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# University students' subject matter knowledge and misconception of teaching games for understanding and its implication to teaching practice

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## **Abstract**

This study is to track the subject matter knowledge of and misconception about Teaching Games for Understanding (TGfU) of fourth year undergraduate pre-service teachers' physical education majors at an Australian university. The test of reliability on misconception scale are subjected to a Rasch analysis (KR-20 = .52) which consists of 20 dichotomous questions with true/false answers. Analyses of the data reveal that students achieve a credit on subject matter knowledge and attain four misconceptions about TGfU. There is a significant ( $p < 0.05$ ) difference in the scores for subject matter knowledge and concepts of TGfU through paired samples t test. These results imply that subject matter knowledge does have an effect on students' concepts of TGfU but with very low relationship ( $r(53) = .19, p < 0.05$ ). The implication of content knowledge to teaching is to resist the pre-concept or misconception of the subject matter. If pre-service teachers are to improve the quality of teaching and learning in content areas, he or she needs to possess a deep understanding of games both within and across categories in TGfU. Misconceptions tend to be very resistant to instruction because learning entails replacing or radically reorganizing student knowledge. This puts teachers in the very challenging position of needing to bring about significant conceptual change in student knowledge. Therefore pre-service teachers must know the subject matter they teach and their performance will be determined by the depth of their content knowledge in relation to teaching, making this an essential component to their teaching practice. Teachers must know the subject they teach and this is important to teacher competency.

## **Keywords**

matter, subject, students, university, its, teaching, practice, implication, misconception, understanding, games, knowledge

## **Disciplines**

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## University students' subject matter knowledge and misconception of teaching games for understanding and its implication to teaching practice

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This study is to track the subject matter knowledge of and misconception about Teaching Games for Understanding (TGfU) of fourth year undergraduate pre-service teachers' physical education majors at an Australian university. The test of reliability on misconception scale are subjected to a Rasch analysis (KR-20 = .52) which consists of 20 dichotomous questions with true/false answers. Analyses of the data reveal that students achieve a credit on subject matter knowledge and attain four misconceptions about TGfU. There is a significant ( $p < 0.05$ ) difference in the scores for subject matter knowledge and concepts of TGfU through paired samples  $t$  test. These results imply that subject matter knowledge does have an effect on students' concepts of TGfU but with very low relationship ( $r(53) = .19, p < 0.05$ ). The implication of content knowledge to teaching is to resist the pre-concept or misconception of the subject matter. If pre-service teachers are to improve the quality of teaching and learning in content areas, he or she needs to possess a deep understanding of games both within and across categories in TGfU. Misconceptions tend to be very resistant to instruction because learning entails replacing or radically reorganizing student knowledge. This puts teachers in the very challenging position of needing to bring about significant conceptual change in student knowledge. Therefore pre-service teachers must know the subject matter they teach and their performance will be determined by the depth of their content knowledge in relation to teaching, making this an essential component to their teaching practice. Teachers must know the subject they teach and this is important to teacher competency.

**Key words:** Teaching games; content knowledge; subject matter knowledge; misconception; teaching practice.

### Introduction

Teaching Games for Understanding (TGfU) is a pedagogical approach that focuses on student-centred and game-centred where the 'why' is taught before the 'how' to play game with the use of tactical problems and solutions (Bunker & Thorpe, 1986). This process involves teaching student a modified or simplified game that is suitable for their physical, social and mental development to gain an appreciation for the demands of sport

games such as soccer, badminton, baseball, and golf. TGfU was introduced in contrast to the traditional method and hoped to develop student's game sense.

At an Australian university where this study took place, the physical education lecturers confer that final year students should be familiar with TGfU because they had already fulfilled course program requirements and that they would therefore be able to benefit from the teaching of games content during teaching practice. These final year students had studied TGfU subjects previously in second year (EDPM202: Teaching and learning net court, striking and target games) and third year (EDPM301: Teaching and learning invasion games). Students have to meet subject requirements through assessments criterion, guidelines and weighting. They have satisfactorily demonstrated their ability to perform teaching and learning in TGfU throughout their studies.

Measuring university students' TGfU knowledge is different scheme from assessing students' assignments for the purposes of giving grades. Students can pass a TGfU course however, on reflection of lecturers' teaching experience, what they have frequently observed does not warrant an understanding of TGfU concepts among students. The manner students (pre-service teachers) explain on TGfU content knowledge depends, on their conceptual knowledge they acquired during their varsity classes. Hence, the need for studies of students' knowledge of TGfU and misconception is pertinent with their teaching practice.

This study represents a preliminary investigation to track the subject matter knowledge of fourth year students in a Physical and Health Education programme at an Australian university and their common misconception on Teaching Games for Understanding. This study addresses three questions: (1) What are the common misconception attained by the fourth year students in a Physical and Health Education programme? (2) At what level and diversity of subject matter knowledge and of misconception about TGfU of fourth year students in a Physical and Health Education programme is achieved? (3) How much magnitude of the differences and relationships between subject matter knowledge and misconception about TGfU of fourth year students in a Physical and Health Education programme is acquired? The study provided the opportunity for students to recognise the importance of knowledge of TGfU to put into their teaching practice.

Reany (1988) defines knowledge as a relation between two or more concepts, where concepts are mental objects. Lucariello (2011) explains that when teachers provide instruction on concepts in various subjects, they are teaching students who already have some pre-instructional knowledge about the topic. The knowledge may be incorrect, irrational or misinformed. These defective understandings are termed alternative conceptions or misconceptions. Misconceptions sometimes are instinctive in students' thinking due to their educational background and are unaware that the knowledge they have is incorrect. Thus will likely to defy to education because learning involves fundamentally on students' knowledge (Lucariello, 2011).

Teachers have to take up challenge to resist the misconceptions for the benefit of students' learning where they must have content knowledge about the subject matter they teach. Grossman and Richert (1988) define teacher's knowledge as a body of professional knowledge that encompasses both knowledge of general pedagogical principles and skills and knowledge of the subject matter to be taught. The challenge is that teachers should equally acquire a good foundation of their subject matter knowledge or content knowledge in order to provide instruction on concepts in the subject. As worded by Shulman (1986), subject matter knowledge is more than knowledge of facts or concepts; it requires knowledge of both the substantive structure (facts and their organising principles)

and syntactic structure (legitimacy principles for the rules) of a subject domain. Subject matter knowledge was little more than context.

The transformation of subject matter knowledge into pedagogical content knowledge is a significant focus in teacher education (Goulding, Rowland and Barber, 2002). Before teachers enter the profession and/or take up employment in a range of different education institutions, they have to have undergone training as pre-service teacher. Practically, preservice teachers will integrate theoretical content knowledge and pedagogical knowledge during the training and it is up to them to integrate those elements in the correct conceptual manner.

## **Literature Review**

There has been a shift in emphasis in education from teaching to learning and Teaching Games for Understanding (TGfU) has caused innovation as games-based approach to learning. The TGfU approach has stimulated research and there was a few studies related to misconception and content knowledge that matter for teaching.

Adams (2011) based on Hopper's research have found that misconception of TGfU as being teaching tactics and not teaching skills. Another misconception found by Hopper is that TGfU atmosphere merely plays games with guidance from the teacher. This lead to another misconception that TGfU in which students play games in order to further understand the importance of skill progression and skill practice. In relation to the misconceptions, Hopper emphasizes that the focus of TGfU is progressing from tactics to skills, not tactics or skills. This means that students will understand the 'why' of a game before the 'how', therefore, students are taught to appreciate the advanced form of the game by participating in a modified game (Hopper, 2003).

Turner (2005) found a common misconception is that a teacher needs to know all of the intricacies (technical and tactical) of each game to teach it to students using the TGfU approach. Turner explained that some tactical knowledge of one game in a category is convertible to another game in the same category using the TGfU approach. Teachers still have to be prepared to teach skills, but within a tactical framework and in a more contextual setting, once they have recognised the tactical and technical deficiencies in the game. That technical development must not necessarily be sacrificed in favour of tactical development (Robinson, 2011).

Bunker and Thorpe (1986) do not accept that tactics are for the development of skills but takes the point of view that games are about tactics in TGfU approach. The misleading criticism of the approach is the claim that TGfU neglects skill and technique in order to focus exclusively on decision making and understanding (Light, 2006). Wright, McNeill, Fry and Wang (2005) concluded that TGfU focuses on teaching games through a conceptual approach, through concepts, tactics and strategies rather than through a basis of skill. Edwards and Brooker (2000) states that TGfU approach allows children to play games without knowing how to perform the skills involved. Thus places the student in a game situation where tactics, decision making, problem solving and skill are developed at the same time (Forrest, Webb & Pearson, 2006).

Thorpe (as cited in Chow et al., 2007) stated that the basic philosophy of TGfU is that a person can play games with limited techniques. The philosophy is to motivate learners the joy of game playing that leads to a desire to learn techniques and generate constructivist learning environment. TGfU creates an environment where students can formulate their own opinions and answers through critical thinking and problem solving. Its goal is to make students think, more on student centred where students has to take

control and make decisions in dynamic game contexts (Pearson and Webb, 2008). The key pedagogical tool is the use of a questioning protocol such as ‘what’; ‘where’; ‘when’; ‘why’; ‘with whom’; and ‘how’ (Griffin & Butler, 2005).

TGfU involves four categories (invasion, net/wall, striking/fielding and target) and within each category having subcategories. These categories allow for the notion of all games in each category having similar concepts (Forrest et al., 2006; Webb & Pearson, 2008). At its expense, the categories do not share similar tactical problems to be solved allowing transfer of tactical understanding across games. Subcategories in invasion include where the ball can be carried or caught across the line, thrown or shot into a target, or it can be struck with a stick or foot into a target area. But in net/wall games, a player or team need to send an object into an opponent’s court so that it cannot be played or returned within the court boundaries (Forrest et al., 2006; Webb & Pearson, 2008). It is essential that students should acquire a deep understanding of games both within and across categories and subcategories.

As such, teachers need to understand subject matter deeply and explicitly so that they can help students construct cognitive maps, transmit innovative ideas, and address misconceptions truthfully. Teachers may relay misconceptions to their students if they possessed limited content knowledge. Their conceptions might limit their ability to present subject matter in an appropriate ways, give helpful explanations and conduct effective discussions (Even & Tirosh, 1995). Rice (2003) found that there is a positive relationship between teachers’ academic proficiency and teacher effectiveness. Orphanos (2008) found that academic performance having a positive influence on selected teaching practice.

Shulman (1986) noted that the role of scholarly teachers is the ability to transform one’s knowledge into teaching and the key to distinguish the knowledge base of teaching lies at the intersection of content knowledge and pedagogy (Shulman, 1987). The transformation and intersection of content knowledge and pedagogy underlies in pedagogical content knowledge. Ward and Paul (2010) stated that teachers must have an in-depth understanding of the content knowledge to demonstrate pedagogical content knowledge.

## **Methods**

### ***Instrument***

The development of misconception instrument was adapted from Rasch model (Bond and Fox, 2007). Some common misconceptions and true concept statements on various aspects of teaching games of understanding were compiled. These statements were subsequently incorporated into a questionnaire that presented 20 dichotomous questions with true/false answers.

Two pilot study (pilot 1:  $n = 25$  and pilot 2:  $n = 31$ ) were conducted with third year students in the Physical and Health Education programme at an Australian university to verify the validity and reliability of the questionnaires. Students were also provided with space to justify their reasoning for their answers so as to provide the researchers with a further understanding of any misconceptions identified.

Some items were amend between the pilot 1 and pilot 2 after having consulted with colleagues to read through the questionnaires to modify any ambiguous statements. The test of reliability on misconception scale were subjected to a Rasch analysis and the misconception instrument reliability was  $KR-20 = .52$  for TGfU.

## ***Subjects***

Subjects were fifty-five (20 male and 35 female) of fourth year undergraduate physical education majors at an Australian university who were between twenty and thirty years old. Of the participating 55 students, 95% are an Australian citizenship and others are citizens of New Zealand. The subjects had qualified an Australian Tertiary Admissions Rank (ATAR) which exceeds 77.00 with prior knowledge of English, Personal Development, Health and Physical Education, and Science at Higher Secondary Certificate level.

They were purposefully selected as participants for their completion of the TGfU subjects at the university. These final year students had studied TGfU subjects previously in second year (EDPM202: Teaching and learning net court, striking and target games) and third year (EDPM301: Teaching and learning invasion games). At the time of this study these students were completing their internship (teaching practice) for seven weeks during their spring session (Faculty of Education, 2011). This provided the opportunity for these students to put TGfU into practice.

## ***Data collection***

The study was conducted during class session were students were asked consent prior to completing the misconception questionnaires in the fourth week of their spring semester. Students were asked to complete the questionnaires without restrictions on time or resources in class. Students were asked again to complete the same misconception questionnaires after four weeks of their internship.

Content knowledge data was gathered through students' achievement from TGfU courses that they have undertaken during their academic session. The courses or subjects were EDPM202: Teaching and learning net court, striking and target games and EDPM301: Teaching and learning invasion games. The marks were not on a mere subject matter examination (See Table 1 for subjects' assessments).

## ***Measures***

Data for students' subject matter knowledge and conceptions of TGfU achievements were distinguished based on final grades of performance for undergraduate drawn from Faculty of Education Handbook (2011). The levels of percentage grades were as follow:

High distinction	85% to 100%
Distinction	75% to 84%
Credit	65% to 74%
Pass	50% to 64%
Pass conceded	45% to 49%
Satisfactory/unsatisfactory completion	e.g. Professional experience placements
Fail	0% to 44%

The level and diversity of subject matter knowledge and of misconception about TGfU were analysed through descriptive statistics. The magnitude of the differences and relationships between subject matter knowledge and misconception about TGfU were analysed using paired samples *t* test.

Table 1. The Weighting on subjects' assessment tasks

Subject	Assessment Tasks	Weighting
EDPM202:		
Teaching and learning net court, striking and target games	Game skill competency	Satisfactory/unsatisfactory
	Target presentation/video analysis	30%
	Session exam	25%
	Net court striking fielding	45%
	Presentation/movement and audio analysis	
EDPM301:	Resource folder	30%
Teaching and learning invasion games	Teaching presentation	10%
	Analysis	30%
	Examination	30%
	Game skill competency	Satisfactory/unsatisfactory

Source:

Subject outline: EDPM202: Teaching and learning net court, striking and target games. Undergraduate Education, Faculty of Education.SpringsSession2009. Subject outline: EDPM301: Teaching and learning invasion games. Undergraduate Education, Faculty of Education. Autumn Session 2010.

## Results

Data were generated from 20 dichotomous questions with true/false answers on conceptions of TGfU. A total of fifty-five of fourth year undergraduate physical education majors at an Australian university were asked to complete the conceptions of TGfU questions before and after four weeks of their internship. A summary of the descriptive results are displayed in Figure 1.

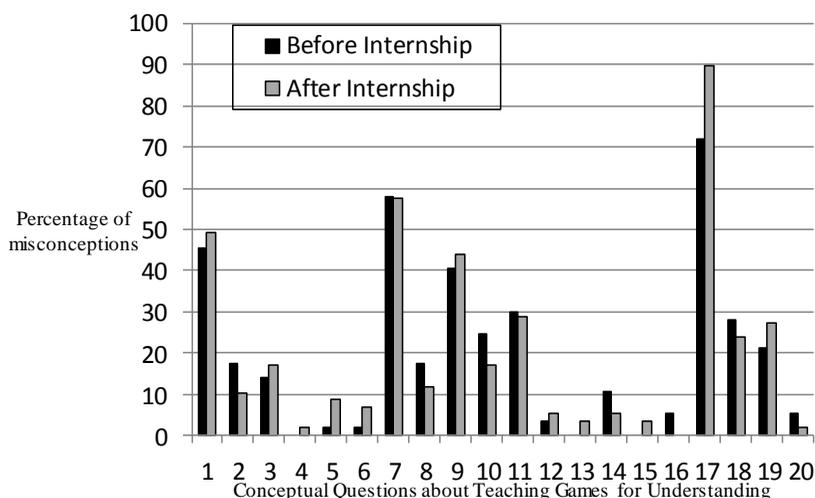


Figure 1. Percentage of students' composite responses to questions about conception of Teaching Games for Understanding.

Figure 1 showed that question number 17 which refers to ‘I conceptualised TGfU as having four categories with similar concepts and tactical problems across all four games categories’ scored highest percentage of students’ misconception either before (71.93%) and after internship (89.83%). The second highest students’ misconception of TGfU which scored 57.89% before and 57.63% after internship was question number 7 (I conceptualised TGfU in which students play games in order to further understand the importance of skill progression and skill practice). The first question; ‘I conceptualised TGfU as teaching tactics and not teaching skills’ was another misconception possessed by students (45.61% before internship and 49.15% after internship). Although the percentage was only 40.35% before internship and 44.07% after internship, question 9 was also pertinent to students’ misconception. They perceived TGfU approach is that a teacher needs to know all of the intricacies (technical and tactical) of each game to teach it to students.

Figure 2 showed students’ composite responses to the instrument questions about TGfU to determine whether the diversity of misconceptions changed from before to after internship.

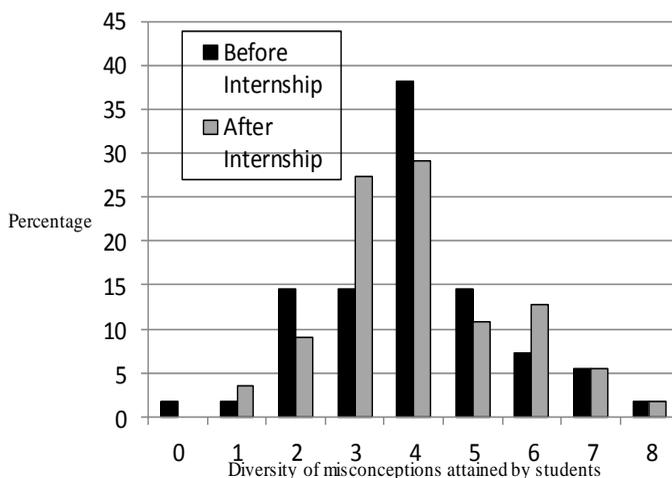


Figure 2. Diversity of misconceptions students attained against percentage.

It was found that a score of 8 was the diversity of misconceptions attained by students (Figure 2). Meaning that, 1.8 percent students attained eight misconceptions out of twenty questions about TGfU in both before and after internship. As much as 3.64 percent of the students attained no or one misconception before and after internship, 29.09 percent attained two or three misconceptions before and 36.36 percent after students’ internship. It was also found that 52.73 percent students attained four or five misconceptions before and 41.82 percent after internship and 14.54 percents attained six or more misconceptions before and 18.18 percent after students’ internship.

Data on Table 2 displayed information of students’ achievements in subject matter knowledge and conceptual knowledge of TGfU. Most of the students (54.55%)

achieved at credit level for EDPM202: Teaching and learning net court, striking and target games. 49.09% students achieved distinction and 40% achieved credit for EDPM301: Teaching and learning invasion games in their final grades. Their overall subject matter knowledge achievement was at credit level with mean marks of 73.56% ( $SD=5.09$ ).

Table 2. Level with percentage achievements of students' subject matter knowledge and conception on Teaching Games for understanding

Level	Percentage	% Achievement of subject Matter			% Achievement of correct conception		
		EDPM202	EDPM301	Overall	Before	After	Overall
		Internship			Internship		
High Distinction	85 to 100	01.82	07.27	01.82	32.73	40.00	21.82
Distinction	75 to 84	36.36	49.09	38.18	52.72	41.82	63.64
Credit	65 to 74	54.55	40.00	58.18	12.73	16.36	14.54
Pass	50 to 64	07.27	03.64	01.82	01.82	01.82	-
Pass conceded	45 to 49	-	-	-	-	-	-
Fail	0 to 44	-	-	-	-	-	-
<i>M</i> marks	72.47	74.65	73.56	80.18	79.91	80.05	
<i>SD</i>	05.85	05.46	05.09	07.82	07.67	06.34	

Note: EDPM202: Teaching and learning net court, striking and target games. EDPM301: teaching and learning invasion games.

As compared to students' achievement on their conceptions of TGfU (Table 2), 52.72% students acquired distinction and 32.73% high distinction before internship. Students' achievement on their conceptions of TGfU after internship was at distinction level (41.82%) and another 40% achieved high distinction. The overall achievement made by students on their conceptions of TGfU was at distinction level with mean marks of 80.05% ( $SD = 6.34$ ).

There was no significant difference ( $t = 0.23$ ,  $df = 54$ ,  $p = 0.821$ ; Table 3) in the diversity of misconceptions attained by students although the achievements frequency of some of the misconceptions increased after the internship (Figure 1). A paired samples  $t$  test does not show a statistically reliable difference between the mean before internship ( $M = 80.18$ ,  $SD = 7.82$ ) and after internship ( $M = 79.91$ ,  $SD = 7.67$ ) of misconceptions about TGfU that the students encompass.

Table 3. Statistical differences between students' concepts of teaching games for understanding before and after internship, and overall subject matter knowledge with overall concepts of teaching games for understanding

	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>
Concepts of TGfU before internship	80.18	7.82	.23	54	.821
Concepts of TGfU after internship	79.91	7.67			
Overall subject matter knowledge	73.56	5.09	-6.53	54	.000*
Overall concepts of TGfU	80.05	6.34			

Note: \* $p < 0.05$ .

A paired samples test was also conducted to compare the overall subject matter knowledge and overall concepts of TGfU. There was a significant difference in the scores for subject matter knowledge ( $M = 73.56$ ,  $SD = 5.09$ ) and concepts of TGfU ( $M = 80.05$ ,  $SD = 6.34$ );  $t(54) = 6.53$ ,  $p = 0.000$ . These results showed that subject matter knowledge does have an effect on students' concepts of TGfU.

In addition to the study, we analysed data between subject matter knowledge and students' misconception of TGfU to quantify its relationship. It was found that there is a very low relationship ( $r(53) = .19$ ,  $p = .176$ ) between subject matter knowledge and students' misconception of TGfU.

## Discussion

This study sought to explore the subject matter knowledge of fourth year students in a Physical and Health Education programme at an Australian university and their common misconceptions on Teaching Games for Understanding (TGfU). It was anticipated that this study would provide the opportunity for students to recognise the importance of knowledge of TGfU to put into their teaching practice.

Analyses of the data sources revealed that four misconceptions on TGfU appeared to be prevalent among the fourth year students. The four misconceptions were (1) TGfU as having four categories with similar concepts and tactical problems across all four games categories, (2) TGfU in which students play games in order to further understand the importance of skill progression and skill practice, (3) TGfU as teaching tactics and not teaching skills and (4) TGfU approach is that a teacher needs to know all of the intricacies (technical and tactical) of each game to teach it to students. These results reflect with literature studies that reveal a substandard concept of TGfU.

### *Misconception 1: Teaching Games for Understanding as having four categories with similar concepts and tactical problems across all four games categories*

Teaching Games for Understanding involves four categories and they are invasion, net/wall, striking/fielding and target but did not have similar concepts and tactical problems across all four games categories. Butler and McCahan (2005) outlined conceptual framework where game components used to distinguish the categories which include intent, concepts and skills, players' roles, playing area and offensive and defensive strategies. As made example by Webb and Pearson (2008), invasion are team games where the purpose is to invade the opponents territory with the aim being to score more points within the time limit than the opposing team, while endeavouring to keep their score to a minimum. The aim of net/wall games is for a player or team to send an object into an opponent's court so that it cannot be played or returned within the court boundaries. Striking/fielding games is a contest between the fielding and batting team where the aim is to score more runs than the other team using the number of innings and time allowed. The aim of target games is to place a projectile near or in a target in order to have the best possible score.

### *Misconception 2: Teaching Games for Understanding in which students play games in order to further understand the importance of skill progression and skill practice*

Turner (2005) stated that playing games is about solving tactical problems; skills are used to overcome these problems. TGfU is a pedagogical approach that focuses on student-centred and game-centred where the 'why' is taught before the 'how' to play

game with the use of tactical problems and solutions (Bunker and Thorpe, 1986). Therefore, students play games in order to further understand the importance of skill progression and skill practice do not reflect to TGfU approach.

TGfU allows for progressive development of skill/technique, tactical and cognitive development and decision making within a game setting. Skill practice is advocated but only when the learner is motivated to learn based on game play and then within a game-like practice (Hopper, 2009). Hopper and Kruisselbrink (2002) explained that if skill practice lacks a tactical frame, then it can sink into the “isolated skill focus” where students practice but without meaning with a limited chance for the skill transferring into the play of the game. It was suggested that a modified game adapted to players’ playing abilities should be introduced to develop skill improvement progressively through game practice in their learning process.

*Misconception 3: Teaching Games for Understanding as teaching tactics and not teaching skills*

Hopper (2002) emphasizes that the focus of TGfU is progressing from tactics to skills. The statement reflects TGfU as a pedagogical approach that underlines tactical awareness as a basis for making game play decisions before skills are needed in a game context. It is a misconception that TGfU only teaches tactics and not teaching skills. Berkowitz (cited in Hopper and Kruisselbrink, 2002) agreed that physical skills always as it would be in the game and mostly as a means to accomplish tactical problem. Berkowitz highlighted that skills cannot be taught without tactical awareness.

Therefore, teachers need to combine tactics and skills as games teaching that is suitable for students’ physical, social and mental development. TGfU model underlies a game-centred where games are modified and progressively to teach tactical understanding. Questioning and discussion are the main focus as to allow students to come up with their own ideas and solutions to tactical problems in a game setting. Technique is taught when students recognise tactics and skills are performed in a game like situation and not as isolated drills.

*Misconception 4: Teaching Games for Understanding approach is that a teacher needs to know all of the intricacies (technical and tactical) of each game to teach it to students*

It is of no uncertainty that a teacher should possess subject matter knowledge and be responsible for all aspects of the pedagogical process. As of the physical education teacher on teaching games for understanding approach, he/she needs to teach some basic skills such as catching, kicking and striking that are needed to play the game. The teacher needs to select games that will match the developmental needs of their students and at the same time teach a progression of tactical understandings to play effectively, that is anticipate where the ball will travel and/or aim for the spaces; within the primary rules of the game (Hopper, 2001).

Students will become literate in a variety of games by exposing them to the primary rules, fundamental skills and tactical problems associated with each game category. As made example by Hopper (2001), if a student understands the basic premise behind maintaining possession of an object in an invasion game (example; use short passes, shield a ball, support the player with the ball), this will help he/she play a variety of invasion games where these tactical solutions transfer between similar games (soccer, field hockey, European handball, basketball). Therefore, a teacher does not necessarily need to know all of the intricacies (technical and tactical) of each game to teach it to students.

This study also explored diversity of misconceptions attained by students to pose some possibilities of their misconceptions. A score of eight with only 1.8 percent students' attained misconceptions out of twenty questions about TGfU in both before and after internship was the highest possible diversity in the measure (Figure 2). The diversity of 4 misconceptions was the highest frequency attained by students from 20 questions on conception of TGfU. The diversity relates that students significantly not improved (Table 3) in their conceptions of TGfU after their internship with respect to before internship, predominantly for questions number 17, 7, 1, and 9 (Figure 1). It is possible that a lack of motivation to respond fully, rather than a lack of knowledge, led to misconceptions of TGfU. Probably students may choose an incorrect answer simply because they are guessing or a lack of clarity in the instrument itself, or combinations thereof. As noted in the methods, students completed the questionnaire without restrictions on time or resources and they were provided second opportunity to answer the TGfU conceptions questions after four weeks of their internship. However, we found that the post results contained the similar elements of misconceptions attained by students in the Physical and Health Education programme (Figure 1).

Although all of the undergraduate students who participated in this study had successfully completed two semesters of their subject matter (EDPM202: Teaching and learning net court, striking and target games and EDPM301: Teaching and learning invasion games), most of them achieved only at credit level for overall subject matter knowledge with mean marks of 73.56% (Table 2). As compared to students' achievement on their conceptions of TGfU, the overall achievement was at distinction level with mean marks of 80.05%. A paired samples *t* test (Table 3) showed that there was a significant difference in the scores for subject matter knowledge and concepts of TGfU. These results implicates that subject matter knowledge does have an effect on students' concepts of TGfU but with very low relationship.

### **Implications of Content Knowledge to Teaching**

Kandel (2002) explained that teachers with rich subject matter knowledge tend to emphasize conceptual, problem solving and inquiry aspects of their subjects. Less knowledgeable teachers tend to emphasize facts, rules and procedures and may stick closely to detailed plans or the textbook. As for physical education teachers, they need to be more knowledgeable about games and have had practical experience of what games have to offer. Almond (1986) wrote that teachers with little experience or knowledge of games will not make further progress, they will simply revert back to traditional practices where the emphasis is on technique. Almond (1986) also stated that teachers feel more confidence when they are repeating or copying ideas presented to them rather than developing ideas which can be translated into practical suggestion in their teaching.

If teachers are to improve the quality of teaching and learning in content areas, they need to resist the pre-concept or misconception of the subject matter. A deep understanding of games both within and across categories is essential for both pre-service and teachers' development. Forrest et al. (2006) proposed the use of a theoretical four phase model for pre-service teachers to understand the TGfU process. The theoretical model for games understanding consists of Phase 1: Elementary understanding of games within a category that involves deconstructing a game. Phase 2: Elementary understanding of games across categories. It involves comparing games across categories so that principles of play, tactics and strategies, rules and technical skills are examined to find general similarities and differences. Phase 3: Advanced understanding of a game

within a category. This means that the teacher should have an appropriate level of games understanding to provide pedagogically challenging lessons for most students in secondary education classes. Phase 4: Advanced understanding of games within and across categories. Teachers should analyse a series of games within a category developing a summary sheet of the game elements divided into the three subcategories. This will allow comparisons between games noting the areas of technique, rules and tactics and strategies that are similar and which are sport specific, allowing teachers to determine whether specific strategies of attack in squash can be used in or adapted for badminton, whether methods used to create an overlap in touch can be used to create an extra player in basketball offence.

Ward (2009) identified four components of content knowledge in physical education: (1) knowledge of the rules and etiquette of the activity, (2) knowledge of the techniques and tactics required to perform the activity, (3) knowledge of performance errors made by beginners, and (4) knowledge of tasks that facilitate learning of the content.

When teaching subject matter, teachers' actions will be determined to a large extent by the depth of their pedagogical content knowledge, making this an essential component of their ongoing learning. Subject matter is an essential component of teacher knowledge and therefore they must know the subject they teach. Indeed, there may be nothing more foundational to teacher competency. At the same time, however, just knowing a subject well may not be sufficient for teaching (Evenand Tirosh, 1995).

To teach all students according to today's standards, teachers need to understand subject matter deeply and flexibly so they can help students create useful cognitive maps, relate one idea to another, and address misconceptions. Teachers need to see how ideas connect across fields and to everyday life. This kind of understanding provides a foundation for pedagogical content knowledge that enables teachers to make ideas accessible to others (Shulman, 1987).

## **Conclusion**

Analyses of the data revealed that four misconceptions on TGfU appeared to be prevalent among the fourth year students in the Physical and Health Education programme. The four misconceptions were (1) TGfU as having four categories with similar concepts and tactical problems across all four games categories, (2) TGfU in which students play games in order to further understand the importance of skill progression and skill practice, (3) TGfU as teaching tactics and not teaching skills and (4) TGfU approach is that a teacher needs to know all of the intricacies (technical and tactical) of each game to teach it to students. A score of 8 was the diversity of misconceptions attained by students and relates that students significantly not improved in their conceptions of TGfU after having through their internship with respect to before internship.

Although all of the undergraduate students who participated in this study had successfully completed two semesters of their subject matter (EDPM202: Teaching and learning net court, striking and target games and EDPM301: Teaching and learning invasion games), most of them achieved only at credit level for overall subject matter knowledge with mean marks of 73.56%, as compared to students' achievement on their conceptions of TGfU at distinction level with mean marks of 80.05%. The study implicates that subject matter knowledge does have an effect on students' concepts of TGfU but with very low relationship. The implication of content knowledge to teaching is to resist the pre-concept or misconception of the subject matter. Teachers must know

the subject they teach and when teaching subject matter, teachers' actions will be determined to a large extent by the depth of their pedagogical content knowledge, making this an essential component of their ongoing learning.

### Further Research Recommendations

It is hoped that the recommendation made here will stimulate further research about subject matter knowledge or content knowledge and misconceptions in relation to pedagogical aspect in Teaching Games for Understanding.

First, in studying teachers' content knowledge, it would be useful to find out whether there are aspects of teachers' misconceptions of TGfU that will predict to students' achievement.

Secondly, it could be useful to study whether and how different approaches to TGfU have different effects on students' conceptualize and achievement.

Finally, the design for TGfU module probably will clarify curriculum content for the preparation of professional teachers to practice and to the knowledge and skill demanded by their work.

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