Integrating the Inducement of Cognitive Conflict into the Pedagogical Model of the Tactical Approach to Teaching Volleyball Tactics in Physical Education

I. Mastrogiannis[1], P. Antoniou[2], S. Sotiriou[3], & V. Gialamas[4]

Abstract

The aim of the study was the integration of the teaching strategy of inducing cognitive conflict in the context of the tactical approach of TGfU (Teaching Games for Understanding) to teaching game tactics in PE and the comparison of its effectiveness to the dominant pedagogical model of the technical approach. 140 8th grade students from all public schools of Mytilene, Greece, participated in the study. Two 45-minute teaching interventions were realized, whereas students completed a previously validated volleyball tactics questionnaire on a pretest and posttest basis. While no statistically significant improvement was exhibited in both the control group and the typical teaching strategy group, results recorded statistically significant increase in the adoption of the accepted tactics conceptions in the discipline by students involved in the constructivist orientation intervention. The study confirmed that students' active cognitive engagement in the construction of their knowledge constitutes a more effective teaching strategy than the typical teaching strategy of demonstration, explanation and practice, which perceives learning as a reproductive process. Moreover, the consideration of student preconceptions in the formulation of the appropriate questions for inducing cognitive conflict provides a promising teaching proposal in the context of the dialectical methodology of the tactical approach of TGfU.

Keywords: Physical Education; tactical approach; TGfU; cognitive conflict; moderate constructivism; preconceptions

1. Introduction

1.1. Pedagogical models to teaching games in Physical Education

---

[1] Department of Physical Education and Sport Science, Democritus University of Thrace, 69100, Komotini, Greece, +306972703448, iakomas@sch.gr

[2] Department of Physical Education and Sport Science, Democritus University of Thrace, 69100, Komotini, Greece, +306946044470, panton@phyed.duth.gr

[3] Experimental Senior High School of Mytilene, G. Papandreou str., 81100, Mytilene, Greece,

[4] Department of Early Childhood Education, University of Athens, Navarinou 13A, 10680, Athens, Greece, bgialamas@ecd.uoa, Corresponding author Email: iakomas@sch.gr

Despite the enrichment of curricula with new activities, the time devoted to games has not diminished (Brooker, Kirk, Braiuka, & Bransgrove, 2000; Gubacs-Collins, 2007), reaching more than 65% of the total time in Physical Education (PE) classes (Werner, Thorpe, & Bunker, 1996). The dominant behavioral theory to teaching sports and games in school PE adopts a 'coaching' approach (Light, 2008, p. 23), i.e. the teacher-centered, direct teaching strategy of the technical approach (Bell, 2005; Gubacs-Collins, 2007; Kirk, 2010; Light, 2008), where demonstration and necessary explanations are first provided, followed by practice (Gubacs-Collins, 2007; McKeen, Webb, & Pearson, 2007). Indeed, it has been observed that PE teachers exhibit greater resistance in adopting student-centered teaching approaches than teachers in other disciplines (Light & Georgakis, 2005) and a preoccupation with the physical aspects of learning while cognitive aspects remain marginalized (Bell, 2005; Light & Fawns, 2003). The pedagogical model of the technical approach focuses the acquisition of technical skills (Dyson, Griffin, & Hastie, 2004; Kossiva & Hatziharistos, 2007; Light, 2008; Webb & Pearson, 2008), isolated from the context of the actual game in which they unfold and prior to the understanding of the game and its tactics (Adam, 2013; Brooker et al., 2000; Bunker & Thorpe, 1986; Kirk & MacPhail, 2002; Light, 2008; McKeen et al., 2007). As a consequence, the application of the technical approach has resulted in an inability to transfer these technical skills in the actual game (Adam, 2013; Kirk & MacPhail, 2002; Turner, 1996b) and in decreased participation and alienation of students from physical activity (Johnston, Delva, & O' Malley, 2007; Tsoulfas, Avgerinos, & Kampas, 2011; Webb & Pearson, 2008).

In the search of more effective teaching, there has been observed a generalized shift in education since the late '80s from direct, teacher-centered teaching models to indirect, student-centered constructivist models which emphasize active involvement of the student in the construction of knowledge (Cakir, 2008; Driver, 1989; Limòn, 2001; Sjoberg, 2010). In PE, the constructivist philosophy's tactical approach to teaching games offers an attractive alternative (Light, 2006; Light, 2008), addressing the issue in an holistic manner (Dyson et al., 2004; Webb & Pearson, 2008) by incorporating the cognitive aspect of learning into PE teaching (Brooker et al., 2000; Griffin, Brooker, & Patton, 2005; Webb & Pearson, 2008). It focuses on teaching students why a skill is needed before teaching it (Griffin et al., 2005), since "students learn best if they understand what to do before they understand how to do it" (Butler, Griffin, & Nastazi, 2003, p. 215). Emphasis is placed on the need for student engagement at high levels of cognitive processing, like tactics, decision-making, problem-solving, that are considered essential for learning (Adam, 2013; Kirk, 2005; Kirk & MacPhail, 2002; Webb & Pearson, 2008). Therefore, students are introduced to actual game-playing from the beginning or to modified forms of games depending on student developmental level (Grehaigne, Richard, & Griffin, 2005; Kirk & MacPhail, 2002).

The PE teacher's role in the learning process becomes that of the facilitator and mediator (Dyson et al., 2004; Mitchell, Griffin, & Oslin, 2006; Pill, Penney, & Swabey, 2012). Thus, a more dialectical approach is adopted (Stolz & Pill, 2014) that utilizes pedagogically appropriate questions (Bell, 2003; Chatzipanteli & Digelidis, 2012; Griffin & Sheehy, 2004; McNeill, Fry, Wright, Tan, & Rossi, 2008; Mitchell et al., 2006) in an authentic learning environment related to real-game situations (Dyson et al., 2004; Pill et al., 2012). Students are provided with opportunities to collaboratively investigate and solve tactical and strategic problems (Light, 2008) that facilitate the construction of their knowledge (Dyson et al., 2004). Nonetheless, technical skills are not neglected (Kirk & MacPhail, 2002; Thorpe & Bunker, 2010) but exercised after the need emerges in the game situation (Grehaigne et al., 2005; Griffin et al., 2005). In contemporary PE, the pedagogical model of the tactical approach is reflected in student-centered models such as Bunker and Thorpe's (1982) TGFU and an assortment of its variations.

1.2 Inducing cognitive conflict and the role of student preconceptions

A fundamental principle in the constructivist paradigm is the consideration that, even before their participation in formal school teaching, students has accumulated experiences and have already formed pre-existing conceptions (preconceptions) on a variety of matters (Driver, 1989; Duit, Treagust, & Widodo, 2008; Limón, 2001; Piaget, 1929). In turn, these preconceptions affect the way they interpret, organize and process new information (Driver, 1989; Duit et al., 2008; Piaget, 1929). PE does not constitute an exception on the issue, which means that students come to PE classes with prior experience. Their exposure to mass media, as well as teaching in PE classes itself, have already shaped their preconceptions regarding the common cultural forms of sports and games (Kirk & MacPhail, 2002). Thus, since student preconceptions constitute the supportive framework upon which all future learning is based (Driver, 1989; Millar, 1989; Vosniadou & Mason, 2012), their investigation entails serious implications to both teaching and learning. A fortunate finding is the commonality that student preconceptions exhibit in several science content areas (Driver, 1989; Sjoberg, 2010; Tan et al., 2008; Vosniadou & Brewer, 1987).

In addition, while the behaviorist learning theory views learning as an accretion of new knowledge in memory (Hewson & Hewson, 1983; Scott, Asoko, & Driver, 1991; White & Gunstone, 1989), the constructivist paradigm views learning as a process of change in student's preconceptions, i.e. as a process of conceptual change (Hewson & Hewson, 1983, Limón, 2001; Scott et al., 1991; White & Gunstone, 1989). The notion that a state of inconsistency or conflict between a student's preconceptions and new knowledge is highly likely to facilitate conceptual change -i.e. learning-, has been formulated since the beginning of the 20th century.

It constituted the driving force for a substantial body of research on the effect of the teaching strategy of inducing a conflict, on a cognitive level (Limòn, 2001; Snyder & Feldman, 1977; Tsai & Chang, 2005), namely a cognitive conflict. However, in order to effectively induce cognitive conflict, knowledge of student preconceptions is considered to be a prerequisite (Limòn, 2001; Millar, 1989; Scott et al., 1991). Based on this knowledge, the teacher is enabled to develop those learning activities that will lead students to the recognition of a contradiction, a problematic situation to which they fail to provide a solution based on their preconceptions (Hewson & Hewson, 1984; Limòn, 2001; Scott et al., 1991). When students recognize a cognitive conflict, this recognition itself motivates them to resolve the conflict, either by trying to reorganize existing conceptions or by seeking new information (Berlyne, 1965; Biggs, 1990; Keller, 1987; Piaget, 1980; Posner, Strike, Hewson, & Gertzog, 1982). In spite of its extensive use in science and the recognition of its effectiveness (Cakir, 2008; Vosniadou & Mason, 2012), no remarkable dissemination of the strategy has been recorded in PE teaching.

1.3. Aim of the study

The aim of the study was the integration of the teaching strategy of inducing cognitive conflict in the context of the pedagogical model of the tactical approach to teaching games tactics in PE -specifically volleyball- and the comparison of its effectiveness to the dominant pedagogical model of the technical approach. The relative effectiveness of the interventions was determined by the extent to which conceptual changes were achieved, by comparing the preconceptions held by students regarding volleyball tactics before the teaching interventions to the adopted conceptions after the teaching interventions.

2. Method

The present study addressed the curriculum volleyball tactics topic for 8th graders, which refers to the positioning of the players in the volleyball court, when a team is defensively organized against the opponent's offense, with single block, defensive formation with 6 in the front, team formation 4-2 and the setter in zone 3.

2.1. Framework

The design of learning environments was based, among others, on pragmatological foundations, which reflect concerns on practical issues and dictate the extent to which the various alternatives are viable (Hannafin, Hannafin, Land, & Oliver, 1997). Given:
 (a)   the prevailing direct teaching practice employed by PE teachers (Gubacs-Collins, 2007; Kirk, 2010; Light, 2008; Light & Georgakis, 2005),
 (b)   the limited time available for the interventions,

(c) along with the need -indicated in the literature review regarding the tactical approach- to integrate the cognitive aspect of learning in game teaching in PE by focusing on understanding the game tactics as well as the need for early introduction to real-game situations through the use of a more dialectical approach (both of which constitute foundational principles of TGfU and align with constructivist principles of learning), the researcher attempted to synthesize a pragmatological theoretical framework in which to integrate the inducement of cognitive conflict into the dialectical methodology of the tactical approach while at the same time aligning to moderate constructivism. Since it is not probable -nor necessary- for students to discover everything for themselves through experience (Cakir, 2008) in order to actively build their knowledge, no individual typical approaches are rejected when needed. In particular, to obtain introductory knowledge -an issue on which constructivism is criticized for lack of proposals-, direct teaching approaches are suggested, while constructivist approaches are considered more appropriate for higher level knowledge acquisition (Kapravelou, 2011). Indeed, Willis (1998), referring to learning environments designed based on principles of moderate constructivism states that direct teaching could be employed when judged appropriate and students could still construct meaning from information provided either by the teacher, the learning material or some other source. Case in point, in the present study students are not expected to discover that the defensive formation will be with 6 in the front and our setter in zone 3. This information was provided by the researcher. On the contrary, for the understanding of volleyball tactics, constructivist teaching approach was selected, following the basic principles of the tactical approach in games teaching, which emphasizes the need for student engagement at high levels of cognitive processing (Adam, 2013; Kirk, 2005; Kirk & MacPhail, 2002; Light, 2002; Webb & Pearson, 2008) and the construction of knowledge through active involvement in the learning process (Forrest, Webb, & Pearson, 2007; Kirk & MacPhail, 2002; Webb & Pearson, 2008).

2.2. Procedure

2.2.1. Sample

The study involved 140 14-years old students from all public schools of Mytilene. They were explicitly informed of the voluntary nature of their participation and parental approval was granted. All pertinent information remained confidential.

2.2.2. Initial investigation of student preconceptions / Distribution to groups

Initially, student preconceptions regarding volleyball tactics under consideration were investigated, with the completion of a pretest tactics questionnaire (Appendix I) on an individual basis, in a classroom setting in the presence of the researcher.

The questionnaire consisted of eight questions that reflect the principles upon which the positioning of the players in the volleyball court relies, for the topic under examination (Mastrogiannis, Antoniou, & Kasimatis, 2015). Besides the selection of an answer to multiple-choice questions, students were provided with the opportunity to express their preconceptions in written text as well as graphically, thus making them explicitly available to the researcher. Students were then randomly distributed to a control group and two intervention groups (Table 1) in which two 45-minute teaching interventions were implemented:

(1)   Control Group: no teaching intervention
(2)   Typical Experimental Group: typical teacher-centered intervention
(3)   Experimental PreC Group (PreC: Preconceptions): constructivist intervention

Table 1. Gender distribution of students by group

Group	Gender		Total
	Boys	**Girls**	
Control group	21	34	**55**
Typical Experimental Group	25	16	**41**
Experimental PreC Group	24	20	**44**
Total	**70**	**70**	**140**

2.2.3. Teaching interventions

2.2.3.1. Teaching intervention in the Typical Experimental Group

The teaching strategy employed by the researcher for the teaching of volleyball defensive tactics, was that of the typical teaching strategy. Information regarding the teaching strategy practiced in high schools was derived from eight secondary education PE teachers in the cities of Athens and Mytilene, six of whom possessed a specialization in volleyball. The methodological approach followed by all eight PE teachers was the teacher-centered, direct teaching approach of demonstration, explanation and drill and practice, on which teaching in PE is intertemporally based (Gubacs-Collins, 2007; McKeen et al., 2007). Needless to say that student preconceptions were not considered, instead transfer of predefined knowledge from teacher to students was attempted. The teaching intervention was implemented in school volleyball courts with a net and a volley ball. Six students were placed in the indicated positions in the field for iconic offensive attempts from opponent zones 2, 3 and 4. For each iconic offensive attempt the researcher stated:

- the positioning of each player
- the area covered by each player.

For each iconic offensive attempt, a student was standing in the opponents' field with the ball raised over his head, indicating the opponent's attack position, while six students were randomly assigned to zones 1 through 6, with the rest attending off the field (Figure 1).

Figure 1. Snapshots from the teaching intervention to the Typical Experimental Group during the iconic offensive attempts from opponent zones 2, 3 and 4

Students alternated at every change in the position of the iconic offensive attempt. For example, for the iconic offensive attempt from opponent zone 2, the positioning of each player and the space he defensively covers are reported (Figure 2):

i.   The block is performed by our player in zone 4 located opposite the attacking opponent. His aim is to cover the central area of our court and thus performs the block towards the center of the court.

ii. Our player in zone 6 defends the area behind the player who performs the block at the attack line level. His aim is to cover the front area of the court behind the blocker in case the ball passes through or over the block (dink).
      The rest of the teammates defend outside the area covered by the block. Specifically:

iii. Our setter, the player in zone 3, retreats from the net to cover the front central area of our court in case the ball passes through or over the block (dink).

iv. Our player in zone 2 retreats from the net to the attack line to cover the front right area of our court.

v.   Our player in zone 1 assumes a position to the right back court, outside the area covered by the block, to cover the rear right area of our court.

vi. Our player in zone 5 assumes a position to the left back court, outside the area covered by the block, to cover the rear left area of our court.

Figure 2. Iconic offensive attempt from opponent zone 2
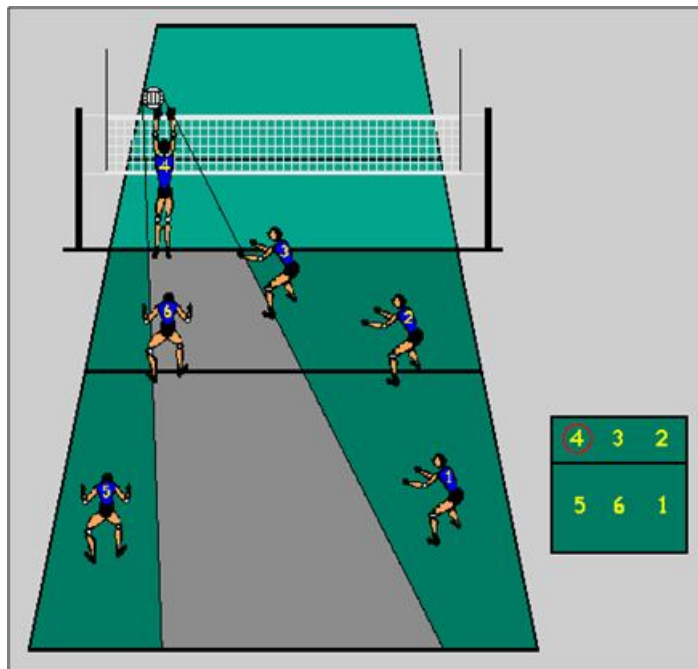
Sufficient time was allotted to all students for practice at the end of the teaching intervention, during which six students at a time assumed positions for all three iconic offensive attempts.

2.2.3.2. Teaching intervention in the constructivist experimental group

The teaching strategy employed by the researcher in the Experimental PreC Group for the teaching of defensive volleyball tactics under consideration was the constructivist teaching strategy of inducing cognitive conflict. Student preconceptions in relation to the intended learning outcome constituted the decisive main factor for the design of the teaching intervention, in order to facilitate students to actively construct their knowledge. Having identified students' most common erroneous preconceptions, the researcher formulated those questions that could promote cognitive conflict thus facilitating the adoption of the accepted conceptions in the discipline. These questions were then incorporated into the dialectical strategy of the tactical approach. The teaching intervention in the Experimental PreC Group was also implemented in the same setting used in the typical intervention. However, the researcher was posing the aforementioned questions (see Appendix II) to students, without indicating the adequate positioning and they, through discussion and the justification and negotiation of their conceptions and ideas, were called to assume the position considered most adequate in each zone (Figure 3). The researcher's role was

mainly that of urging for the expression of student preconceptions, encouraging the exploration of their functionality and efficiency and fostering the dialogue. Interventions were always in the form of questions and with a focus on the essentials. Answers or solutions were not provided even when students were led to incorrect conclusions, but instead effort was directed towards ensuring that the control of students' conceptions was conducted in a systematic manner. It was expected that students would experience a cognitive conflict between their erroneous preconceptions and the accepted conceptions in the discipline, which would lead to the voluntary adoption of the latter.

Figure 3. Snapshots from the teaching intervention in the Experimental PreC Group during iconic offensive attempts from opponent zones 2, 3 and 4

There follows a detailed description of a sample learning activity during the constructivist teaching intervention. For every question included in the pretest tactics questionnaire, student's dominant erroneous preconceptions are stated, along with the corresponding accepted conception in the discipline and the researcher's questions that provided opportunities for the inducement of cognitive conflict (see Appendix II for the full range of the learning activities). The accepted conceptions in the discipline are based on knowledge provided by Bergeles (1978), an author foundational to volleyball knowledge that despite years passed remains contemporary. Let it be noted that the initial questions were in essence rhetoric and were used to highlight the conflicting situation.

Question 7: In students' responses, the dominant, common erroneous preconceptions were that, besides the player that performs a block, most of the players should defend:
(a) equally dispersed throughout our entire field
(b) in our field's region behind the player that performs the block
(c)
However, '… A really good block creates the ideal conditions for effective ground defense and the reason is that, when the block covers the planned area properly, then the rest low-defense players defend more specific points.' (Bergeles, 1978, p. 72).

Researcher's questions for inducing cognitive conflict: Whenever a teammate performs a block, are there cases that the ball somehow could pass to our court? ... If yes, from where? ... Therefore, where is the ball more likely to end up? ... So, where should most players defend?

Students alternated at every change in the position of the iconic offensive attempt. Particular emphasis was given to the participation of all students in the process. Those students in the court had to justify their choices while the rest of the students were encouraged to participate by presenting their own ideas and justifying their choices. Sufficient time was allotted to all students for practice at the end of the teaching intervention, during which six students at a time assumed positions for all three iconic offensive attempts.

2.2.4. Completion of the tactics questionnaire on a posttest basis

20-25 days following the teaching interventions, students in all groups completed the same tactics questionnaire for the second time on a posttest basis. The particular time interval was considered as most appropriate since it would be long enough for students not to remember their responses from the first measure and relatively short as to not change their responses due to maturation (Ouzounis & Nakakis, 2011). The completion of the tactics questionnaire on a posttest basis provided the capability to determine whether and to what extent students had adopted the accepted volleyball tactics conceptions in the discipline.

2.3. Limitations

All participants originated from junior high schools of the city of Mytilene, Greece. A larger sample with a wider geographical spread would have provided more generalizable conclusions. In addition, it was not examined whether conceptual changes achieved were permanent or temporary, due to time constraints imposed by the Ministry of Education.

3. Results

3.1. Group equivalence testing

Each student's answer to each of the eight questions was characterized as either Satisfactory, if the appropriate response to the multiple choice question was chosen and was satisfactorily justified, or as Unsatisfactory. Group equivalence was measured with Pearson's correlation coefficient, by comparing Satisfactory and Unsatisfactory responses to each question in the pretest tactics questionnaire, for each group.

The test was performed on the sample of 140 students that participated in the research. Results revealed no statistically significant difference between the groups in all student responses but the 8th (Table 2).

Table 2. Pearson's correlation coefficient values for group equivalence

Question	Pearson χ^2 value	df	Significance Asymp. Sig. (2-sided)
Question 1η	2.43	2	0.296
Question 2η	0.64	2	0.725
Question 3η	2.20	2	0.333
Question 4η	2.97	2	0.226
Question 5η	2.20	2	0.333
Question 6η	0.48	2	0.787
Question 7η	0.82	2	0.665
Question 8η	8.05	2	0.018

This difference between groups was weighted by the methodology followed in the statistical analysis. Besides, examination of pretest and posttest number of Satisfactory responses to the 8th question for each group (Table 3) revealed a minor change between the two measures and, therefore, less impact on the results.

3.2. Test of reliability of tactics questionnaire

Two variables were created for each student to reflect the overall score in Satisfactory responses in each measure. The first variable expressed the pretest satisfactory response rate and the second the posttest satisfactory response rate. For their formation, a value of 1 was added for each answer characterized as Satisfactory at the pretest and posttest measure respectively and the sum was divided in both cases by the total number of questions (by eight). The reliability of the measurements of the two percentages of satisfactory responses was tested on the 55 students of the Control Group with Pearson's correlation coefficient and was found satisfactory (r = 0.66).

3.3. Investigation of the statistical significance of the change in the number of Satisfactory responses by group

To explore the effectiveness of the teaching interventions **in respect** to the adoption of the accepted conceptions in the discipline for each question -as recorded in the pretest and posttest measures respectively-, a series of McNemar's Chi-square

tests were performed, one for each question. The results revealed no statistically significant differences in the Control Group and the Typical Experimental Group between measures, whereas statistically significant differences (p <0.05) were observed for the majority of the questions in the Experimental PreC Group (Table 3).

Table 3. Number of student responses characterized as Satisfactory in pretest and posttest measures by group and question

Question	Control Group			Typical Experimental Group			Experimental PreC Group		
	N=55			N=41			N=44		
	Pretest	Posttest	χ^2 *	Pretest	Posttest	χ^2 *	Pretest	Posttest	χ^2 *
Question 1η	0	0	-	0	0	-	0	7	-
Question 2η	22	20	0.804a	17	21	0.388a	21	24	0.508a
Question 3η	0	0	-	0	0	-	1	18	<0.001a
Question 4η	3	2	1.000a	2	3	1.000a	6	12	0.031a
Question 5η	0	0	-	0	0	-	1	3	0.500a
Question 6η	14	18	0.344a	13	12	1.000a	13	19	0.031a
Question 7η	1	1	1.000a	2	3	1.000a	2	11	0.004a
Question 8η	6	6	1.000a	8	7	1.000a	15	17	0.687a
Total number of pretest tactics questionnaires: 140 Total number of posttest tactics questionnaires: 140 * McNemar test									

3.4. Investigation of the factors affecting Satisfactory response rates

To investigate the effect of the group, as well as the possible effect or interaction between gender and group, on the two variables created to express the overall rate of Satisfactory responses in both measures for each student, a covariance analysis with two factors, group and gender, was conducted (two-way ANCOVA). With posttest satisfactory response rate as dependent variable and pretest satisfactory response rate as covariate. The results of the analysis documented statistically significant main effect of the group factor ($F_{(2,133)}$=21.1, p<0.001), but no statistically significant effect of gender and no interaction between gender and group (Table 4).

Table 4. Results of the covariance analysis with two factors

| Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2.680[a]	6	0.447	27.308	<0.001
Intercept	0.410	1	0.410	25.076	<0.001
Percentage of Satisfactory responses in pretest	1.187	1	1.187	72.592	<0.001
Group	0.689	2	0.345	21.063	<0.001
Gender	0.041	1	0.041	2.515	0.115
Group * Gender	0.024	2	0.012	0.745	0.477
Error	2.175	133	0.016		
Total	9.500	140			
Corrected Total	4.855	139			
a. $R^2 = 0.552$					

To further investigate the differences between groups as to the pretest and posttest Satisfactory response rates, a Bonferroni comparison test was conducted. An overview of the Bonferroni test outcome indicated that the Experimental PreC Group exhibited a statistically significant higher number of Satisfactory responses from both the Control and Typical Experimental Group, while no statistically significant differences were observed between the latter two (Table 5).

Table 5. Pair-wise comparisons of means

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig. (p)[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Control Group	Typical Experimental Group	-0.008	0.027	1.000	-0.073	0.058
	Experimental PreC Group	-0.158[*]	0.027	0.000	-0.223	-0.094
Typical Experimental Group	Control Group	0.008	0.027	1.000	-0.058	0.073
	Experimental PreC Group	-0.151[*]	0.028	0.000	-0.219	-0.082
Experimental PreC Group	Control Group	0.158[*]	0.027	0.000	0.094	0.223
	Typical Experimental Group	0.151[*]	0.028	0.000	0.082	0.219
b. Adjustments for multiple comparisons: Bonferroni. * The mean difference is significant at the 0.05 level.						

Figure 4 graphically depicts the means of pretest satisfactory response rate and posttest satisfactory response rate by group.

Figure 4. Means of pretest and posttest satisfactory response rate by group
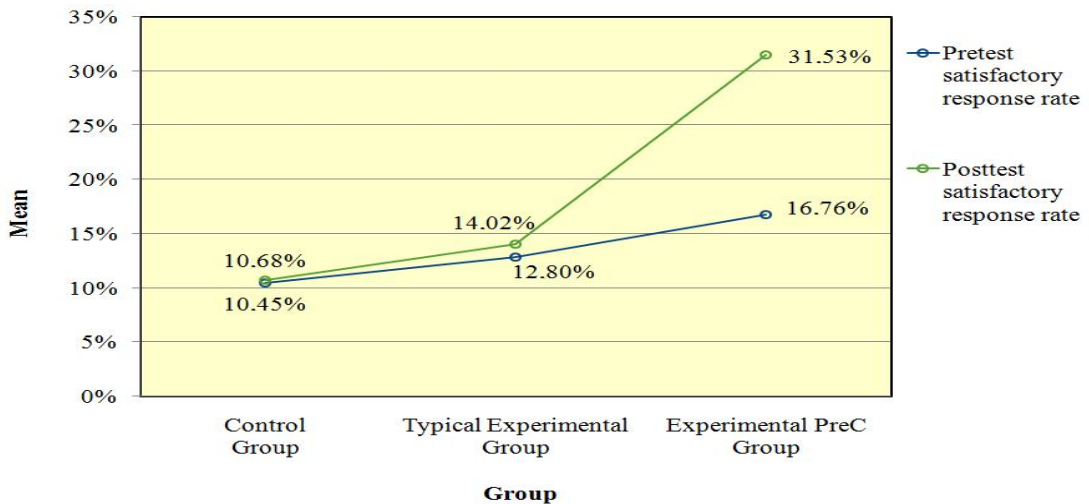
4. Discussion and conclusions

The present study subjected students to the completion of the tactics questionnaire in a pretest and a posttest phase, which enabled the assessment of the effect of the teaching interventions on the shaping of student conceptions regarding the volleyball tactics topic under consideration. Results revealed statistically significant main effect of the group. No statistically significant improvement between measures was recorded in the Typical Experimental Group. The prevailing direct teaching strategy of demonstration, clarification and drill and practice (Gubacs-Collins, 2007; McKeen et al., 2007) -that transfers knowledge from the teacher to the students in the form of monologue telling them what and how to do it (Light, 2003) and hinders the development of students' critical ability and creative thinking (Digelidis, 2007; Papaioannou, Theodorakis, & Goudas, 2006)- did not yield the desired level of conceptual changes. On the other hand, students in the Experimental PreC Group recorded statistically significant improvement between measures (88.13%). The initial investigation of student preconceptions regarding volleyball defensive tactics revealed the common erroneous student preconceptions, as they were shaped by their experience and exposure to the popular cultural forms of sports (Brooker et al., 2000; Kirk & MacPhail, 2002). If a study on a larger scale confirmed the commonality of student preconceptions -as is exhibited in several science content areas (Driver, 1989; Sjoberg, 2010; Tan et al., 2008; Vosniadou & Brewer, 1987)-, that could pose serious implications for the teaching of game tactics and could outline new research directions.

Informed PE teachers, regarding student preconceptions on a tactics topic, could be exempted from the unfeasible and time consuming process of investigating student preconceptions, since the majority of students would exhibit common preconceptions, directly available for the design of teaching approaches tailored to students' needs. This initial investigation enabled the researcher to challenge student preconceptions by formulating pedagogically appropriate questions that could provide students with opportunities to experience cognitive conflict. Realizing the inability to resolve the problems posed by the researcher's questions based on their erroneous preconceptions, students reached to the unprompted adoption of the accepted conceptions in the discipline, on a statistically significant level. The proposed methodology suited well to the principles of the tactical approach of TGfU, i.e. its commitment to the focus on the cognitive aspect of learning a game in a collaborative learning environment of solving authentic tactical problems and the active engagement of students in the construction of their knowledge through its dialectical approach to teaching game tactics.

Several comparative studies examine the effectiveness of the technical and tactical approach in relation to their impact on tactical knowledge and decision making, student motivation and engagement in the learning process, technique and technical knowledge acquisition as well as the level of physical activity (Alexander, Taggart, & Thorpe, 1996; Alison & Thorpe, 1997; Chatzipanteli & Digelidis, 2012; Clarke & Quill, 2003; Garcia & Ruiz, 2003; Graham, Ellis, Williams, Kwak, & Werner, 1996; Gray & Sproule, 2011; Griffin, Oslin, & Mitchell, 1995; Hastie & Buchanan, 2000; Hastie & Curtner-Smith, 2006; Light, 2002; McCaughtry, Sofo, Rovegno, & Curtner-Smith, 2004; McNeill, Fry, Wright, Tan, & Schempp, 2004; Mitchell, Griffin, & Oslin, 1995; Nevett, Rovegno, & Babiarz, 2001; Ormond, DeMarco, Smith, & Fischer, 1995; Pope & Grant, 1996; Rovegno, Nevett, & Babiarz, 2001; Turner, 1996a; Turner & Martinek, 1999). Recorded results indicate encouraging findings for the adoption of the tactical approach. The common element in the aforementioned studies, which differentiates them from the present study, was the multiple duration of the teaching interventions. An additional element that differentiates this study is the consideration of student preconceptions and the inducement of cognitive conflict for the acquisition of tactical knowledge, in the context of the tactical approach.

Despite the use of the inducement of cognitive conflict since the 1980's in science and the recognition of its effectiveness in promoting conceptual change (Cakir, 2008; Limòn, 2001; Posner et al., 1982; Vosniadou & Mason, 2012), no worth mentioning diffusion of the strategy is observed in PE, let alone the development of relevant studies. In conclusion, the consideration of student preconceptions for the inducement of cognitive conflict provides a promising teaching proposal in the context of the tactical approach of TGfU to teaching games in PE.

References

Adam, A. (2013). Η θέση των ομαδικών αθλημάτων στο Λύκειο [The place of team sports in senior high school]. Εκηβόλος, 10, 16-21.

Alexander, K., Taggart, A. & Thorpe S.T. (1996). A spring in their steps? Possibilities for professional renewal through sport education in Australian schools. Sport, Education and Society, 1, 23-46.

Alison, S., & Thorpe, R. (1997). A comparison of the effectiveness of two approaches to teaching games within physical education. A skills approach versus a games for understanding approach. The British Journal of Physical Education, 28(3), 9-13.

Bell, T. (2003). The PlaySmart programme: Thinking through physical education. 2003 Australian Association for Research in Education (AARE) Conference [Electronic Version]. Auckland, New Zealand: AARE. Retrieved from http://www.aare.edu.au/03pap/bel03619.pdf

Bell, T. (2005). The Play SMART research project: Promoting thinking through physical education. Learning and Teaching in Action, 4(1), 35-40.

Bergeles, N. (1978). Το Βόλλεϋ Μπωλ (Τόμ.1) [The Volleyball (Vol.1)]. Athens: Bergeles Nikolaos.

Berlyne, D. E. (1965). Curiosity and education. In J. D. Krumboltz (Ed.), Learning and the Educational Process. Chicago: Rand McNally & Co.

Biggs, J. (1990). Teaching for desired learning outcomes. In N. Entwistle (Ed.), Handbook of educational ideas and practices (pp. 681–693). New York: Routledge.

Brooker, R., Kirk, D., Braiuka, S., & Bransgrove, A. (2000). Implementing a game sense approach to teaching junior high school basketball in a naturalistic setting. European Physical Education Review, 6(1), 7-26.

Bunker, D., & Thorpe, R., (1982). A model for the teaching of games in secondary schools. Bulletin of Physical Education, 18(1), 5-8.

Bunker, D., & Thorpe, R. (1986). The curriculum model. In R. Thorpe, D.Bunker, & L. Almond (Eds.), Rethinking games teaching (pp. 7-10). Loughborough, UK: University of Technology.

Butler, J., Griffin, L., & Nastazi, R. (2003). Teaching games for understanding in physical education & sport. Reston, VA: National Association for Sport and Physical Education.

Cakir, M. (2008). Constructivist Approaches to Learning in Science and Their Implications for Science Pedagogy: A Literature Review. International Journal of Environmental & Science Education, 3(4), 193-206.

Chatzipanteli, A., & Digelidis, N. (2012). Promoting the development of metacognitive processes through teaching games for understanding. Inquiries in Sport & Physical Education, 10(1), 30-37.

Clarke, G. & Quill, M. (2003). Researching sport education in action: a case study. European Physical Education Review, 9(3), 253-266.

Digelidis, N. (2007). Το φάσμα των μεθόδων διδασκαλίας στη Φυσική Αγωγή: από τη θεωρία στην πράξη [The spectrum of teaching styles in Physical Education: from theory to practice]. Thessaloniki: Christodoulides.

Driver, R. (1989). Students' conceptions and the learning of science. International Journal of Science Education, 11(5), 481-490.

Duit, R., & Treagust, D. F. (2003). Conceptual change: a powerful framework for improving science teaching and learning. International journal of science education, 25(6), 671-688.

Duit, R., Treagust, D., & Widodo, A. (2008). Teaching Science for Conceptual Change: Theory and Practice. In S. Vosniadou (Ed.), International handbook of research on conceptual change (pp. 61-82). New York, NY: Routledge.

Dyson, B., Griffin, L. L., & Hastie, P. (2004). Sport education, tactical games, and cooperative learning: Theoretical and pedagogical considerations. Quest, 56(2), 226-240.

Forrest, G. J., Webb, P. & Pearson, P. (2007). Games for understanding in pre-service teacher education: A 'Game for outcome' approach for enhanced understanding of games. In R. Light (Ed.), 2006 Proceedings for the Asia Pacific Conference of Teaching Sport and Physical Education for Understanding (pp. 32-44). Sydney: University of Sydney.

Garcia, J.A.H. & Ruiz, L.M.P. (2003). Analysis Comparativo de dos modelos de intervencion en el aprendizaje del balonmano. Revista de Psicologia del Deporte, 12(1), 55-66.

Graham, K.C., Ellis, S.D., Williams, C.D., Kwak, E.C. & Werner P.H. (1996). High and low-skilled target students' academic achievement and instructional performance in a 6-week badminton unit. Journal of Teaching in Physical Education, 15(4), 477-489.

Gray, S., & Sproule, J. (2011). Developing pupils' performance in team invasion games. Physical Education and Sport Pedagogy, 16(1), 15-32.

Grehaigne, J. F., Richard, J-F., & Griffin, L. L. (2005). Teaching and learning team sports and games. New York: RoutledgeFalmer.

Griffin, L., Brooker, R., & Patton, K. (2005). Working towards legitimacy: Two decades of teaching games for understanding. Physical Education & Sport Pedagogy, 10(3), 213-223.

Griffin, L. L., Oslin, J. L., & Mitchell, S. A. (1995). An Analysis of two instructional approaches to teaching net games. Research Quarterly for Exercise and Sport, 66(March supplement), A-64.

Griffin, L., & Sheehy, D. (2004). Using the tactical games model to develop problem solvers in physical education. In J. Wright, D. Macdonald, & L. Burrows (Eds.), Critical inquiry and problem solving in physical education (pp. 33-48). London: Routledge.

Gubacs-Collins, K. (2007). Implementing a tactical approach through action research. Physical Education and Sport Pedagogy, 12(2), 105-126.

Hannafin, M. J, Hannafin, K. M., Land, S. M., & Oliver, K. (1997). Grounded practice and the design of constructivist learning environments. Educational Technology Research and Development, 45(3), 101-117.

Hastie, P., & Buchanan, A. (2000). Teaching Responsibility Through Sport Education: Prospects for a Coalition. Research Quarterly for Exercise and Sport, 71(1), 25-35.

Hastie, P., & Curtner-Smith, M. (2006). Influence of a hybrid Sport Education-Teaching Games for Understanding unit on one teacher and his students. Physical Education and Sport Pedagogy, 11(1), 1-27.

Hewson, M. G. & Hewson, P. W. (1983). Effect of instruction using students' prior knowledge and conceptual change strategies on science learning. Journal of Research in Science Teaching, 20(8), 731-743.
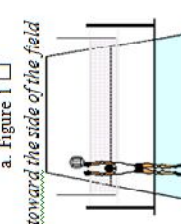
Hewson, P. W. (1981). A conceptual change approach to learning science. European Journal of Science Education, 3(4), 383-396.

Hewson, P. W., & Hewson, M. G. A. (1984). The role of conceptual conflict in conceptual change and the design of science instruction. Instructional Science, 13(1), 1-13.

Johnston, L. D., Delva, J., & O' Malley, P. M. (2007). Sports Participation and Physical Education in American Secondary Schools Current Levels and Racial/Ethnic and Socioeconomic Disparities. American Journal of Preventive Medicine, 33(4), S195-S208.

Kapravelou, A. (2011). Η σημασία των θεωριών μάθησης στο πλαίσιο των ΤΠΕ στην εκπαίδευση [Learning theories' importance in the framework of Information and Communication Technologies in Education]. Open Education - The Journal for Open and Distance Education and Educational Technology, 7(1), 98-117.

Keller, J. M. (1987). Strategies for stimulating the motivation to learn. Performance & Instruction, 26(8), 1-7.

Kirk, D. (2005). Future prospects for teaching games for understanding. In L. Griffin, & J. Butler (Eds.), Teaching games for understanding: Theory, research, and practice (pp. 213-227). Windsor: Human Kinetics.

Kirk, D. (2010). Physical Education Futures. London: Routledge.

Kirk, D., & MacPhail, A. (2002). Teaching Games for Understanding and Situated Learning: Rethinking the Bunker-Thorpe Model. Journal of Teaching in Physical Education, 21(2), 177-192.

Kossiva, E., & Hatziharistos, D. (2007). Physical Education in Greek high schools: Is Physical Activity for Health Promoted? Inquiries In Sport and Physical Education, 5(3), 341-351.

Light, R. (2002). Engaging the body in learning: promoting cognition in games through TgfU. ACHPER Healthy Lifestyles Journal, 49(2), 23-26.

Light, R. (2003). The joy of learning: Emotion and learning in games through TGfU. Journal of Physical Education New Zealand, 36(1), 93-108.

Light, R. (2006). Situated learning in an Australian surf club. Sport, Education and Society, 11(2), 155-172.

Light, R. (2008). Complex Learning Theory - Its epistemology and its assumptions about learning: Implications for Physical Education. Journal of Teaching in Physical Education, 27(1), 21-37.

Light, R., & Fawns, R. (2003). Knowing the game: Integrating speech and action through TGfU. Quest, 55(2), 161-176.

Light, R., & Georgakis, S. (2005). Integrating theory and practice in teacher education: The impact of a Game Sense unit on female pre-service primary teachers' attitudes towards teaching physical education. Journal of Physical Education New Zealand, 38(1), 67-80.

Limón, M. (2001). On the cognitive conflict as an instructional strategy for conceptual change: a critical appraisal. Learning and Instruction, 11(4-5), 357-380.

Mastrogiannis, I., Antoniou, P., & Kasimatis, K. (2015). Development of Research Instrument for the Investigation of Students' Prior Knowledge in Physical Education. Inquiries In Sport and Physical Education, 13(1), 1-16.

McCaughtry, N., Sofo, S., Rovegno, I., & Curtner-Smith, M. (2004). Learning to teach sport education: misunderstandings, pedagogical difficulties, and resistance. European Physical Education Review, 10(2), 135-155.

McKeen, K., Webb, P., & Pearson, P. (2007). Promoting physical activity through teaching games for understanding (TGfU). In J. Diniz, F. Carreiro da Costa, & M. Onofre (Eds.), AIESEP World Congress-Active lifestyles: The Impact of Education and Sport (pp. 251-258). Portugal: Lisbon University.

McNeill, M.C., Fry, J.M., Wright, S.C., Tan, K.S., & Schempp, P.G. (2004). In the local context: Singaporean challenges to teaching games on practicum. Sport, Education and Society, 9, 3-32.

McNeill, M., Fry, J., Wright, S., Tan, W., & Rossi, T. (2008). Understanding time management and questioning strategies used in a games concept approach to develop 'Game Sense'. Physical Education and Sport Pedagogy, 13, 231-249.

Millar, R. (1989). Doing Science: Images of science in science education. Bristol, PA: Taylor & Francis.

Mitchell, S., Griffin, L., & Oslin, J. (1995). An analysis of two instructional approaches to teaching invasion games. Research Quarterly for Exercise and Sport, 66, 31-65.

Mitchell, S., Griffin, L., & Oslin, J. (2006). Teaching sport concepts and skills: A tactical games approach. Champaign, IL: Human Kinetics.

Nevett, M., Rovegno, I. & Babiarz, M. (2001). Fourth Grade Children's knowledge of cutting, passing and tactics in invasion games after a 12-lesson unit of instruction. Journal of Teaching in Physical Education, 20(4), 389-401.

Ouzounis, Ch., & Nakakis, K. (2011). Η Αξιοπιστία και η Εγκυρότητα των Εργαλείων Μέτρησης σε Ποσοτικές Μελέτες [The Reliability and Validity of Measurement Instruments in Quantitative Research]. Νοσηλευτική, 50(2), 231-239.

Ormond, T.C., DeMarco, G.M., Smith, R.M. & Fischer, K.A. (1995). Comparison of the sport education and traditional approaches to teaching secondary school basketball. Research Quarterly for Exercise and Sport, 66, A-65.

Papaioannou, A., Theodorakis, Y., & Goudas, M. (2006). Για μια καλύτερη φυσική αγωγή [For a better physical education]. Thessaloniki: Christodoulides.

Piaget, J. (1929). The Child's Conception of the World. London: Routledge and Kegan Paul.

Piaget, J. (1980). Adaptation and intelligence: Organic selection and phenocopy. Chicago, IL: University of Chicago Press.

Pill, S., Penney, D., & Swabey, K. (2012). Rethinking Sport Teaching in Physical Education: A Case Study of Research Based Innovation in Teacher Education. Australian Journal of Teacher Education, 37(8), 118-138.

Pope, C. C., & Grant, B. C. (1996). Student experiences in sport education. Waikato Journal of Education, 2, 103-118.

Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. Science Education, 66(2), 211-227.

Rovegno, I., Nevett, M., & Babiarz, M. (2001). Learning and Teaching invasion games tactics in 4th grade: Introduction and Theoretical Perspective. Journal of Teaching in Physical Education, 20(4), 341-351.

Scott, P. H., Asoko, H. M., Driver, R. H. (1991). Teaching for conceptual change: A review of strategies. In A. Tiberghien, E. Jossem, & J. Barojas (Eds.), Connecting Research in Physics Education with Teacher Education-International Commission of Physics Education (pp. 71-78). Retrieved from

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.95.7608&rep=rep1&type=pdf#page=71

Sjoberg, S. (2010). Constructivism and learning. In E. Baker, B. McGaw, & P. Peterson (Eds.), International Encyclopedia of Education (3rd Edition, pp. 485-490). Oxford: Elsevier.

Snyder, S. S., & Feldman, D. H. (1977). Internal and external influences on cognitive developmental change. Child Development, 48(3), 937-943.

Stolz, S., & Pill, S. (2014). Teaching games and sport for understanding: Exploring and reconsidering its relevance in physical education. European Physical Education Review, 20(1), 36-71.

Tan, K. C. D., Taber, K. S., Liu, X., Coll, R. K., Lorenzo, M., Li, J., Goh, N. K., & Chia, L. S. (2008). Students' conceptions of ionisation energy: A cross-cultural study. International Journal of Science Education, 30(2), 263-283.

Thorpe, R., & Bunker, D. (2010). Preface. In J. Butler, & L. Griffin (Eds.), More teaching games for understanding: Moving globally (pp. vii-xv). Champaign, IL: Human Kinetics.

Tsai, Y. Y., & Chang, C. Y. (2005). Learning effects of instruction guided by the conflict map: Experimental study of learning about the causes of the seasons. Journal of Research in Science Teaching, 42(10), 1089-1111.

Tsoulfas, Ch., Avgerinos, A. G., & Kampas, A. (2011). Physical Activity Level of Elementary and Secondary School Students in a Semi-Urban Area of North Greece. Inquiries In Sport and Physical Education, 9(2), 80-90.

Turner, A. (1996a). Teachers' Perceptions of Technical and Tactical Models of Instruction. Research Quarterly for Exercise and Sport, 67(March supplement), A-90.

Turner, A. (1996b). Teaching for Understanding: Myth or Reality? Journal of Physical Education, Recreation & Dance, 67(4), 46-51.

Turner, A., & Martinek, T. (1999). An investigation into teaching games for understanding: Effects on skill, knowledge, and game play. Research Quarterly for Exercise and Sport, 70(3), 286-296.

Vosniadou, S., & Brewer, W. F. (1987). Theories of knowledge restructuring in development. Review of Educational Research, 57, 51-67.

Vosniadou, S., & Mason, L. (2012). Conceptual Change Induced by Instruction: A Complex Interplay of Multiple Factors. In K. R. Harris, S. Graham, & T. Urdan (Eds.), APA Educational Psychology Handbook (pp. 221-246). Washington DC, US: American Psychological Association.

Webb, P. & Pearson, P. (2008). An integrated approach to teaching games for understanding (TGfU). 1st Asian Pacific Sport in Education Conference (pp. 1-9). Adelaide: Flinders University.

Werner, P., Thorpe, R., & Bunker, D. (1996). Teaching games for understanding: evolution of a model. The Journal of Physical Education, Recreation & Dance, 67(1), 28-33.

White, R. T., & Gunstone, R. F. (1989). Metalearning and conceptual change. International Journal of Science Education, 11(5), 577-586.

Willis, J. (1998). Alternative instructional design paradigms: What's worth discussing and what isn't. Educational Technology, 38(3), 5-16.
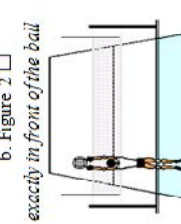
Appendix I: Tactics Questionnaire (Mastrogiannis et al., 2015)

Boy □ Girl □ Student code ☐

Are you enrolled in a volleyball team? Yes □ No □

If so, do you participate regularly in the training sessions? Yes □ No □

> The opponent team is in the white field and is trying to land the ball into the colored field where our team is on defense.
> Our team plays with the setter always in the center, at the front court close to the net. Only one player at a time performs block (single block).

1. *A player from the opponent team (white field) attacks the ball close to the net:*

What does our teammate opposite to him do?

I. Moves away from the net □
II. Performs a block □
III. Stays put □
IV. I do not know □

Justify your answer:

2. *A teammate of ours that is not the setter, contacts the ball first (any ball touching our teammate that performs the block is not considered a contact).*

To whom of our teammates will he attempt to pass the ball?

I. To the closest teammate □
II. To the best offensive teammate of his □
III. To the tallest teammate of his □
IV. To the setter □
V. Other □
VI. I do not know □

Justify your answer:

3. *A teammate of ours performs a block.* In which of the following figures has he taken the best position in regard to the ball and our field?
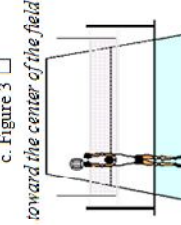
a. Figure 1 □ — *toward the side of the field*
b. Figure 2 □ — *exactly in front of the ball*
c. Figure 3 □ — *toward the center of the field*
d. I do not know □

Justify your answer:

4. *A player from the opponent team (white field) attacks the ball and a teammate of ours (colored field) performs a block opposite to him.*

The probability of the ball reaching at any part of our court (colored field):

I. Is the same for every part of the field □
II. Is not the same for every part of the field □
III. I do not know □

Justify your answer:

Draw and illustrate (the same, higher or lower probability) on the figure.

5. *A player from the opponent team (white field) attacks the ball between and at an equal distance from our setter (S) and another teammate of ours.*

Which one of our teammates will position himself opposite the opponent in order to perform a block?

- I.   Our setter   ☐
- II. The other teammate of ours   ☐
- III. It does not matter which one   ☐
- IV. I do not know   ☐

Justify your answer:

6. *The ball is passed to our field by the opponent team and it first reaches a teammate of ours that is not the setter.*

What does our setter do?

- I.   Makes a run to the net in order to receive the ball and perform a spike   ☐
- II. Is in readiness to receive the first pass   ☐
- III. Moves towards our teammate that received the ball   ☐
- IV. Turns towards the net facing the opponents' field   ☐
- V.   Other   ☐
- VI. I do not know   ☐

Justify your answer:

7. Besides the player that performs a block, most of the players should defend:

- I.   in our field's region behind the player that performs the block   ☐
- II. equally dispersed throughout our entire field   ☐
- III. in our field's region to the right and to the left of the player that performs the block   ☐
- IV. Other   ☐
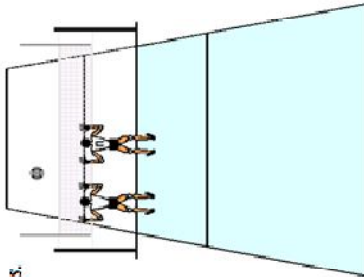- V.   I do not know   ☐

Justify your answer:

8. Whenever our setter does not perform a block, is he involved in our team's defense? In other words, is he responsible for defending a region in our field?

- I.   Yes   ☐
- II. No   ☐
- III. I do not know   ☐

Justify your answer:

If you answered Yes, which is that region in our field:

Appendix II: Learning activities during constructivist teaching intervention

Question 1: In students' answers, the dominant, common erroneous preconception was that a player performs a block to obstruct the ball from passing to our court. However, the player who performs a block "... has a duty to act in such a way as to cover the tracks of the ball directed towards the central area of the court." (Bergeles, 1978, p. 64).

Researcher's questions for inducing cognitive conflict: *Whenever a teammate performs a block, are there cases that the ball somehow could pass to our court? ... If yes, from where? ... Therefore, why do we perform a block? ...*

Question 2: In students' answers, the dominant, common erroneous preconceptions were that our teammate will attempt to pass the ball to:

   a. the setter so that he passes the ball to the opponent's court
   b. the best offensive teammate
   c. the closest teammate

However, "Team tactics demand, in order to further help the offense, to direct the first ball to a specific predetermined point at which the setter is either already positioned or is going to be positioned ..." (Bergeles, 1978, p. 27). Furthermore, the setter "Directs the offensive and all-rounded players into an efficient game, supplying them with accurate and suitable passes." (Bergeles, 1978, p 17-18).

Researcher's questions for inducing cognitive conflict: *Passing the ball the opponent's court is more effective when done with a simple pass or a strike? ... Which one of our teammates can more effectively perform a strike, the setter or an offensive player? ... Which one of our teammates can execute the best pass for a strike, our setter, an offensive player or whoever happens to be closer?*

Question 3: In students' answers, the dominant, common erroneous preconception was that a player performs a block right in front of the ball. However, the player who performs a block "... has a duty to act in such a way as to cover the tracks of the ball directed towards the central area of the court." (Bergeles, 1978, p. 64) and "... the defense of the court area is determined by the block. The block is expected to cover the central area of the court, which is the most crucial area because it represents most of the chances of opponent's targeting." (Bergeles, 1978, p. 67).

Researcher's questions for inducing cognitive conflict: *When the opponent attacks the ball close to the net, does he always send the ball straight in front of him? ... If not, where should the player who performs the block be positioned with respect to the ball and the court and why?*

Question 4: In students' answers, the dominant, common erroneous preconceptions were that the ball may end up:

   a. anywhere in the court
   b. close to the player that performs the block
   c. in the center of the court

However, the player who performs a block "….is expected to cover the central area of the court…" (Bergeles, 1978, p. 67), therefore limiting the chances for the ball to reach the covered central area of our field and increasing, respectively, the chances to reach the rest of the uncovered space of our court.

Researcher's questions for inducing cognitive conflict: *Whenever a teammate performs a block, are there cases that the ball somehow could pass to our court? ... If yes, from where? ... Therefore, why do we perform a block? ...*

Question 5: In students' answers, the dominant, common erroneous preconception was that the block should be performed by our other teammate because the setter should be free to receive the first pass. However, our setter is in a better position to perform a block -in regard to the ball and the court- and cover the central area of the court.

Researcher's questions for inducing cognitive conflict: *Which of our two teammates, the setter or the other teammate is in a better position to perform a block in regard to the ball and the court?*

Question 6: In students' answers, the dominant, common erroneous preconceptions were that our setter:

a. moves towards our teammate that received the ball
b. makes a run to the net in order to receive the ball and perform a spike

However, "Team tactics demand, in order to further help the offense, to direct the first ball to a specific predetermined point at which the setter is either already positioned or is going to be positioned ..." (Bergeles, 1978, p. 27). Moreover, the setter "Directs the offensive and all-rounded players into an efficient game, supplying them with accurate and suitable passes." (Bergeles, 1978, p. 17-18).

Researcher's questions for inducing cognitive conflict: *When a teammate focuses on receiving the first ball, is it desirable to know that the setter will be at his position in zone 3? Is it desirable, at the same time, the setter to be moving towards his teammate with the ball or making a run to the net in order to receive the ball and perform a spike?*

Question 7: In students' answers, the dominant, common erroneous preconceptions were that, besides the player that performs a block, most of the players should defend:

a. equally dispersed throughout our entire field
b. in our field's region behind the player that performs the block

However, "… A really good block creates the ideal conditions for effective ground defense and the reason is that, when the block (single or team) properly covers the planned area, then the rest low-defense players defend in more specific points." (Bergeles, 1978, p. 72).

Researcher's questions for inducing cognitive conflict: *Whenever a teammate performs a block, are there cases that the ball somehow could pass to our court? … If yes, from where? … Therefore, where is the ball more likely to end up? … So, where should most players defend?*

Question 8: In students' answers, the dominant, common erroneous preconceptions were that the setter:

a. is responsible for defending some region in our field (other than the accepted in the discipline)
b. is not responsible for defending a region in our field because his duty is to pass the ball

However, the setter needs to have the capability to perform block, defensive or offensive covering of the hitter (Bergeles, 1978).

Researcher's questions for inducing cognitive conflict: *The ball approaches the region close to the setter. What should the setter do?*