of contact with the ball per rally and participants' levels of physical activity. In addition, it permitted the implementation of qualitative techniques to collect information about how PSTs perceived both formats from a curricular viewpoint.

The procedure began with the study's approval granted by the Institutional Investigation Committee for the Protection of Human Rights. After the study's approval, students from the Volleyball Fundamentals course were invited to an orientation meeting. At this meeting, the details of the study were explained, questions answered, and they were provided informed consent to participate. Those who were interested in participating in the study turned in their consent forms before or on the deadline.

After the recruitment process, the researchers evaluated the participants' mastery of three fundamental skills in volleyball (underhand serve, forearm pass, and overhead pass). Participants were classified according to their level of execution: (a) beginner, (b) intermediate and (c) advanced. Four teams of 6 participants were formed using the traditional volleyball format and participated in four 10-minute intervals during a 90-minute period. A 10-minute rest period was provided in between each interval. For the mini-volleyball format, a total of four teams comprising four players

participated in four 10-minute intervals during a 90-minute period. Ten-minute rest periods were provided between each interval. Participants were reduced to 16 participants (7 women and 9 men) because 5 participants withdraw for the second intervention and 2 were injured in activities not related to the investigation. The height of the net was reduced to 2.18 from 2.24 meters and the dimensions of the court to 12 meters long and 6 meters wide. Additionally, participants could only use the underhand serve and were not allowed to change positions once the ball was in play.

The participants used an accelerometer to measure the level of physical activity during the 10-minute intervals. Three researchers were tasked to count the number of contacts the participants had with the ball. Video-recording was used to validate the number of contacts registered by the investigators. Upon finishing both approaches, the participants completed a written reflection regarding their perceptions of the implementation of traditional volleyball and mini-volleyball.

### Data analysis

The statistic program, Stata 14, was used for the quantitative analysis. The Wilcoxon signed-rank test was used to determine any significant difference between the traditional volleyball and mini-volleyball formats in the following areas: (a) the number of contacts with the ball per rally, (b) the number of times that the rally ended with at least two contacts, (c) the number of times that the rally exceeded 10 contacts or more, and (d) the time spent in MVPA. To determine significant differences among the variables a  $p < .05$  was used.

To analyze the qualitative data, an a priori coding system was used in this study. This system allowed the researcher to establish three categories based on the theme of each reflexive question to accommodate the analytical units. Analyzing the data and writing down initial interpretations were the first steps in the data analysis procedure. This process focused on understanding the participants' intentions and meanings rather

than coding. The second step consisted of revisiting the research questions. It allowed the investigators to refresh their minds about the lenses to use when coding the data. The third step consisted of coding the data. During the coding process, the researcher read and re-read the data and divided it into meaningful analytic units. The process ended when there were no more analytic units to identify. Then, the researcher assigned a category to the analytics units that were identified during the coding process based on the reflexive questions.

## Results

### Contacts per rally

Tables 1, 2, and 3 show the results related to the number of contacts per rally. There was a significant difference among the three variables analyzed: (a) total contacts per rallies, (b) rallies with two contacts or less, and (c) rallies with 10 contacts or more. There was a significant difference ( $p < .0001$ ) between the total contacts made per rally in mini-volleyball ( $M = 8.86$ ) and traditional volleyball ( $M = 5.56$ ). Another significant difference between the two approaches (mini-volleyball/traditional volleyball) was the total of rallies ended with two contacts or less ( $p = .029$ ) and the total number of plays that exceeded 10 contacts or more ( $p = .029$ ). There were fewer rallies of two contacts or less in mini-volleyball (12.44%) than traditional volleyball format (31.94%). There were more rallies of 10 contacts or more in mini-volleyball (35.75%) than traditional volleyball (16.66%). In mini-volleyball format, the average number of contacts per player per play was doubled with 1.08 compared to traditional volleyball with 0.47.

**Table I:** Total Contacts per Rally

Game Format	M	Median	Range	p
Traditional Volleyball	5.56	4	1-38	< .0001
Mini-Volleyball	8.91	7	1-55	

Wilcoxon signed-rank test

**Table II:** Total Number of Rallies with Two Contacts or Less

Game Format	Total Rallies	Total Rallies with 2 contacts or less	%	p
Traditional Volleyball	216	69	31.94	.0294
Mini-Volleyball	193	24	12.44	

Wilcoxon signed-rank test

**Table III:** Total Number of Rallies with 10 Contacts or More

Game Format	Total Rallies	Total Rallies with 10 contacts or more	%	p
Traditional Volleyball	216	36	16.66	.0292
Mini-Volleyball	193	69	35.75	

Wilcoxon signed-rank test

Table IV shows the results of the minutes in which the participants were MVPA while participating in both game formats. The results indicate that there was no significant difference ( $p = .2706$ ) between the format of mini-volleyball and traditional volleyball regarding the number of minutes that the participants were in MVPA during the 10-minute intervals.

**Table IV:** Minutes of Moderate to Vigorous Physical Activity (MVPA)

Game Format	M	Medium	Range	p
Traditional Volleyball	3.03	2.50	0-10	.2706
Mini-Volleyball	2.60	2.00	0-10	

Wilcoxon signed-rank test

### Teacher's Perceptions

The results of the reflexive questions exhibited three emergent themes that fit within the three pre-established categories: (a) mini-volleyball provided more opportunities for contact with the ball compared to traditional volleyball, (b) the number of players and court sizes influenced PST's perceptions of which format promoted more physical activity, and (c) the mini-volleyball format was more appropriate for teaching beginning learners.

Mini-volleyball provided more opportunities for contact with the ball than traditional volleyball. All of the participants understood that the mini-volleyball format provided more opportunities for contact with the ball than traditional volleyball. The two-principle reasons that the participants

identified were the modifications of the size of the court and the reduction of the number of players per team. This was expressed as follows:

"This style of game gave me more opportunity to have contact with the ball. The limited space and the number of players allows more active participation in the game."

"Mini volleyball promotes a more significant role [for] the player in the game, unlike traditional volleyball. The modified rules and number of players allow more participation in executing the fundamentals skills of the game."

"In mini-volleyball, the students have a greater opportunity for contact in each play. The modification in the reduction of players and the size of the court provide a better opportunity to have contact with the ball."

The number of players and court sizes influences PRTs perceptions on which format promote more Physical Activity. Half of the participants expressed that the mini-volleyball format promoted greater physical activity than the traditional format. The participants' perceptions were founded in that there was greater physical activity owing to fewer players on the court. This understanding was expressed as follows:

"Mini-volleyball promotes more physical activity because having fewer players increases the probability of having contact with the ball."

"The model that I consider that promotes more physical activity is the mini-volleyball because the modifications of the rules (4 vs. 4) that keeps you active at all times looking for contact with the ball."

"The mini-volleyball model promotes more physical activity since the number of players is smaller and the probability of having a contact with the ball is greater along with the limited space of the court; the student is in constant movement."

The other half of the participants indicated that traditional volleyball promoted more physical activity than mini-volleyball. All of the answers were the result of the larger court size and were expressed as follows:

"The size of the court in the traditional volleyball format encourages one to move more."

"In traditional volleyball, the size of the court is greater; therefore, there is more space to cover."

The mini-volleyball format is more appropriate for teaching beginners. All of the participants insisted that the mini-volleyball format was the most appropriate teaching format for individuals who are learning to play volleyball. Among the reasons given: (a) a better context for learning the techniques of the games because of the modifications, (b) greater contact with the ball, and (c) greater participation. This theme was expressed as follows:

"I consider mini-volleyball is suitable to teach a group of beginners because the rules and the size of the court are modified, and it is more beneficial to acquire more learning."

"For beginners, I consider the mini-volleyball better because there is more control of the ball and there is more participation, and with that, you can learn the technique more easily."

"For a group of beginners, I would use the mini-volleyball since they will have more contact with the ball and they will have more participation."

## Discussion

PE teachers must be creative in the designing of game scenarios that promote contact time and participation. One of the best means for an individual to improve any skill is through repeated practice (Magil, 2011). Therefore, the mini-volleyball format is an appropriate approach to increase

participation and contact times among participants. The results of this study support the findings of previous investigations of modified games that reported greater participation during the game's activities (Mahedero *et al.*, 2015; Nathan, 2015; Arias, Argudo, & Alonso, 2009; Gray & Sproule, 2009) [2, 15, 22, 26]. The increase of contact and participation could be attributed to the modified rules (Arias, Argudo & Alonso, 2009) [2]. The different mini-volleyball rules modifications promote the increase of contact with the ball per rally owing to the reduced number players and the size of the court. Having fewer players on the court and covering less space compared to traditional volleyball allows a greater probability to have more contact with the ball.

The underarm serve rule in the mini-volleyball format played a vital role in increasing the number of contacts per rally. During the mini-volleyball format, rallies were longer in number of contacts because of the underhand serve rule modification with 12.44%, compared to traditional volleyball, where 31.44% of the plays ended because of the serve (serve error, direct serve, or a serve that the opposing team could not control.). The underarm rule can be important when working with beginners since the goal should be to increase the number of contacts during rallies to improve the learners' experience. If the plays end because of the serve, the learning is significantly limited.

The game of volleyball is an open and dynamic system where an innumerable number of variables constantly change (Storey & Butler, 2013) [30]. The more quickly the learner experiments with the variables and the dynamics of the game, the quicker they will be able to develop the cognitive aspects of the game. In contrast to traditional volleyball, the participants had more opportunity to explore the variables and dynamics of the game with the mini-volleyball format owing to the modified rules that promote more participation and contact time with the ball. It is important to note that mini-volleyball not only provides a favorable context to develop the learners' physical motor skills but also allows more opportunities for the development of the cognitive component.

Contrary to modified games research (Bělka *et al.*, 2016; Clemente *et al.*, 2015; Van Acker *et al.*, 2010) [5, 6, 31] the results of the levels of physical activity indicated that there was no significant difference between the formats. However, these results are extremely important because it shows that mini-volleyball did not significantly reduce the players' levels of physical activity because of the reduced court size. From a pedagogical perspective, mini-volleyball offers better conditions for the learner to develop motors skills and cognitive components about the sport of volleyball without sacrificing the levels of physical activity related to traditional volleyball.

The results of this study are aligned with PETE programs in relation that PST experiences in teacher education programs influenced teacher's candidate identity (Lee & Jo, 2016; Fletcher, Mandigo, & Kosnik, 2013) [13, 20]. During this investigation, participants experienced the strengths and weaknesses of both formats and through a reflective process concluded that mini-volleyball is more appropriate for teaching the game of volleyball to beginners. Participants explained that mini-volleyball, because of the rules modification, provides a better context for student learning. They were all aware that in mini-volleyball students have more participation and contact time, which are two challenges that PE teachers are confronting in the field.

There was an erroneous perception about the levels of physical activity in both formats. The results indicated that there was not a significant difference between the formats, even though some of the participants mentioned that there was a greater level of physical activity in mini-volleyball because of fewer players or that there was greater physical activity in traditional volleyball because the court size is larger. Clarifying these erroneous perceptions is important because it allows the educator to plan objectives that can be achieved.

### Conclusions

The results of this investigation showed that mini-volleyball increased contact time and participation. Mini-volleyball's modified rules contribute to promoting more opportunities to develop physical literacy in individuals. PSTs should consider mini-volleyball as an alternative for teaching the sport of volleyball. PETE programs should provide more experience-based learning for PSTs to explore different teaching formats that contribute to their teacher's identities. It is suggested that further research must focus on the impact of mini-volleyball in the school context.

**Conflicts of interest:** If the authors have any conflicts of interest to declare.

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