AN ABSTRACT OF THE DISSERTATION OF

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Title: Effects of Teaching Games for Understanding on Game Performance and Understanding in Middle School Physical Education

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Most students arrive at game-focused physical education (PE) with neither the skills nor the tactical knowledge to be successful (Metzler, 2000). Although the Teaching Games for Understanding (TGFU) approach can enhance both on- and off-the-ball skills in game play performance (Griffin et al., 1995; Harvey et al., in review, Harvey 2003; Mitchell et al., 1995) results from previous research examining TGFU's effectiveness in PE settings have been equivocal. The present study was conducted to a) examine whether an 11-13 lesson unit of soccer taught using the TGFU approach would improve the Game Performance (GP) and Game Understanding (GU) of grade six PE students; and b) assess the relationship between GP and GU. Using a single subject, delayed multiple baseline design, three students (a higher-, moderate- and lower-skilled student) were randomly selected from four different grade six (11-12 years) PE classes (n=12). Data were collected on eight measures of GP (using the Game Performance Assessment Instrument, [GPAI]) and three measures of GU (using a modified version of the Verbal Protocol Analysis [VPA] technique). Students were followed over an 11-13

soccer unit taught using the TGFU approach. Elements of GP were formulated into four GP indices: Decision Making Index (DMI); Skill Execution Index (SEI); overall Game Performance Index (GPI); and Game Involvement (GI). The latter GI Index was further divided into appropriate/inappropriate on- and off-the-ball actions. All GP data were plotted graphically and analyzed visually using standard analytic criteria. Developments in the total, variety (i.e. 'goal', 'condition', action etc), and level of sophistication (i.e. '0', '1', '2' and '3') of coded verbal statements from the VPA GU task were assessed using a series of 12 separate repeated measures ANOVA's. The relationship between the GP and GU was also assessed using a Pearson correlation. All GP indices and GI remained somewhat variable between the baseline and intervention phases of the study and no individual participants improved on all GP and/or GI indices. However, 10 of the 12 participants improved at least one aspect of their GP, with seven improving their SEI, four their DMI and six their GPI when compared to baseline. Furthermore, nine of the 12 participants improved either their appropriate GI or reduced their inappropriate GI when compared to baseline, with 10 if the 12 participants improving their on-the-ball GI and five of 12 their off-the-ball GI when compared to baseline. In the VPA GU task, findings were also variable. Participants significantly increased the total number of coded verbal statements, and the use of condition 'if' and 'then' statements. In addition, they significantly decreased their use of affective 'opinion' statements. However, participants also demonstrated minimal improvements in their use of more sophisticated descriptions of the game play action. Finally, there appears to be no strong link between the way in which GP and GU emerges and/or develops, at least within the limitations of this study (i.e. such as the small sample size and the short duration of the learning period.

However, a TGFU-based unit of soccer, focused on teaching both on- and off-the-ball elements of game play, is associated with developments in participants' GP and GI indices across participants from high, moderate and low skill levels. Moreover, although some improvements in GU were also observed (i.e. in terms of the variety, level of sophistication and total numbers of coded statements), these were less likely to discriminate skill levels than measures of GP.

Effects of Teaching Games for Understanding on Game Performance and Understanding in Middle School Physical Education

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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

Stephen Harvey, Author

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DEDICATION

To my Grandma ‘Bingo’ for all she did for me during her life. She will be remembered fondly by all.

Effects of Teaching Games for Understanding on Game Performance and Understanding in Middle School Physical Education

Chapter 1 – General Introduction

Students arrive at game focused physical education (PE) with neither the skills nor the tactical knowledge to be successful (Metzler, 2000). Indeed, skills learned in traditional technique-oriented games teaching approaches lead to breakdowns in game play (Bunker & Thorpe, 1982). The Teaching Games for Understanding (TGFU) approach (see appendix 1 for further information) has the potential to facilitate the development of not only on-the-ball but off-the-ball skills and movements to enhance game play performance (Allison and Thorpe, 1997; Griffin Mitchell, & Oslin, 1995; Harvey, Wegis, & Massa-Gonzalez., in review, Harvey 2003; Lawton, 1989; Mitchell, Oslin, & Griffin, 1995; Turner, 1996; Turner and Martinek, 1999; Turner, 2003) whilst at the same time providing enhanced student motivation (Griffin et al., 1995; Holt, Strean, & Benegochea, 2002). TGFU can make learning experiences authentic and meaningful connecting students' experiences in PE to their previously held cultural conceptions of games (Kirk & McPhail, 2002). Indeed, with such an emphasis on games in PE curricula (65% in the UK and 50% in Canada) there is a need to identify effective ways to instruct students to play these games (Mandigo et al., 2004; Werner, Thorpe, & Bunker, 1996).

In the last decade, TGFU has received much support from practitioners and the research community alike. Indeed, Rink, French, and Tjeerdsma, (1996) noted that research on TGFU has produced some positive learning outcomes for students, especially in tests of tactical knowledge. However, these authors also noted that, despite these positive findings, more empirical support for TGFU is warranted.

Previous research to assess the impact of TGFU interventions on middle school students game play ability consisted mainly of comparative studies (Allison & Thorpe, 1997; Griffin et al., 1995; Lawton, 1989; Mitchell et al., 1995; Turner & Martinek, 1992, 1999; Turner, 1996) and to observing three dependant variables; skill, knowledge and game play. Other comparative studies have looked at the use of the TGFU approach in elementary school (Tallir, Musch, Lenoir, & Valcke, 2003) and high school settings (French, Werner, Rink, Taylor, & Hussey, 1996; French, Werner, Taylor, Hussey, & Jones, 1996), with college-aged students (Blomqvist, Luhtanen, & Laasko, 2001; Harrison et al., 2004), and with adults (McPherson & French, 1991).

Skill

Research into the effectiveness of TGFU as an instructional approach began with Lawton's (1989) study in badminton. The TGFU group showed a greater degree of improvement of techniques than the technique-orientated group, although this difference was not statistically significant. Similar improvements on badminton skills tests were also evident in the TGFU, technique-orientated and combination of methods groups (over the control group) in six week and three week studies in badminton (French, Werner, Rink, et al., 1996; French, Werner, Taylor et al., 1996). A 20 lesson badminton intervention (Blomqvist et al., 2001) also found that both treatment groups (one technique-orientated and one technique-orientated plus video based training) performed better than the control group with both the TGFU group and technique-orientated groups showing a significant improvement over time on serving skill.

McPherson and French (1991) had earlier noted that the forehand and backhand tennis stroke improved for groups taught using a technique-orientated based approach

while the volley improved more in the TGFU group. Also in a 10 lesson tennis unit Turner (2003) noted a trend to better control, decisions and execution for the group taught by the TGFU method.

Allison and Thorpe (1997) noted that the skills of the two groups taught using a TGFU approach were as good if not better than those taught by a technique-orientated approach, in a 12 week, six lesson intervention (male groups was taught basketball and the female groups were taught field hockey). Turner and Martinek (1999) found that the technique-based group was significantly faster than the control group on the skills test in field hockey. In an earlier study, Turner and Martinek (1992) also found no significant differences in skill levels when the two approaches were used to teach field hockey. No significant differences between groups were found in an eight lesson soccer unit (Mitchell et al., 1995) and in a nine lesson unit of volleyball (Griffin et al., 1995).

A more recently published study by Harrison et al., (2004) showed that *both* the TGFU and technique-orientated groups showed significantly different scores on pre and post test measures of volleyball skills using the American Alliance for Health Physical Education, Recreation and Dance (AAHPERD) skills tests.

These studies lend support to the notion that playing games do not make techniques worse, which also may be a concern to a physical educator or coach who is worried about students/players losing skills by playing too many games but does not lend conclusive support to TGFU's ability to heighten technique.

Knowledge

The main sources of assessing development of knowledge of study participants in TGFU research has been through the use of written knowledge tests (Allison & Thorpe,

1997; French, Werner, Rink et al., 1996; French, Werner, Taylor et al., 1996; Jones & Farrow, 1999; Turner & Martinek, 1992, 1999). Turner, Allison, Pissanos and Law (2001) advocated that declarative knowledge (i.e., factual information such as rules) is a precursor to procedural knowledge (i.e., how to apply the rules in the context and constraints of the game). Previously, Thomas and Thomas (1994) highlighted this point.

The research employing these aforementioned knowledge tests produced equivocal findings with some authors observing a change in knowledge and others not. Indeed, Harrison et al., (2004) found no significant differences between pre- and post knowledge test of the rules, strategies and techniques of volleyball. Previously, Lawton (1989) found no significant differences in declarative and procedural knowledge development over time. Lawton concluded that a low level of improvement by the group being taught badminton using a technique-orientated approach over the course of six one hour sessions indicated that technique-orientated approaches to teaching games did little in developing intelligent performance. Indeed, the TGFU group made more progress in understanding tactics and strategies than the technique-orientated group.

Turner and Martinek (1992) found there was no relationship between knowledge and decision making and found no significant differences in declarative and procedural knowledge development over time. However, Turner (1996a) replicated the field hockey study of Turner and Martinek (1992) with a longer intervention and found that the TGFU group did improve significantly on declarative knowledge. More recently, Turner and Martinek (1999) also found that the TGFU group scored significantly higher than the control group on both declarative and procedural knowledge. A further study of tennis (Turner, 2003) revealed higher skill knowledge for the TGFU group but not a better

understanding of rules and tactics for the TGFU group as against a technique-orientated group.

Using field hockey and basketball Allison and Thorpe (1997) found greater increases on knowledge and understanding tests for the TGFU group. Studies by Mitchell et al., (1995) in soccer and Griffin et al., (1995) in volleyball also found declarative knowledge to be higher in the TGFU group than the technique-orientated group. These studies therefore lend support to the notion of declarative knowledge development before procedural and that contextual game play contexts may aid in this knowledge development.

Although Tallir, Musch, Lenoir, et al., (2003) found higher memory scores in non-TGFU group in basketball contexts, they concluded that this was just a result of the focused nature of this particular teaching strategy. In the TGFU condition Tallir, Musch, Lenoir et al. found more efficient acquisition of decision making knowledge and they explained this was due to the complex nature of the learning context. They further stated that players have to sink or swim with the TGFU approach. However, results for the study indicated no statistically significant impact of either instructional approach on a decision making and memory test.

Due to concerns regarding the authenticity of written tests, (i.e. the likely transfer of this written knowledge to practical performance), Blomqvist et al., (2001) used not only a written knowledge test, but also tested Game Understanding (GU) in badminton using problem representation *'situations'* (i.e. situations they felt would occur in the game). The results indicated that the treatment groups did better than the control group on tests of both knowledge and GU in badminton, but only the TGFU group showed a

significant improvement over time in these tests. In the study methodology the TGFU group and technique-orientated groups received the same on-court instruction but the TGFU group participated in additional video-based problem representation situation training (tactical instruction). The authors concluded that the cognitive aspects of Game Performance (GP) were limited to the TGFU group, i.e. those who received separate tactical instruction.

Although the findings on the development of knowledge through using the TGFU approach to teaching also remain equivocal, it may once again be due to poor measurement and/or study design. However, Rink, French and Graham (1996) have noted that students taught by the TGFU approach seemed to perform better on tests of tactical knowledge than those taught from a technique-orientated approach. So to aid in advancing the empirical base of evidence TGFU researchers need to decide on one methodological design and/or instrument to measure knowledge development and construction if their work is to contribute more to the development of motor learning research, cognition and learning theory (McMorris, 1998). Studies using an alternative approach of ascertaining knowledge construction and development of individuals in high strategy sports, verbal protocol analysis (McPherson & Thomas, 1989), will be discussed in a later section. This is a relatively new tool that has had limited use in TGFU research to date.

Game Play

Most of the studies in this section have used a game play protocol technique (McPherson & French, 1991; Thomas & McPherson, 1989) to assess GP. In this technique descriptors are formed for items such as decision-making and skill execution

and coded 1 if they are successfully achieved and 0 if the students in the context of the game are unsuccessful in achieving these descriptors. Using this technique, McPherson and French found that a group instructed by way of a technique-orientated approach in tennis improved technique execution during practice and game play, but did not continue to improve when strategies were introduced. Those who followed a TGFU approach improved their ability to execute techniques only after the introduction of direct teaching of technique. Again using game play protocols, Turner (2003) found that the TGFU group was significantly better in game play at contacting the tennis ball, permitting better selection of an action stroke. TGFU students were also better at putting the ball back into play and this group showed a trend to better decision making in games.

In an earlier study also using the aforementioned technique with field hockey, Turner (1996a) found that the game centered group did improve significantly on decision making in game play. More recently, also in field hockey, Turner and Martinek (1999) found that the TGFU group scored significantly higher on passing decision making, control and passing execution in post-test game play, and Allison and Thorpe (1997) showed that the TGFU group had a better understanding of game concepts in both field hockey and basketball.

In badminton, French, Werner, Taylor et al., (1996) established that the TGFU and technique-orientated groups performed better than a group taught by a combination of these two approaches and a control group on important measures of game play at the mid-point assessment. However, by the sixth and final week of the study, the combination group caught up. In their previous study French, Werner, Rink et al., (1996) found no differences between any of the aforementioned groups in terms of game play.

Blomqvist et al., (2001) used video analysis to assess similar game components in badminton and findings indicated there was a trend in higher GP for favoring treatment groups (both technique-orientated and TGFU) in the amount of forceful shots. Earlier Lawton (1989) found that the TGFU group made more progress in understanding tactics and strategies of badminton than the technique-orientated group by playing games, although results were not statistically significant.

Using the Game Performance Assessment Instrument (GPAI) in soccer Mitchell et al., (1995) reported that the TGFU approach was effective in improving GP, particularly in off-the-ball movement and decision-making. In a volleyball context, Griffin et al., (1995) found GP also improved particularly in the areas of court positioning and decision-making.

Harrison et al., (2004) found no significant differences between approaches in terms of game play in 6 v 6 volleyball games. They assessed the amount of *successful* (legal and tactically appropriate) hits, *legal* (successful but not tactically appropriate) hits and *unsuccessful* (none of the aforementioned) hits. They reported that although there were no differences between treatment groups, better skills from the students in both treatment groups were the precursors to higher percentages of successful and legal hits. Those, in turn, produced more contacts per serve and longer, more exciting rallies. Having already separated the players into high and low skilled groupings the authors noted that the low-skilled students' learning curve did get closer to that of the higher skilled students over the course of the study, but higher-skilled students remained higher contributors to more successful and legal hits per serve than the low-skilled students.

These previous comparative studies have shown that game play can be improved by using TGFU instruction. Indeed, Rink, French and Tjeerdsma (1996) argued from two studies completed by McPherson and French (1992) that skill is not fully developed until incorporated with game play. More recently, McPherson and Kernodle (2003) have also forwarded the notion that there may be a need to target tactical skills with more direct instruction as these skills may take as long to develop as technical skills. Thus, there is a need to develop the cognitive aspects of performance as they also contribute to skillful play in games at all levels as well as the technical aspects of play such as the control of an object. The cognitive aspects of performance (i.e. GU) will be discussed later in the introduction.

The acceptance of TGFU as an approach to teaching has been compromised by equivocal empirical support. It has been hampered further by the dependence on the use of a comparative theoretical framework which has compared TGFU's effectiveness to the technique-orientated approach (Kirk, 2005). While this is one theoretical framework, and one that has been extensively used in previous studies for evaluating the effectiveness of TGFU, an alternative theoretical framework has been suggested by Kirk (2005). He suggested the use of a "practice-referenced approach" (p.216). His rationale for this approach is centered on the issue of whether TGFU can be an effective teaching approach. Thus, it is not about whether TGFU is better than other approaches, or about 'how' we teach, but about 'what' we teach and how we can integrate technical skills into game play to make students successful games players. He stated that TGFU has different learning outcomes in mind than the traditional technique-orientated teaching approach. TGFU is characterized by small group, task based learning, which is focused on the

strategic, decision making and movement execution aspects that are part of effective game play, and not by organizing students in row lines and giving them direct instruction (to teach them about safety and control), which are common features of the traditional technique-orientated approach.

The need for a high level of technical skills were never rejected by advocates of the TGFU approach (Thorpe & Bunker, 1982), but the ways students were taught games and game skills needed changing in order to adapt them to learning outcomes reflective of game play. The fact that much research has centered on comparing the approaches has only compounded this debate about "which method is best", rather than looking at the issue more holistically and assessing if TGFU can teach students how to play the game, based on behavioral, cognitive and/or affective outcomes (Mandigo, et al., 2004).

The practice referenced approach is designed to fit into the routine circumstances and the real-time issues the teacher/coach and his/her class/group face on a day to day basis, and is much like a "teaching experiment". Within this approach units of work are implemented as faithfully as circumstances allow, learning outcomes are set, and the participants in the experiment are evaluated based on these learning outcomes. For example, the teacher/coach or the participants in the class may discuss weaknesses the students are having in combating the tactical problem of 'maintaining possession of the ball' in soccer after having them play an initial game form (4 v 4 game). After this discussion, the teacher/coach would organize a play practice (Launder, 2001) where students play a keep away game. Once they have mastered this keep away game, with varying degrees of defensive pressure, the participants would be guided back to the initial 4 v 4 game. This time, however, to stress the tactical problem of 'maintaining possession

of the ball' a modification to the game could be made where each team could only shoot on goal after they have kept the ball for three consecutive passes. In sum, this final game stresses the tactical on-the-ball skills of 'when' and 'how' to pass, 'which type' of pass to use, and the off-the-ball skills of 'how' and 'when' to 'get open/free' to receive a pass.

In two previous studies, Harvey (2003) and Harvey, Wegis, and Massa-Gonzalez, in review) used a practice-referenced approach to teach high school-aged soccer players off-the-ball defending concepts with the TGFU approach,. In both studies defending players were assessed in units of three players whilst playing a 3 v 3 modified half-field soccer game. Findings from the first study (Harvey, 2003) with one group of 16 – 18 year old English players indicated that the 12 lesson TGFU intervention aided the development of overall GP due to the increase in adjust and cover skills, particularly during the second part of the intervention. In the second study (Harvey et al., in review), with two groups of American high school players, varsity (14 – 18 year old players) and first year (14 – 15 year old players) teams received a similar 8 lesson TGFU intervention as the previous study. Findings indicated differences between the first year group of players and the varsity group , with the first year group responding more favorably to the TGFU intervention, significantly improving both adjust and cover skills. Previously, in comparative research, Mitchell et al., (1995) has also demonstrated that a TGFU intervention can improve off-the-ball movements in soccer, and Griffin et al., (1995) noted TGFU instruction improved court positioning in volleyball.

Results from these studies indicated that using the TGFU approach may allow instructors to focus on 'teaching through and in the game' and, thus, more emphasis can be placed on off-the-ball skills, such as supporting a teammate who has possession of the

ball, or adjusting to cover for a player who is out of position in defense (Launder, 2001). This is an important aspect of any team game, especially soccer, as time "on-the-ball" is limited (Light, 2005). In addition, teachers can aid in raising the students' awareness of concepts such as time, space, and risk and safety that are required to make appropriate decisions and effective skill executions in the game.

The use of a single subject research design will allow for the evaluation of the practice referenced "teaching experiment" approach, and assess the effects of the TGFU intervention on *small units of individuals*. Only one previous study in the TGFU literature (Holt, Ward & Wallhead, 2006) has employed a single subject design. In this study the authors used a multiple treatment design to assess six college-aged participants (three from two different classes) 4 v 4 game play performances immediately following either a 2 v 1 or a 3 v 2 soccer 'play practice' (Launder, 2001). Results revealed that the 14 sessions of instruction via the play practices were successful for the most able participants as they were able to consistently perform the appropriate tactical responses in the game, whilst the less able had more difficulty. Although data from three participants indicated that the 3 v 2 practice condition was more effective in transferring learning from the practice to the 4 v 4 game, the type of practice (i.e. 2 v 1 or 3 v 2) did not appear to impact learning. The authors concluded that performance above 70% correct allowed for the greatest transfer of learning from 'play practice' to the 4 v 4 game, the instructors timely and appropriate feedback was essential in creating learning, and finally, research to address the common problem of teaching individuals in group settings to examine how this prevents individuals from practicing small but significant mistakes is needed.

A study by Hastie and Curtner-Smith (2006) further examined the effects of the practice referenced teaching experiment approach, but this time using a 22-lesson hybrid TGFU sport education striking and fielding unit with sixth grade students. Data were collected via a) a critical reflection data sheet on conclusion of each class period, b) four tactical quizzes, c) a game design form, and d) a group interview. Critical reflection data were analyzed using the frequency of thoughts and perceptions of the students, tactical quizzes were sorted to examine the numbers of students who gave the correct responses and interview data were explored for content before being coded and categorized using the same procedures as the critical incident data. Findings revealed that students responded well to the myriad of problems offered by the game, executing most rudimentary and sometimes more sophisticated batting and fielding problems transferring the problems associated with batting and fielding across the variety of games played in the intervention sessions. Although the combination of the two teaching approaches (TGFU and sport education) did not weaken curricula, the combination did place more emphasis on the teacher to drive and motivate proceedings, thus, teaching with this approach relied on the teacher possessing both more content and pedagogical knowledge.

The integration of the cognitive component of learning to the study follows recommendations by Grehaigne, Godbout, and Bouthier (2001) who suggested that in order to better understand how decision making skills evolve in game play action, consideration must be given to more than just game play performance. They stated that verbalization can be considered observable information about cognitive processes, and overt verbalization can be used as a tool for teachers and students to collect information about their thought processes, and be used as a tool for eliciting reflection and critical

thinking about performance to bring transformation to action play. In a verbalization settings, the teacher may then hear information such as 'I should have", "I might have" "I did or did not" and so on. Indeed, these statements are similar to 'if' and 'then' statements and condition-action sequences that characterize the development of procedural and strategic knowledge. These developments may be associated with more playing experiences of a particular activity (Beilock & Carr, 2004).

Turner (2003) recommended using Verbal Protocol Analysis (VPA) in order to provide more insight into the effectiveness of the TGFU teaching method. The VPA technique has been used to assess problem representations of sports performers whilst in the act of competing in high strategy sports. This procedure was originally devised for tennis and has been used with various populations within this sport such as boys tennis (McPherson & Thomas, 1989), youth and adult women's tennis (McPherson 1999a), and collegiate women's tennis (McPherson, 2000). VPA has also been used in PE settings with high school badminton students (French, Werner, Rink et al., 1996; French, Werner, Taylor et al., 1996), with collegiate volleyball blocking (McPherson, 1993b), and with collegiate baseball batting preparation (McPherson, 1993a) and with male baseball shortstops using a talk-aloud procedure (Nevett & French, 1997). However, the VPA technique has had limited use in studying invasion type games where game play is more dynamic in nature, and has primarily been used in studies focused on net/wall and striking and fielding games where there are natural breaks in play, and games are less dynamic in nature when compared to invasion games such as soccer.

One benefit of using VPA in previous net/wall and striking and fielding contexts was that it allowed researchers to interview players between points/pitches (called

immediate recall interviews and *planning interviews*) by asking them "what were you thinking about in the last point/pitch" and "what are you thinking about now" respectively.

Logistically McPherson and Thomas (1989) reported that they placed tape recorders at the back of each court for the players whilst they played, and in between points players approached the tape recorder, pressed record and then answered the prompts in the quotation marks above that were placed next to the tape recorder. In the current study a modified version of the previously discussed VPA protocol will be used to assess participants GU whilst watching a classmate perform in a 4 v 4 endzone soccer game (see Chapter 3 for more detail).

Once collected, data are then transcribed and analyzed for content. They are coded by identifying a) concepts (G: goal orientated statements; C: condition orientated statements; A: action statements; D: do statements; R: regulatory statements; Aff: affective statements, and lastly, P: predict statements); and, b) the sub concepts category (excluding goals): the level of sophistication (0 = inappropriate or weak; 1 = appropriate, but no features; 2 = appropriate and one feature; 3 appropriate and two or more features). Examples of these statements can be seen in appendix 28.

However, an example of data coded from one player's verbalizations is provided below for both a novice tennis player and a professional tennis player in competition. A novice player's statements have previously been coded using the aforementioned format. They primarily generated goals in response to game situations:

> "I just have to keep making him make mistakes as I go through" (Goal, Level 1) and "I gotta just keep putting the ball in play (Goal, Level 0) and making him make mistakes throughout the match (Goal, Level 1)".

In contrast professionals formed solutions in response to their goals. One player stated:

> "Ok, so far my plan is working (Condition, their strength, 1 feature), just let Dan make the mistakes here (Goal, Level 1), keep everything in play (Goal, Level 0), once he starts to fold a little bit (Condition, opponents weakness, 1 feature), I'm going to put some pressure on him (Goal, Level 1) and start coming in (Condition, position type, 1 feature)" (McPherson & Kernodle, 2003, p. 150).

McPherson and Kernodle (2003) characterized these statements into a macro-level profile stating that novice players had poor problem representations and only used working memory to plan their performance on points in tennis. Weaker players usually try and accomplish basic execution goals. At the intermediate levels players started to use some problem representations as well as working memory to develop "action plan profiles". At the advanced level of performance players used problem representations that they had stored in their Long Term Working Memory (LTWM) from previous performances and constantly update their action plan profile to develop a "current event profile". Results of the various studies mentioned above show that those players with more experience have more advanced problem representations due to developments in LTWM. For example, youth experts have more advanced representations than youth novices but less advanced representations than older youth or adult players. Experts also plan, regulate and monitor their performance better.

Nevett and French (1997) used a talk-aloud procedure with male baseball shortstops and found that shortstops 12 years or younger did not produce advanced defensive plans, active rehearsal of plans and updating of plans was also poor. High school shortstops produced all these qualities with advanced quality. Similarly in tennis McPherson (2000, 1999a) showed that experts generated more total, varied and

sophisticated goal, condition, action and do concepts than novices. Experts planned for actions based on elaborate action plan and current event profiles whereas novices rarely planned and lacked these knowledge structures. Novices therefore had weak problem representations.

The VPA technique has been used in two previous TGFU studies with high school students playing badminton in PE settings (French, Werner, Rink et al, 1996; French, Werner, Taylor et al., 1996). Findings from these studies revealed that none of the 48 students in the three-week study (French, Werner, Rink et al., 1996) thought in sophisticated ways about their play and/or used condition-action statements, although some students could demonstrate tactical reasoning in game play. In the six-week study (French, Werner, Taylor et al., 1996) only two of 52 players reported plans with condition-action linkages. Since these two studies VPA has had limited use in TGFU research.

In addition to gleaning more information about the cognitive processes students go through during performance and whether their knowledge changes with more experiences actually playing the game, an attempt was made to examine whether GU (i.e. cognitive awareness) is related to GP (i.e. do the better players in terms of GP have higher levels of procedural and/or strategic knowledge of the game and vice versa?).

French et al., (1995) examined the relationships between cognitive and behavioral aspects of play from a sample of seven to 10 year old baseball players (N = 159). From their findings they concluded that the skill aspects of performance discriminated skill levels whilst cognitive components. Blomqvist et al., (2005) assessed the link between GU and GP. GU was measured by 14 and 15 years old participants (N = 12) responding

to 'problem representation' situations from 3 v 3 soccer video film, and GP was measured using the constructs of decision-making and skill execution though observation of actual performance by the same players in 3 v 3 games. The authors found that a) those players who responded better in problem representation situations were also better in game play situations, suggesting that GU is related to GP, b) players made more decisions than skill executions (see also McPherson & Kernodle, 2003), and c) players found actions related to offensive aspects of the game easier than defensive actions (see also Griffin et al., 2001). The authors concluded that teachers should target their teaching toward a) decision making, as decisions occurred more often than skill executions, and, b) off-the-ball movements in game play as these remain largely are ignored in games teaching. That is, they deserve more attention in games teaching.

Therefore, this study will assess both students' response selection and response execution (the elements of "what to do" and "how and when to do it" in the TGFU model [McPherson, 1994]) with the information processing model as a framework. Specifically, the study is concerned with the three phases of (a) perception, (b) cognition i.e. decision making, and (c) action, i.e. movement execution (Kirk & McPhail, 2002).

The purposes of this study were to:

a) Examine whether an 11-13 lesson unit of soccer taught from the TGFU perspective improved the GP and GU (i.e. procedural and strategic knowledge) of grade six PE students, across skill levels, and classes.

b) Assess the *relationship* between GP and GU (i.e. does more knowledge of the game of soccer translate into improved GP, and vice versa?).

Running Head: Effects of TGFU on Game Performance in Middle School PE

Effects of Teaching Games for Understanding on Game Performance in Middle School Physical Education

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Abstract

Background and Significance: Most students arrive at game-focused physical education (PE) with neither the skills nor the tactical knowledge to be successful (Metzler, 2000). Although the Teaching Games for Understanding (TGFU) approach can enhance both on- and off-the-ball skills in game play performance (Griffin et al., 1995; Harvey et al., in review, Harvey 2003; Mitchell et al., 1995) results from previous research examining TGFU's effectiveness in PE settings have been equivocal. **Study Aims**: The present study was conducted to assess whether an 11-13 lesson unit of soccer taught using the TGFU approach could improve the Game Performance (GP) of grade six physical education students (ages 11-12), across skill levels, and class periods. **Experimental Design and Methodology**: Using a single subject delayed multiple baseline design, three students (a higher-, moderate- and lower-skilled student) were randomly selected as the unit of analysis from four different grade six PE classes (n=12). Students were followed over an 11-13 soccer unit taught using the TGFU approach. Data were collected on eight measures of GP using the Game Performance Assessment Instrument (GPAI). Elements of GP were formulated into four GP indices: Decision Making Index (DMI); Skill Execution Index (SEI); overall GP Index (GPI); and Game Involvement (GI). The GI Index was divided further into appropriate/inappropriate on- and off-the-ball actions. All GP data were plotted graphically and analyzed using standard visual analysis tactics. **Results:** All GP indices and GI remained somewhat variable between the baseline and intervention phases of the study and no individual participants improved on all GP and/or GI indices. However, 10 of the 12 participants improved at least one aspect of their GP, with seven improving their SEI, four their DMI

and six their GPI when compared to baseline. Furthermore, nine of the 12 participants increased either their appropriate GI or decreased their inappropriate GI when compared to baseline, with 10 if the 12 participants improving their on-the-ball GI and five of 12 their off-the-ball GI when compared to baseline. Results also showed that two of the moderate skilled girls had significantly lower on-the-ball involvement than the other participants in the study. Finally, participants in the classes who had both fewer participants and fewer teaching sessions performed better on their GP indices when compared to baseline. **Conclusions:** A TGFU-based unit of soccer, focused on teaching both on and off-the-ball elements of game play, is associated with developments in participants' GP and GI indices across participants from high, moderate and low skill levels, especially those in class periods with fewer teaching sessions and participants.
Key Words: Teaching Games for Understanding, game performance, soccer, assessment, physical education.

Introduction

Students arrive at game focused physical education (PE) with neither the skills nor the tactical knowledge to be successful (Metzler, 2000). Indeed, skills learned in traditional technique-oriented games teaching approaches lead to break downs in game play (Bunker & Thorpe, 1982). The Teaching Games for Understanding (TGFU) approach (see appendix 1 for further information) has the potential to facilitate the development of both on- and off-the-ball skills to enhance game play performance (Allison & Thorpe, 1997; Griffin Mitchell, & Oslin, 1995; Harvey, Wegis, & Massa-Gonzalez., in review, Harvey 2003; Lawton, 1989; Mitchell, Oslin, & Griffin, 1995; Turner, 1996; Turner & Martinek, 1999; Turner, 2003) whilst at the same time providing enhanced student motivation (Griffin et al., 1995; Holt, Strean, & Benegochea, 2002). Moreover, TGFU can make learning experiences authentic and meaningful connecting students' experiences in PE to their previously held cultural conceptions of games (Kirk & McPhail, 2002). Indeed, with such an emphasis on games in PE curricula (65% in the UK and 50% in Canada) there is a need to identify effective ways to instruct students to play these games (Mandigo et al., 2004; Werner, Thorpe, & Bunker, 1996).

In the last decade, TGFU has received much support from practitioners and the research community alike. Indeed, Rink, French, and Tjeerdsma, (1996) noted that research on TGFU has produced some positive learning outcomes for students, especially in tests of tactical knowledge. However, these authors also noted that, despite these positive findings, more empirical support for TGFU is warranted.

Not only has the acceptance of TGFU as an approach to teaching been compromised by equivocal empirical support, it has been hampered further by the

dependence on the use of a comparative theoretical framework which has compared TGFU's effectiveness to the traditional, technique-based approach (Kirk, 2005). While this is one theoretical framework, and one that has been extensively used in previous studies for evaluating the effectiveness of TGFU, an alternative theoretical framework has been suggested by Kirk (2005). He suggested the use of a "practice-referenced approach" (p.216). His rationale for the practice referenced approach is centered on the issue of whether TGFU can be an effective teaching approach. Thus, it is not about whether TGFU is better than other approaches, or about 'how' we teach, but about 'what' we teach and how we can integrate technical skills into game play to make students successful games players.

The use of a single subject research design (commonly used in Applied Behavior Analysis research) allows for the evaluation of the practice referenced "teaching experiment" approach, and will, in addition, assess the effects of the TGFU intervention on *small units of individuals*. Only one previous study in the TGFU literature (Holt, Ward and Wallhead, 2006) has employed a single subject design. In this study the authors used a multiple baseline multiple treatment design to assess six college-aged participants (three from two different classes) 4 v 4 game play performances immediately following either a 2 v 1 or a 3 v 2 soccer 'play practice' (Launder, 2001). Results revealed that the 14 sessions of instruction using play practices was successful for the most able participants as they were able to consistently perform the appropriate tactical responses in the game, whilst the less able had more difficulty. Although data from three participants indicated that the 3 v 2 practice condition was more effective in transferring learning from the practice to the 4 v 4 game, the type of practice (i.e. 2 v 1 or 3 v 2) did

not appear to impact learning. The authors concluded that performance above 70% correct allowed for the greatest transfer of learning from 'play practice' to the 4 v 4 game, the instructors timely and appropriate feedback was essential in creating learning, and finally, research to address the common problem of teaching individuals in group settings to examine how this prevents individuals from practicing small but significant mistakes is needed.

A study by Hastie and Curtner-Smith (2006) further examined the effects of the practice referenced teaching experiment approach, but this time using a 22-lesson hybrid TGFU sport education striking and fielding unit with sixth grade students. Data were collected via a) a critical reflection data sheet on conclusion of each class period, b) four tactical quizzes, c) a game design form, and d) a group interview. Critical reflection data were analyzed using the frequency of thoughts and perceptions of the students, tactical quizzes were sorted to examine the numbers of students who gave the correct responses and interview data were explored for content before being coded and categorized using the same procedures as the critical incident data. Findings revealed that students responded well to the myriad of problems offered by the game, executing most rudimentary and sometimes more sophisticated batting and fielding problems transferring the problems associated with batting and fielding across the variety of games played in the intervention sessions. Although the combination of the two teaching approaches (TGFU and sport education) did not weaken curricula, the combination did place more emphasis on the teacher to drive and motivate proceedings, thus, teaching with this approach relied on the teacher possessing both more content and pedagogical knowledge.

By focusing on 'teaching through and in the game' more emphasis can be placed on off-the-ball skills, such as supporting a teammate who has possession of the ball, or adjusting to cover for a player who is out of position in defense (Griffin et al., 1995; Harvey et al., in review, Harvey, 2003; Mitchell et al., 1995; Light, 2004). Moreover, this type of games-based instruction will aid in raising the students awareness of concepts such as time, space, and risk and safety that are not only required to make appropriate decisions and effective skill executions in the game, but are needed to become an effective games player (Griffin et al., 1997; Mitchell, et al., 2006; Oslin et al., 1998).

This study will assess both students' response selection and response execution (the elements of "what to do" and "how and when to do it" in the TGFU model [McPherson, 1994]) with the information processing model as a framework. Specifically, the study is concerned with the three phases of (a) perception, (b) cognition i.e. decision making, and (c) action, i.e. movement execution (Kirk & McPhail, 2002).

Therefore, the purpose of this study was to examine whether an 11-13 lesson unit of soccer taught from the TGFU perspective improved the Game Performance (GP) of grade six PE students, across skill levels, and classes.

Methodology

Participants and Setting

Participants were members of four grade six PE classes (N = 12; 6 male and 6 female) at an urban middle school in the Pacific North Western United States. PE classes met daily with total teaching time available for class instruction being approximately 35 minutes. All students in classes used for the study received the TGFU intervention. Three participants from each class (a higher-, moderate- and lower-skilled student) were

randomly selected from the available students to be part of the final data analysis (see Table 1).

Informed consent was received from participants using standardized procedures after they had been approved by the Institutional Review Board for the protection of human subjects. Permission was also gained from the school principal and resident PE teacher to use the schools PE classes for the study. This school was chosen because its students had previously had little exposure to the TGFU approach, either in their present schools, or in previous grade levels. The resident PE also viewed this as a professional development opportunity by "seeing TGFU in action".

Selection of participants for final data analysis

Students in each class had equal chance of selection for the final data analysis, and no participant ever knew they were going to be a subject or not. Due to the fact that class membership far exceeded the amount of subjects needed for the final data analysis, the criteria for selecting participants used in the final data analysis were:

a) Attendance and participation in 100% of TGFU sessions

b) Attendance and participation at **ALL** assessment sessions

c) Completion of assent/informed consent documentation

The resident PE teacher chose names from a hat by skill level that included names of all students who met these criteria. The demographics of the final participants (names are pseudonyms) their class, skill level, previous soccer experience and how much soccer they played during the intervention can be found in appendix 5.

<u>Instruments</u>

The GPAI instrument was chosen to assess participants' improvements in game play performance (Mitchell, Oslin, & Griffin, 2006; Oslin, Mitchell, & Griffin, 1998). It was developed to measure "GP behaviors that demonstrate tactical understanding, as well as the player's ability to solve tactical problems by selecting and applying appropriate skills" (Oslin et al., 1998, p.231). To measure single components of GP, Mitchell et al., (2006), together with experts with knowledge across all four game categories (invasion, net/wall, striking and fielding, and target), proposed seven tactical components (base, adjust, decision made, skill execution, support, cover, guard/mark) associated with effective GP (see appendix 6 for descriptions of these elements of game play).

Two benefits of using the GPAI are that a) it can be adapted to various sports and game activities and, b) it allows for data collection of on-the-ball skills and off-the-ball skills (Mitchell et al., 2006). Some of the GPAI components such as decisions made, skill execution, support and adjust have previously been validated for soccer, basketball and volleyball contexts (Oslin et al., 1998). The validity of the GPAI was achieved through face validity, content validity and construct validity. They assessed content validity and construct validity using the known-groups method. In soccer contexts the GPAI was able to significantly discriminate between high and low skilled performers for decisions made, skill execution and support. Intra-class correlation coefficients (ICC) ranged between 0.84 and 0.97. Inter-observer reliability values ranged from 0.73 – 0.93 using ICC (overall average range pre and post 0.81 – 0.86).

Target behaviours

Two GP behaviors from the GPAI were chosen to be measured in this study: (a) decision-making (response selection – *'what' to do*), (b) skill execution (response

execution – *'when' and 'how' to do it*). Decision making and skill execution were assessed both ON-AND OFF-THE-BALL in both OFFENSE AND DEFENSE, (i.e. when the participants' team HAD and DID NOT HAVE possession of the ball). Definitions of the target behaviors can be seen in appendix 7.

Instructor

The investigator served as the teacher of the TGFU soccer unit. The instructor had extensive previous experience implementing the TGFU model in both coaching and teaching settings in both the USA and England, thus, this gave a potential to see the effects of a TGFU intervention in its fullest sense.

The 'TGFU Intervention'

The intervention consisted of a series of 'teaching sessions' that employed a games based (TGFU) approach to instruction. Each teaching session in the TGFU unit comprised of small-sided game type practices, some used regular goals; other modified goals and rules (see appendix 8 for complete content information for each teaching session for each classes A – D). Teaching sessions focused specifically on *off-the-ball* skills, such as playing in a 'diamond formation' or in 'triangles' in order to be able to pass and move quickly, cutting into open spaces when a team had possession of the ball, and/or guarding players and/or spaces when the other team had possession of the ball. The intervention was centered on increasing participants' decision-making and skill execution *within the game* or the 'what to do' and 'when' and 'how to do it associated with the TGFU model (see appendix 1). Examples of the first two teaching sessions conducted can be seen in appendix 9. Practice of isolated techniques were kept to a minimum and used only when the instructor felt it was essential in order to help the

participants become more aware of certain concepts within game play (Thorpe & Bunker, 1982).

The instructor used various techniques to engage the participants, including the principle of *exaggerating* games (by modifying rules, modifying the size and shape of the playing areas, restricting players to certain zones of the field, altering the number and size of the goals used etc.), as well as the three pedagogical principles outlined by Launder (2001): a) shaping play, b) focusing play, and c) enhancing play, and, using "questioning" as a form of instruction, "coach as a player" and "freeze replays" (Metzler, 2000).

The games approach used was a mixture of play practice (Launder, 2001), games sense (Australian Sports Commission [ASC], 1997), the tactical games approach (Mitchell et al., 2006), and the original proposed TGFU approach (Bunker & Thorpe, 1982). The general format for each of the teaching sessions followed closely the one outlined by Meztler (2000) and the ASC (1997):

a) Introduction to 'tactical problem' and 'initial game form': Make suggestions to, and ask participants 'why' they think the tactical problem is important to them being able to successfully play the game
b) Use of effective communication skills
c) Instruction: Use of effective instructional techniques during game play. Instructor thinks about 'when to ask' and 'when to tell'; 'where and when' to introduce skill practice; 'when' to stop the whole group or small groups for instruction; 'how' modify 'initial game form' by shaping, focusing or enhancing play (Launder, 2001).

d) Review of lesson content and 'tactical problem' with questions, and provide an introduction to the next session.

Although each class, A through D, received similar content (see appendix 8), the content was manipulated slightly due to the different needs of each class, class size, facilities available and initial ability levels. How the class was organized for the teaching sessions is detailed in appendices 10, 11 and 12.

Fidelity of TGFU Teaching Session Instruction

To ensure treatment integrity and procedural reliability and control for treatment drift over the course of the TGFU intervention, as well as ensure that this research using TGFU was being undertaken validly as per the guidelines of Metzler (2005), the instructor was observed at each session by a minimum of one independent observer at each teaching session using the validation protocol set out by Turner and Martinek (1992, 1999) (see appendix 13). Results of the training of observers in using this protocol indicated all observers were able to distinguish between the TGFU approach to teaching and 'traditional' technique-orientated instruction.

For 42% of the teaching sessions, two observers validated the use of appropriate TGFU instruction. Inter-Observer Agreement (IOA) levels between these two observers were 100%. In addition, for the other 58% of teaching sessions, one observer validated the TGFU approach was being utilized 100% of the time.

Research Design

For this study a research design from Applied Behavioral Analysis (ABA) which is typically referred to as a single subject (N=1) research design was used. In particular, a **delayed multiple baseline design** (d.m.b.d) across subjects' research design was

employed (see Figure 1). The benefit of this design was that it allowed for the in-depth analysis of individual participants (n = 3) from within the same, and across different class periods, and across different skill levels (higher, moderate and lower). This design further allowed for GP to be measured on multiple occasions (n = 8). Indeed, the strength of the single subject design is its ability to demonstrate internal validity, as it allows the researcher to investigate variation across and between individuals (or small units of individuals) in the same class, different classes, and of individuals of varying skill levels.

Single subject designs have had limited use in the TGFU literature to date (only Holt, Ward, & Wallhead [2006] employed this type of design), contrary to previous studies that have investigated the effectiveness of the TGFU teaching approach by employing group designs where only one pre, one mid and one final/post assessment has taken place (for example, Allison & Thorpe, 1997; Griffin et al., 1995; Lawton, 1989; Mitchell, et al., 1995; Turner, 1996, Turner & Martinek, 1999).

The d.m.b.d. was preferable to other single subject design techniques (i.e. reversal design techniques) for this particular study due to the irreversibility of the TGFU teaching sessions. That is, once it is given it cannot be taken away. Moreover, a d.m.b.d allows for the assessment of *baseline logic* associated with single subject behavioral research designs, using the processes of prediction, verification and replication (Heward, 1987). In the d.m.b.d prediction would be observed when the levels of the target behaviors of the groups not yet receiving the TGFU intervention remain unchanged. Verification would be ascertained by the observation of an increase in appropriate actions and a decrease in the inappropriate actions associated with each of the target behaviors on introduction to the TGFU intervention. Finally, replication would be shown by the effect

of the treatment being demonstrated across all participants, across classes and for skill levels. Thus, if the process of baseline logic is followed then a *functional relationship* will be established by observing a change in the level of the target behaviors upon the introduction of the treatment, i.e., TGFU teaching sessions.

Procedures

Apparatus

Two digital video cameras with microphones were used to record the assessment games (see appendix 14). During the assessment sessions these cameras were placed at one end of the gymnasium up high on a set of bleachers to aid in gaining a better perspective of the game. Cameras were kept on a wide angle lens to obtain a complete record of all participants' decisions and actions for subsequent data collection and analysis.

Assessing out-of-class soccer participation

All participants completed a weekly soccer diary to ensure potential improvements in performance were due to the TGFU intervention and not a result of extensive out-of-class soccer participation (see appendix 15).

Assessment Game

Participants were assigned a priori to play assessment games in small teams of four (or five) students. Half of Class B and all of Class D played 5 v 5 games due to larger class sizes (see Table 1). Participants were assigned to teams by the resident PE teacher based on a) a previous soccer experience questionnaire (see appendix 16); b) the evaluation of their playing performance in two familiarization sessions; and c) the resident PE teachers previous knowledge of participants performance in teaching units on

similar content to soccer. The same rule for assigning participants to teams was used for all classes A through D.

On assessment days two 'assessment games' were played simultaneously either side of a large curtain that aided in dividing the gymnasium into two halves. One side of the curtain was comprised of more experienced participants and a less experienced half of the class played on the other side of the curtain (see appendix 14).

Participants were assigned a number and wore a coaching bib where this number was embossed for all assessment games so they could be clearly identified. Each 4 v 4 (or 5 v 5) assessment game was played for 8 minutes (the rules of the assessment game can be seen in appendices 17 and 18). Scores were kept for the assessment games counted toward an overall team score which was kept for the duration of the study.

Data on each of the participants for the assessment game were collected on three separate occasions before the participants received any TGFU instruction ('baseline' assessments one, two and three), three times during the time they were receiving the TGFU teaching sessions (mid-assessments one, two and three), once on completion of the intervention (final assessment) and once within three weeks of completion of the final teaching session with all classes, A to D to examine the retention of knowledge and GP skills in the teaching sessions (post-check assessment). Therefore, a total of eight assessment sessions were undertaken in addition to the TGFU unit (see appendices 8 and 19).

Observer Training & Inter-Observer Agreement

Observer training was conducted in five stages. Stage one of the training was a general introduction to the study and the game components to be analyzed (see appendix

7). In stage two, the 'expert gold standard' observer (the first author) introduced each observer to the Game Breaker® (www.sportstecinternational.com) match analysis software (on an Apple® laptop computer platform) and how to incorporate using this software with the behavioral definitions seen in appendix 7, using a video of game footage from a previous study (Harvey, et al., in review). Observers were trained how to:

- use the 'coding input window'
- use the computer keypad to code the data
- edit mistakes and move behaviors from one category to another along the Game Breaker® "timeline"
- review of judgments using the "make movie" feature
- slow the playback speed of the assessment game video

An image of the set up of the Game Breaker® software on the laptop computer screen can be seen in appendix 20.

Stage three of training comprised of coding five minutes of "decisions made" and "skill executions" from a moderate skilled player, and the fourth and final stage of training was coding eight minutes of "decisions made" and "skill executions" of a low skilled player.

When watching the videos, observers were to press the key on the laptop computer keyboard related to each target behavior (decision making and or skill execution, both on-and off-the-ball) 'every time the ball and/or the player they were coding moved' (see appendix 7). Observers were prompted to do this so as to encapsulate the dynamic nature of the game, and evaluate the real 'overall' performance of the participants game, both when their team HAD possession of the ball, and when

their players team DID NOT have possession of the ball, as these concepts had been taught in the TGFU intervention. Observers watched each video twice, once to identify appropriate and inappropriate "decisions made" by the player, and then a second time to evaluate a) each appropriate/inappropriate decision based on whether each decision was effective/ineffective in terms of "skill execution", b) to look for decisions they might have missed, and c) to double-check their original coding decisions made.

Stage five consisted of the 'expert gold standard' observer checking the accuracy of the coding in terms of total actions coded, as well as any timing and pattern discrepancies of the data between him and individual observers on the Game Breaker® "timeline" window.

For the purposes of determining Inter-Observer Agreement (IOA) the author was considered the 'expert' or 'gold standard' observer due to his extensive experience. Thus, the observers had to obtain an 80% IOA level (based on total coding numbers only) with the author. On completion of training all observers met the 80% IOA level in terms of agreement with the 'expert gold standard' observer using an ICC (see appendix 22).

At the completion of the observer training, observers also completed a 22-item "movie test" which played four seconds of a clip of various decisions made by a moderately skilled player. Observers had to identify whether the clip showed an appropriate/ inappropriate decision and whether this led to either an effective/ineffective skill execution. All observers met the required IOA training percentage of 80% IOA using the agreements/ (agreements + disagreements) x 100 method (van der Mars, 1989b) (see appendix 22).

Data Collection

For the purposes of determining inter-observer reliability during the data collection phase of the study, the author was again considered the 'expert gold standard' observer due to his extensive experience. Each observer had to obtain an 80% IOA level (based on total coding numbers only) with the author. The same behavioral descriptions used for the observer training sections were also used for coding the study data (see appendix 7).

Following training, each observer coded the eight sessions of two (or three) participants of two (or three) different skill levels. Observers were unaware which of the sessions related to which time point of the study (i.e. baseline, mid and final/post-check assessment sections of the study). In addition, the first author maintained procedural reliability and controlled observer drift by systematically and randomly checking data evaluated by each of the observers throughout coding of study data period.

Systematic IOA checks were conducted on approximately 30% of the data (Baumgartner & Jackson, 1991) across baseline, mid and final/post-check assessment sections of the study using the event-recording method (van der Mars, 1989a). Each observer was asked to code half the regular length (four minutes) of one assessment game already coded by another observer. IOA checks were conducted between the 'expert gold standard' observer, the actual observer of the data, and a third observer, to enhance the IOA process. Observers were unaware which of the coded sessions they had coded was being used for IOA purposes. Reliability coefficients for all observed constructs met the required 80% IOA level between observers and between observers and the 'expert gold standard' observer using an ICC (see appendix 22).

The lead researcher also separated on-and off-the-ball behaviors coded by the observers. IOA checks were completed on approximately 30% of the data (Baumgartner & Jackson, 1991) and reliability coefficients for all observed constructs met the required 80% IOA level using an ICC (see appendix 22). The final numbers were then placed into Microsoft Excel® (2003) for the calculation of percentage appropriate/ inappropriate on- and off-the-ball involvement.

Data Analysis

Calculating GP Indices

Target behaviors were analyzed on three levels. GP (GP) indices (see Mitchell et al., 2006 and Appendix 6 for example calculations) were constructed for each assessed target behavior: a) Decisions Made Index (DMI), b) Skill Execution Index (SEI), and c) an overall GP Index (GPI). Game Involvement (GI) was measured by summing the total numbers of appropriate and inappropriate behaviors. Finally, the proportions of on- and off-the-ball involvement for the aforementioned appropriate and inappropriate game involvement were also calculated.

Presenting GP Data using Visual Graphical Analysis

Data were plotted graphically, depicting changes in the participant's behavior for each game component and were constructed using Microsoft Excel® (2003) (Carr & Burkholder, 1998). Data are presented by skill level (i.e. high, moderate, and low) across the four classes. The vertical dashed line signifies the staggered start of the TGFU intervention.

The decision on whether there is a (functional) relationship hinges on using the various analytical criteria in combination (i.e., level change; number of data points per

phase, between phase data overlap, within- and between phase trends, within- and between phase variability etc.) (Parsonson & Baer, 1978). Thus, these were used as the criteria in analyzing the graphical data.

In addition, the percentage of between phase data overlap was calculated by dividing the number of intervention data points that overlapped with baseline data and multiplying this number by 100 (see notes under Tables 2 and 3). *The amount of between phase overlap needed to determine whether a 'functional relationship' was present in this particular study was 40% or less*. The less the overlap that is present constitutes a greater change in level/trend from one phase to the next and, thus, the stronger the case for claiming experimental control. Measuring the percentage overlap between the baseline and intervention phases of the study also aided in establishing the variability between phases of the experiment, and the changes in level and trend in the data.

Results

GP results are presented in graphs. They are shown by skill level: High skill level (Figures 2a – d); moderate skill level (Figures 3a – 3d); and low skill level (Figures 4a – 4d). In addition to the graphical data, the results of the percentage between-phase overlap for participants from each of the three skill levels for each GP/GI behavior are provided in Tables 2 and 3.

High Skilled Participants

Neal

Although Neal's GP levels were generally high in both the baseline and intervention phases of the study, there was variability in both phases. After a variable baseline phase where Neal performed well in the first baseline assessment, Neal

increased the level of all GP indices during the intervention showing the least amount of overlap with baseline on SEI (see Figure 2a and Table 2). The disappointing aspect of Neal's GP was his inability to maintain higher levels of GP toward the end of the intervention, although he improved in the post-check assessment.

As shown in Figure 2b, Neal was highly involved in most of the games indicated by his high levels of overlap with baseline, but his GP was poorer when the amount of inappropriate involvement increased whilst appropriate involvement decreased (see Table 2). Specifically, Neal's poorer performances were related to the inappropriate off-the-ball aspects of play (see Figure 2d and Table 3).

Nancy

Nancy had high levels of GP in both the baseline and intervention phases of the study, with little variability in each phase and virtually complete data overlap between the two phases for all GP and involvement components, except her inappropriate game involvement (see Figure 2b and Table 2). There was as substantial difference in her levels of appropriate and inappropriate game involvement and her GP was only reduced when levels of appropriate involvement were reduced and, simultaneously, inappropriate involvement increased (see Figure 2b). Specifically, Nancy reduced her inappropriate on-the-ball involvement especially in the latter part of the intervention (see Figures 2c/2d and Table 3).

Lane

Lane's level of GP increased during the intervention, as shown by the upward trend. However, he did show some variability in each phase. After only two teaching sessions of the intervention Lane improved his GP in the first mid assessment and this

level was maintained until the final and post check assessments where GP was reduced. Lane had least amount of overlap on SEI (see Figure 2a and Table 2). Lane was more involved both on-and off-the-ball during the intervention where his inappropriate involvement was lower and his appropriate involvement was higher (see Figure 2b). Lane's highest GP scores were associated with increases in appropriate on-and off-the-ball involvement coupled with a reduction in inappropriate off-the-ball play (see Figures 2c and 2d).

Harry

Harry showed a higher overall trend during the intervention for both overall GP and SEI in terms of overlap with baseline (see Figure 2a and Table 2). However, there was some variability in his GP in the intervention phase. Harry was heavily involved in both phases of the study resulting in high levels of overlap, both on-and off-the-ball (see Figures 2b, 2c and 2d and Tables 2 and 3). Specifically, Harry was highly involved on-the-ball in all assessments (average on-the-ball involvement was 36% during the intervention – see Figures 2c and 2d). Harry's higher GP scores were associated with higher levels of appropriate play (both on-and off-the-ball) and his poorer GP scores were associated with higher levels of inappropriate off-the-ball actions coupled with lower levels of appropriate off-the-ball play.

Moderately skilled participants

Abby

Abby improved her GP throughout the intervention phase of the study demonstrated by an absence of data overlap with baseline all three GP measures (see Figure 3a and Table 2) with little variability in her GP during the intervention. Abby

decreased her inappropriate involvement during the intervention (see Figure 3b and Table 2) and increased her appropriate off-the-ball involvement, whilst her inappropriate off-the-ball involvement declined (see Figures 3c/3d and Table 2). Although she increased her on-the-ball involvement throughout the intervention phase (until the final and post check assessments where this declined) her on-the-ball involvement remained low (see Figures 3c/3d). When Abby increased her appropriate on-the-ball involvement her appropriate off-the-ball involvement decreased, and vice versa (see Figures 3c and 3d).

Lisa

Lisa's GP scores declined over the baseline phase. Due to the fact that the first mid assessment was after eight teaching sessions she immediately improved her GP at the outset of the intervention phase. However, she could not consistently maintain this level of GP, resulting in a variable intervention phase. Lisa had least overlap with baseline on the DMI (see Figure 3a and Table 2). Lisa also improved her appropriate game involvement as result of the intervention although her inappropriate involvement remained high (see Figure 3b and Table 2) and Lisa's overall GP was higher when she had higher levels of appropriate involvement. When inappropriate involvement increased, however, GP was reduced considerably. Poorer GP scores were associated with lower appropriate off-the-ball involvement and higher inappropriate off-the-ball involvement. Lisa also had lower levels of inappropriate on-the-ball involvement in terms of overlap with baseline (see Figures 3c/3d and Table 3).

Mike

After showing some variability in the baseline phase, Mike steadily increased his GP measures over the course of the intervention, in particular Mike improved his DMI

(see Figure 3a and Table 2). Mike improved his appropriate game involvement showing as a consequence of the TGFU intervention which rose to levels above inappropriate involvement over the latter part of the intervention and his was maintained in the post check assessment (see Figure 3b). More specifically, Mike increased his appropriate on-the-ball involvement whilst reducing appropriate off-the-ball involvement, although this remained high. Simultaneously, Mike made less inappropriate off-the-ball actions, but his inappropriate on-the-ball involvement remained high in terms of overlap with baseline (see Figures 3c/3d and Table 3).

Tiffany

Tiffany's GP decreased through the baseline phase, but increased over the first part of the intervention. However, this was not maintained in the remainder of the intervention. Therefore, Tiffany showed a lot of variability in her GP over the course of the intervention demonstrating less overlap with baseline on her overall GP and SEI (see Figure 3a and Table 2). Tiffany' poorer GP scores occurred when levels of inappropriate involvement were higher then appropriate involvement (see Figure 3b). Further analysis revealed that Tiffany increased her appropriate off-the-ball play in the intervention phase (see Figure 3d and Table 3). Indeed, when this declined, and, simultaneously, inappropriate off-the-ball involvement increased, this resulted in poorer overall GP scores. Also of note was Tiffany's low on-the-ball involvement (see Figures 3c/3d).

Lower skilled players

Evelyn

Evelyn's GP scores declined over the baseline phase and showed a clear change in level at the first intervention point after only four teaching sessions. Although

Evelyn's GP decreased at the second mid assessment, her GP scores increased steadily over the intervention phase. Evelyn had the last amount of overlap with baseline on her overall GP (see Figure 4a and Table 2). She increased her appropriate involvement in the intervention whilst decreasing her inappropriate involvement (see Figure 4b and Table 2). Evelyn increased her appropriate on-the-ball involvement whilst simultaneously decreasing the level and variability of her inappropriate off-the-ball involvement. She further decreased her inappropriate on-the-ball actions as reflected in the data overlap with baseline (see Figures 4c/4d and Table 3).

Steve

After a somewhat variable baseline phase, Steve's GP level initially increased during the intervention. However, this improvement in GP level was not maintained, resulting in high overlap with baseline on all his GP measures (see Figure 4a and Table 2).

For being categorized as a low skilled player, Steve showed high amounts of both on-and off-the-ball involvement throughout the baseline and intervention phases of the study, even though he was the only participant not to have had any previous soccer experience. In the early part of the intervention Steve had higher amounts appropriate actions than inappropriate, but this situation was reversed in the latter part of the intervention although his overlap with baseline with baseline was less for appropriate involvement than for inappropriate involvement (see Figure 4b and Table 2). Indeed, Steve's change in overall GP appears to have been determined by the changes in his amounts of appropriate and inappropriate off-the-ball actions. That is, when Steve made

more appropriate off-the-ball actions his GP increased, and when he made more inappropriate off-the-ball actions his GP declined (see Figures 4c/4d).

Naomi

Naomi showed the most dramatic improvement of all the participants in the study. Indeed, Naomi shows a marked increase in level when comparing all of her baseline and intervention GP measures even though Naomi's scores declined in the final and post check assessments (see Figure 4a and Table 2). Naomi's performance was improved by replacing inappropriate game involvement with higher levels appropriate involvement (see Figure 4b and Table 2). Furthermore, Naomi's inappropriate off-the-ball involvement increased (see Figure 4d and Table 3).

Wade

Due to a strong baseline phase, Wade's overall GP and DMI level was not markedly increased during the intervention phase, but he showed higher level of SEI in the intervention (see Figure 4a and Table 2). Wade's greatest improvement in terms of his game involvement was in reducing his inappropriate actions during game play (see Figure 4b and Table 2). Wade decreased his levels of appropriate and inappropriate on-the-ball involvement (see Table 3). This resulted in increases in both his appropriate and inappropriate off-the-ball involvement. However, as the study progressed, Wade's on-the-ball involvement gradually increased to 29% in the final assessment (see Figures 4c/4d). This increase coincided with a gradual increase in overall GP, SEI, appropriate game involvement inappropriate on-the-ball involvement, and a decrease in appropriate and inappropriate off-the-ball involvement.

Discussion

The purpose of this study was to examine whether an 11-13 lesson unit of soccer taught from the TGFU perspective improved the GP of grade six PE students, across skill levels, and classes using a single subject research design. This study has only partly answered the hypothesis that TGFU instruction can improve the various GP and GI indices examined. Indeed, only two participants (Abby from class A and Naomi from class C) showed improvement (i.e. less than 40% overlap with baseline) on all GP measures. However, seven of the 12 participants improved their SEI when compared to baseline (three high skilled, two moderate skilled and two low skilled); four improved their DMI (no high skilled, three moderate skilled and one low skilled); and six participants improved their GPI level (one high skilled, three moderate skilled and two low skilled) when compared to baseline levels (see Figures 2a, 3a and 4a and Table 2). Indeed, although only two participants showed improvements on all three GP measures, only two participants did not improve any aspect of their GP, Nancy and Steve both from class B.

This study supports previous findings that participants taught with TGFU can a) improve decision making (i.e. 'what' to do) in game play (Allison & Thorpe, 1997; Griffin et al., 1995; Harrison, et al., 2004; Mitchell et al., 1995; Turner, 1996, 2003; Turner & Martinek, 1999) and b) improve the execution (i.e. 'how' and 'when' to do it) of technical skills (Allison & Thorpe, 1997; Blomqvist, 2001; French, Werner, Rink, et al., 1996; French, Werner, Taylor et al., 1996; Harrison, 2004; Lawton, 1989; Turner, 2003; Turner & Martinek, 1999).

Holt et al. (2006) found that the use of 'play practices' (i.e. 2 v 1 and 3 v 2 games) were more successful for the most able participants who were more able to consistently

perform the appropriate tactical responses in the game than the less able who had more difficulty. However, in this study the effects of the TGFU intervention was distributed across skill levels, with skill execution particularly being enhanced across skill levels and across the various classes the TGFU intervention was employed with (in terms of overlap with baseline). Furthermore, the fact that this study showed more participants improved their SEI than DMI, may support the contention that skills are not fully developed until incorporated with game play (Rink, et al., 1996), and giving participants a large number of opportunities to respond in small-sided game play may be as important as teaching solely the technical aspects of the game in order to develop overall GP. However, the links between improved decision making and skill execution (i.e. response selection and response execution) still needs further examination when employing the TGFU approach (Holt et al., 2006).

Moreover, although nine of the 12 participants improved their game involvement scores either by increasing their appropriate involvement or decreasing their inappropriate involvement when compared to baseline none of the participants did both (see Table 2). However, the three participants who failed to change any aspect of their involvement levels were all high skilled participants who were already highly 'involved' in the baseline assessments before they received the TGFU intervention (see Figure 2b). Of the nine participants who improved at least one aspect of their GI scores, five improved their appropriate GI (two from the moderate skilled and three from the low skilled) whilst four reduced their inappropriate GI (one from the high skilled; two from the moderate skilled; and one from the low skilled). However, the mixed results again mean more research maybe needed into the exact mechanisms of how instructors

employing the TGFU approach can increase or maintain appropriate involvement whilst reducing inappropriate involvement.

When considering the effect of the TGFU intervention on the appropriate/ inappropriate GI on- and off-the-ball, results showed that only five of the 12 participants (all from the moderate and low skilled groupings), increased either their appropriate off-the-ball involvement or decreased their inappropriate off-the-ball involvement. This was even more disappointing considering the intervention specifically targeted the off-the-ball aspects of play. However, a positive aspect of the study was that improvements in off-the-ball involvement did not compromise the participants' on-the-ball involvement as ALL of the five aforementioned participants' either increased their appropriate on-the-ball involvement or decreased their inappropriate on-the-ball involvement.

Overall, ten participants increased their appropriate on-the-ball involvement or decreased their inappropriate on-the-ball involvement when compared to baseline. However, the effects on both on- and off-the-ball GI due to the TGFU intervention were more apparent with the moderate and low skilled participants, possibly due to the fact that the high skilled students were already 'involved' both on- and off-the-ball (see Figures 2c/2d, 3c/3d, 4c/4d and Table 3). But, the high percentage of off-the-ball involvement observed (on average approximately 70% of the involvement for most of the participants was 'off-the-ball') demonstrates the need to consider these elements of GP when teaching students to play games (Blomqvist et al., 2005; Light, 2004; McPherson & Kernodle, 2003; Mitchell et al., 2006).

That said, another disappointing aspect of the study was that three participants, Wade in the low skill group, and Abby and Tiffany in the moderate skilled group had low

overall levels of on-the-ball involvement during the intervention. Since Wade was highly involved on-the-ball in the baseline, and gradually reached equivalent levels to baseline in the final part of the intervention, this does not raise concerns. However, even though Abby increased her on-the-ball involvement in the first part of the intervention, both she and Tiffany had lower overall levels of on-the-ball involvement than the other nine study participants in both phases of the study (Abby and Tiffany had less than 20% on-the-ball game involvement – see appendix 25). For these girls, playing in assessment games with the higher skilled group made up of a majority of boys did not give them the same opportunities to respond on-the-ball as other participants in the study. For example, Lisa, a moderate skilled participant, played in assessment games with the low skilled group and maintained over 20% on-the-ball involvement in both baseline and intervention phases of the study. Mike, the only male participant in the moderate skilled group also played with the high skilled group and increased his on-the-ball involvement during the intervention when compared to baseline (from 13% in baseline to 22% during the intervention - see appendix 25).

Therefore, Abby and Tiffany might have reached higher on-the-ball involvement if they had been placed in a more appropriate grouping, (i.e. with the low skilled, like Lisa, or in a team of all girls, who played against another team of all girls). Observing the assessment game video footage, it could be seen that Abby was in open spaces to receive passes from her team mates, but was not passed the ball, as the boys chose to ignore her as a passing option. On the other hand, Tiffany seemed to be avoiding engagement on some assessment days possibly as a consequence of the dominance from the boys in her team. In a previous study comparing TGFU and technique-orientated

approaches using volleyball Harrison et al., (2004) noted that higher-skilled students remained higher contributors to more successful and legal hits per serve than the lower-skill students in game play. Furthermore, Kirk (2002) noted that masculinized forms of physical activity influence girls engagement in PE, and these lack of opportunities may, ultimately, limit girls learning and physical activity levels across the lifespan (Azzarito, Soloman, & Harrison, 2006).

The high amounts of overlap with baseline (i.e. variation between the phases) that were found in the study (i.e. more than 40% with baseline) may be attributed to the complex nature of invasion game play. However, the variability of GP/GI does highlight the need to assess GP on multiple occasions during an intervention of this kind to determine whether it has had any socially significant impact on the participants' behavior (Cooper et al. 1987). In a recent study Holt et al. (2006) intimated the need to consider the effects of group instruction on individuals GP in order that instructors can rectify GP. Previous studies examining the effectiveness of TGFU in PE settings have relied on using group designs, only assessing GP on three occasions (i.e. before, during and on conclusion of the study). There are obvious limitations to group designs, as demonstrated by the variation in GP observed in this study. Therefore, future studies could employ single subject designs in order to allow them to a) assess GP on multiple occasions, and b) teach more at the individual level to eradicate simple mistakes (Holt et al., 2006). Rink et al., (1996) previously noted that some of the equivocal findings related to the effectiveness of TGFU were due to the variation in the research designs employed by researchers. The single subject design could therefore provide a way forward for the

TGFU community, especially as it supports the "practice-referenced" or "teaching experiment" approach of evaluating the effectiveness of TGFU (Kirk, 2005).

The variability in GP observed in the current study could be explained by a number of factors (i.e. the particular day of the week that the assessment was conducted, assessment days were too close to each other, having separate assessment and teaching days disrupted the flow of the students learning etc.). Indeed, one participant from one of the assessment day teams being absent may have disrupted the whole dynamic of the team, resulting in those individuals on that team performing poorly on that particular assessment.

Findings showed that seven participants performed poorly on the final assessment, with only three participants having their highest GP score in the final assessment. The fact that separate days for teaching and assessment were employed in this study may have resulted in the students becoming bored with the soccer unit by the final assessment stage, especially as this made the unit twice the length of a usual two-week unit the students' experience. This explanation may be further supported by the observation that improvements were seen in GP scores in the post check assessment and that participants in classes A and C that had the least amount of teaching sessions and the lower class sizes (see Table 1) demonstrated the greatest overall improvements, in terms of stability within phases, less than 40% between phase overlap etc.

Indeed, five of the participants, from two the aforementioned classes (A and C), had their highest overall GP score at the third mid assessment phase after their behavior had shown a stable upward trend up to that time point of the study. It is customary in ABA research to simultaneously observe and analyze the target behaviors, and, in this

way the researcher knows when a socially significant change in behavior has been achieved and a 'functional relationship' established. Thus, the treatment can be stopped. If this were known at the time, the present TGFU intervention could have been ceased with classes A and C, and continued with B and D.

Previous TGFU interventions have shown effects from using the TGFU approach with both shorter interventions (between 6 and 10 sessions) (Allison & Thorpe, 1997; Griffin et al., 1995; Harvey, et al., in review; Lawton, 1989; Mitchell et al., 1995; Turner, 2003) and longer interventions (between 12 and 20 teaching sessions) (Blomqvist, et al., 2001; Harvey, 2003; Turner, 1996; Turner & Martinek, 1999). Two studies with college-aged and adult populations have employed even longer interventions (Harrison et al., 2004; McPherson & French, 1991, respectively).

The number of teaching sessions needed to demonstrate TGFU's effectiveness is yet to be delineated, and will, by the fact that teaching and learning occurs in very different settings and contexts, still vary depending on the nature of the intervention, the age and developmental levels of the participants, the teaching context, the experience and qualifications of the instructor etc. The findings of this study possibly support the adage that less is more (i.e. less teaching sessions were preferable), at least with this population. However, this study also raises the question of how teachers should structure units of games teaching so that the students are not "just playing games" (Metzler, 2000), but building on information gained from preceding units of games to help them with future units. Butler and McCahan (2005) have proposed a curricular organization for TGFU, but this delivery approach still needs empirical investigation.

Furthermore, units of games teaching also need to be structured so that they create meaning for students. One interesting way to do this may be to integrate TGFU with other instructional approaches/models. An attempt at doing this has been forwarded by Hastie and Curtner-Smith, 2006. In this study they linked TGFU with sport education in a 22-lesson unit, noting many positive outcomes for students. However, the authors recognized the need for high levels of content knowledge and pedagogical skill of the instructor in order to conduct the unit. Teacher education courses could do well to equip their students' with the necessary pedagogical tools and field experiences in order that these type of units become commonplace in school PE curricula.

Finally, Rink et al., (1996) has intimated that investigations into TGFU's effectiveness have not been helped by the many different research designs and study methodologies. The findings of this current study could certainly contribute some answers as to how TGFU's effectiveness can be evaluated. Therefore, future studies could:

a) Focus on shorter interventions, and ones that are not employed on consecutive PE class days, (i.e. for three of the days of the week students could be exposed to the intervention, and the other two days, they could complete a unit of work on another activity unrelated to the game taught as part of the TGFU study intervention).
b) Shorter interventions of weekly units of work could be employed, distributed over the whole curriculum year, and possibly spiraled (i.e. in terms of their level of difficulty of the games played - see Butler & McCahan, 2005).

c) Assessment could be integrated into the teaching sessions, possibly by the use of trained observers using technology such as the Game Breaker® software. This would also allow for the concurrent analysis of GP and GI. In addition, these observers could assess the developments of more than one student per class period, by observing individual subjects for short periods of time in each class period, i.e. 5 minutes, in order to gain a record of behavior.

d) Evaluate more units of work that have built TGFU into the sport education season, and ascertain how they create meaning for students in PE settings.

e) Assess the impact of various instructors' use of the TGFU approach on behavioral, cognitive and affective outcomes (Mandigo et al., 2004), across grade levels in PE settings.

Conclusion

A TGFU-based unit of soccer, focused on playing small-sided games and teaching the tactical and strategic elements of game play is associated with developments of participants' game performance and game involvement across middle school students of high, moderate and low skill levels.

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Table 1: *Class Numbers and lesson time in school day, boys/girls in class, and total numbers (and percentages) of Informed Consent/Assent forms received from members of classes A – D used in the study*

CLASS	N	Lesson Time	GIRLS	BOYS	IC (%)	NUMER OF PARTCIPANTS AVAILABLE AFTER SESSIONS	FINAL PARTICIPANT GROUP PER CLASS (N)
A	23	1.09 – 1.54pm	9	14	14 (61)	8	3
B	36	1.57 – 2.41pm	20	16	28 (78)	7	3
C	26	2.45 – 3.30pm	12	14	14 (54)	6	3
D	42	10.49 – 11.33am	22	20	21 (50)	10	3
TOTAL	**127**	**n/a**	**63**	**64**	**76 (61)**	**31**	**12**

Table 2: *Percentage overlap of baseline and intervention sessions for individual and overall GP and overall game involvement measures*

Name	Class Period	Skill Level	DMI	SEI	GP	AGI	IAGI
Neal	A	H	60	40	60	60	60
Nancy	B	H	80	100	100	80	60
Lane	C	H	60	40	60	80	0
Harry	D	H	60	40	40	60	60
Abby	A	M	0	0	0	60	20
Lisa	B	M	40	60	60	0	100
Mike	C	M	20	60	40	60	0
Tiffany	D	M	60	40	40	40	80
Evelyn	A	L	100	60	40	0	100
Steve	B	L	60	60	60	40	60
Naomi	C	L	0	0	0	0	100
Wade	D	L	100	40	80	100	0

Notes: DMI = Decisions Made Index, SEI = Skill Execution Index, GP = Overall GP (i.e., DMI/SEI), AGI = Appropriate Game Involvement (i.e., Appropriate Decisions + Effective Skill Executions), IAGI = Inappropriate Game Involvement (i.e., Inappropriate Decisions + Ineffective Skill Executions).
Percentage overlap was calculated for DMI, SEI and GP by dividing the total number of scores in the intervention sessions (including the post check) below those in the baseline, i.e., for Subject A's Decision Making, this subject had three scores in the intervention sessions below the highest baseline score (3/5 = 60% overlap). For AGI percentage overlap was calculated by dividing the total number of scores in the intervention (including the post check) above the highest baseline score. Finally, for IAGI percentage overlap was calculated by dividing the total number of scores in the intervention (including the post check) below the lowest baseline score.

Table 3: *Percentage overlap of baseline and intervention sessions for appropriate on/off and inappropriate on/off-the-ball plays*

Player	Class Period	Skill Level	Appropriate actions		Inappropriate actions	
			On-the-ball	Off-the-ball	On-the-ball	Off-the-ball
Neal	A	H	80	80	60	60
Nancy	B	H	80	80	40	100
Lane	C	H	40	60	80	60
Harry	D	H	60	60	60	80
Abby	A	M	40	40	80	0
Lisa	B	M	80	60	40	60
Mike	C	M	0	100	100	40
Tiffany	D	M	80	20	0	60
Evelyn	A	L	60	100	20	100
Steve	B	L	100	60	40	60
Naomi	C	L	0	20	100	0
Wade	D	L	80	0	20	80

Note: For appropriate on-and off-the-ball actions percentage overlap was calculated by dividing the total number of scores in the intervention (including the post check) above the highest baseline score.
For inappropriate on-and off-the-ball actions percentage overlap was calculated by dividing the total number of scores in the intervention (including the post check) below the lowest baseline score.

Figure 1: *A schematic figure of a **delayed multiple baseline design** for 4 classes of physical education students (adapted from Kinugasa, Cerin, & Hopper, 2004, p. 1039).*

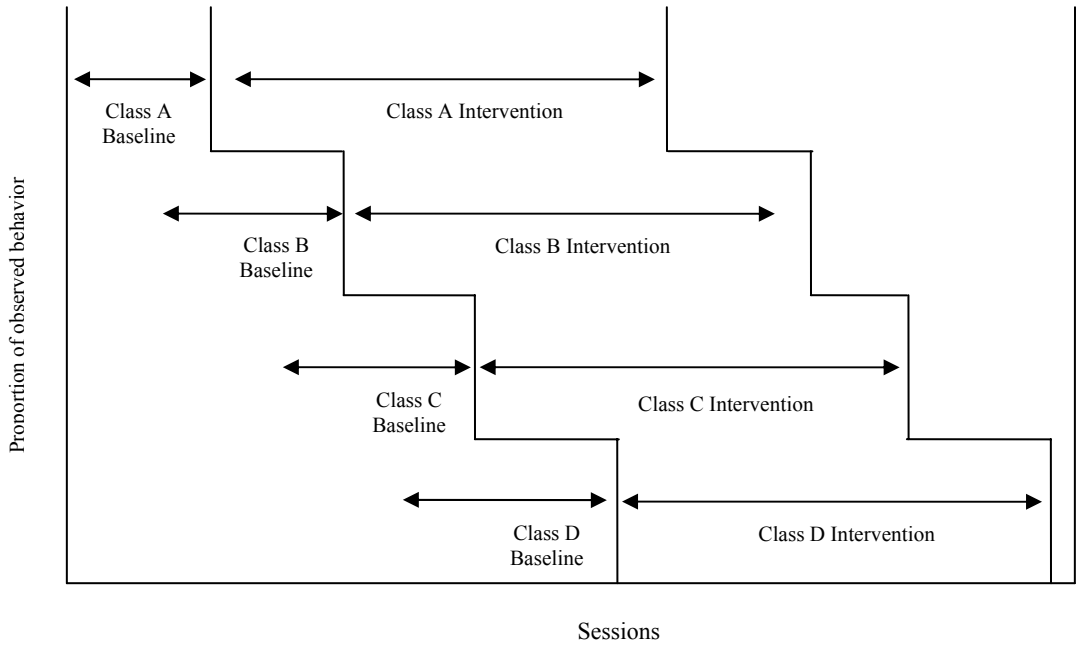


Figure 2a: *Line graphs showing the change in GPAI game performance indices (decision making, skill execution and overall GP) of four highly skilled participants over the baseline, mid and final assessment periods of a TGFU intervention*

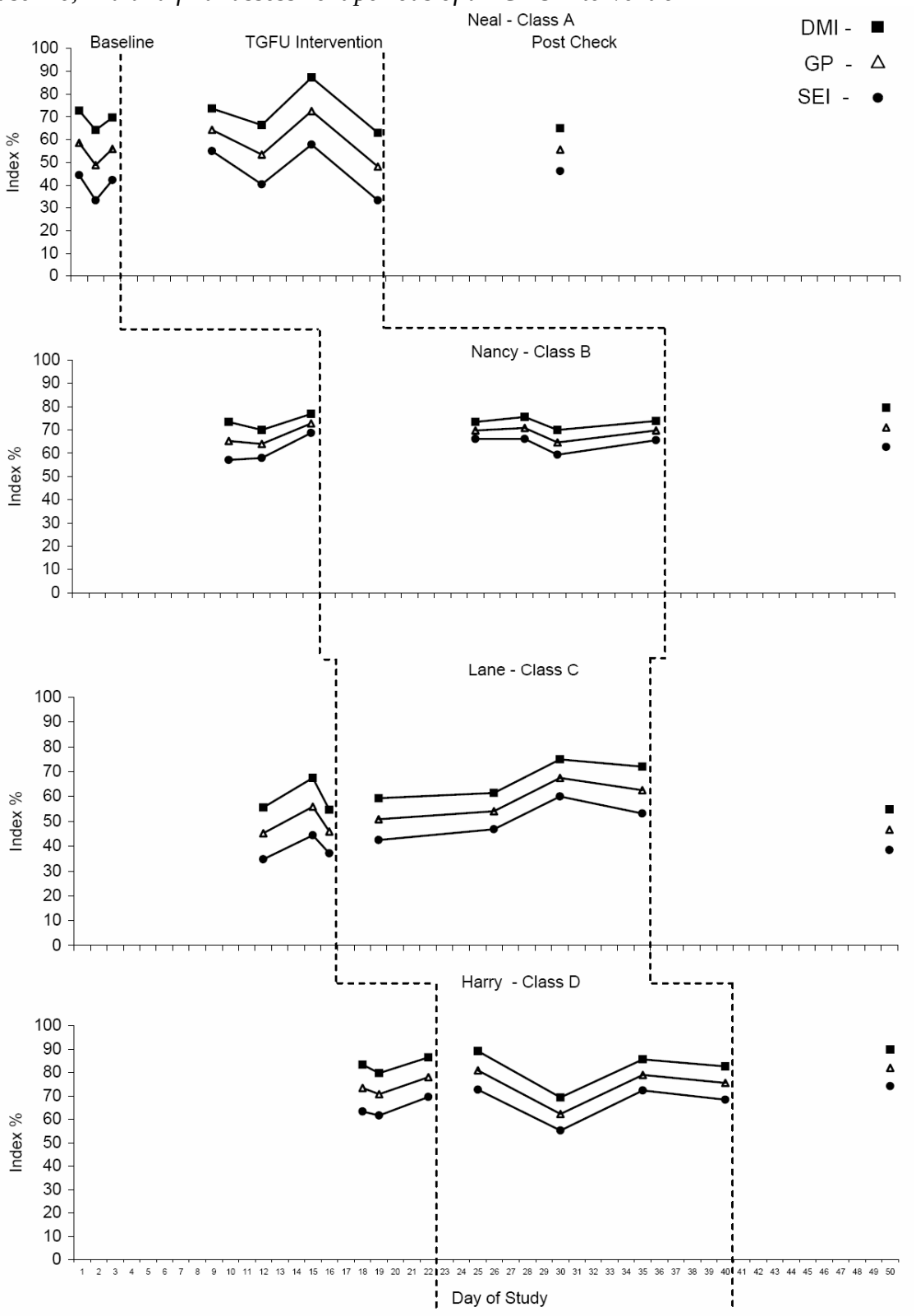


Figure 2b: *Line graphs showing the change in the total amount of appropriate/effective and inappropriate/ineffective game involvement of four highly skilled participants over the baseline, mid and final assessment periods of a TGFU intervention*

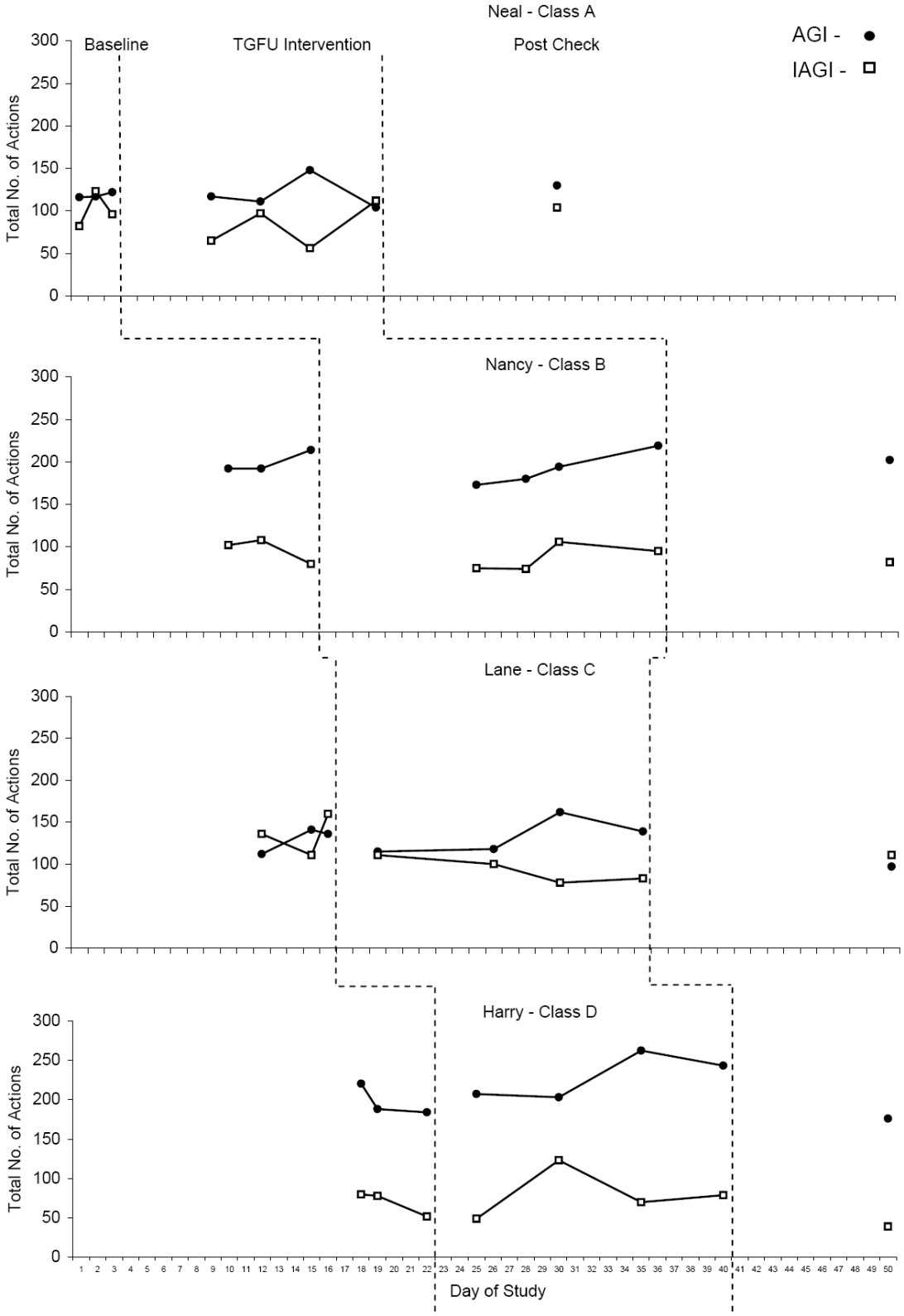


Figure 2c: *Line graphs showing the change in the relative percentage of appropriate/effective on-and off-the-ball game involvement of four highly skilled participants over the baseline, mid and final assessment periods of a TGFU intervention*

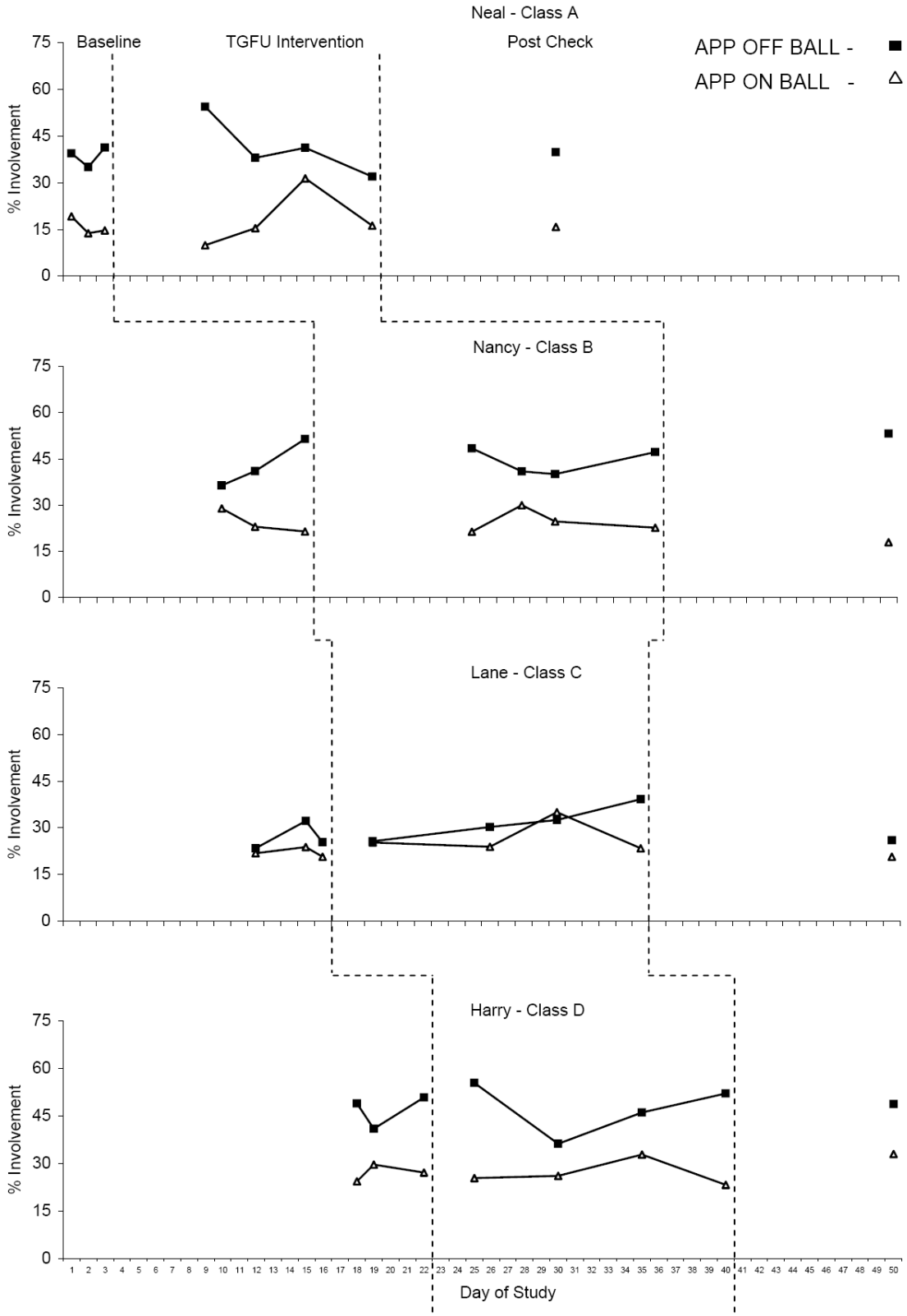


Figure 2d: *Line graphs showing the change in the relative percentage of inappropriate/ineffective on-and off-the-ball game involvement of four highly skilled participants over the baseline, mid and final assessment periods of a TGFU intervention*

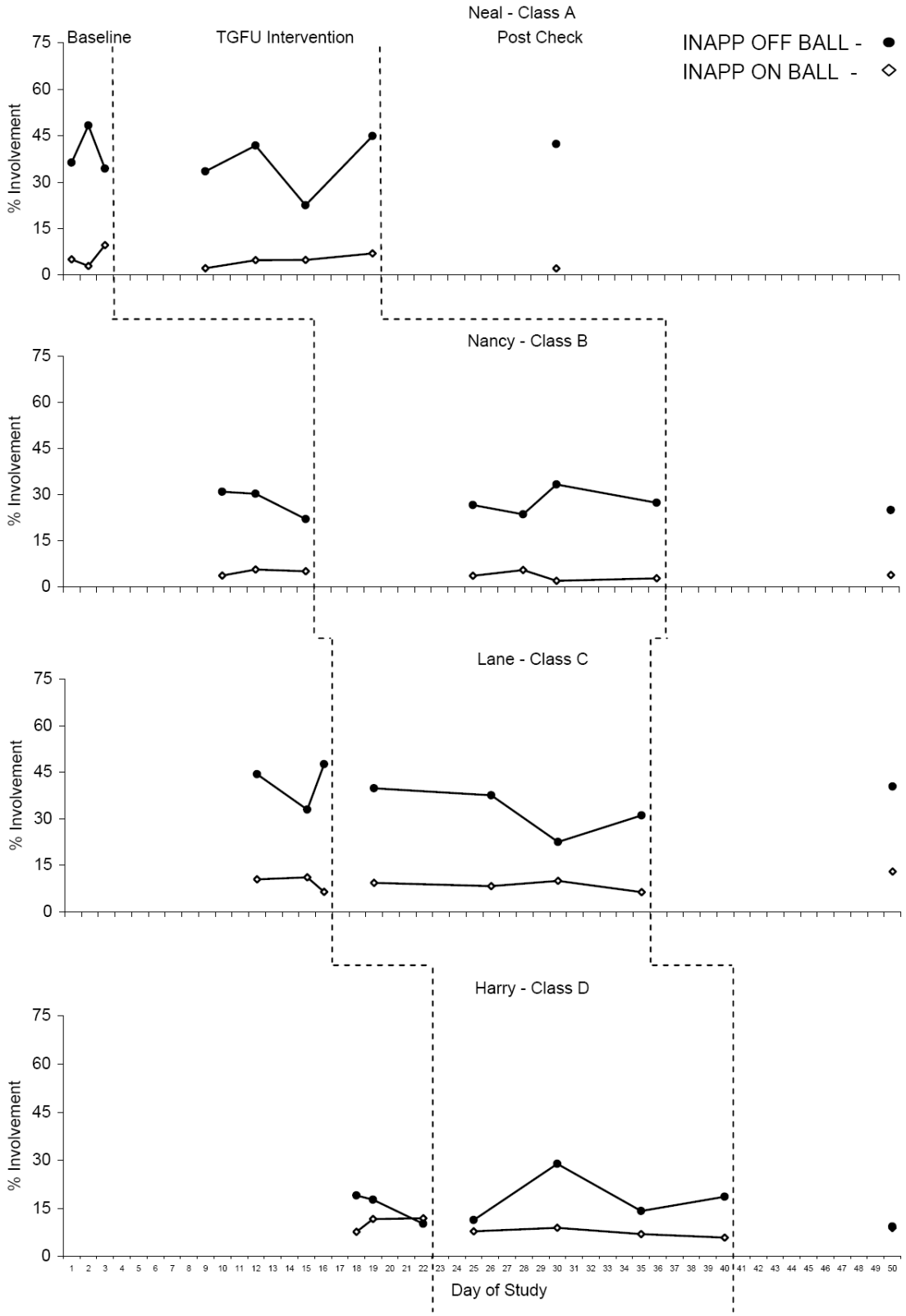


Figure 3a: *Line graphs showing the change in GPAI game performance indices (decision making, skill execution and overall GP) of four moderately skilled participants over the baseline, mid and final assessment periods of a TGFU intervention*

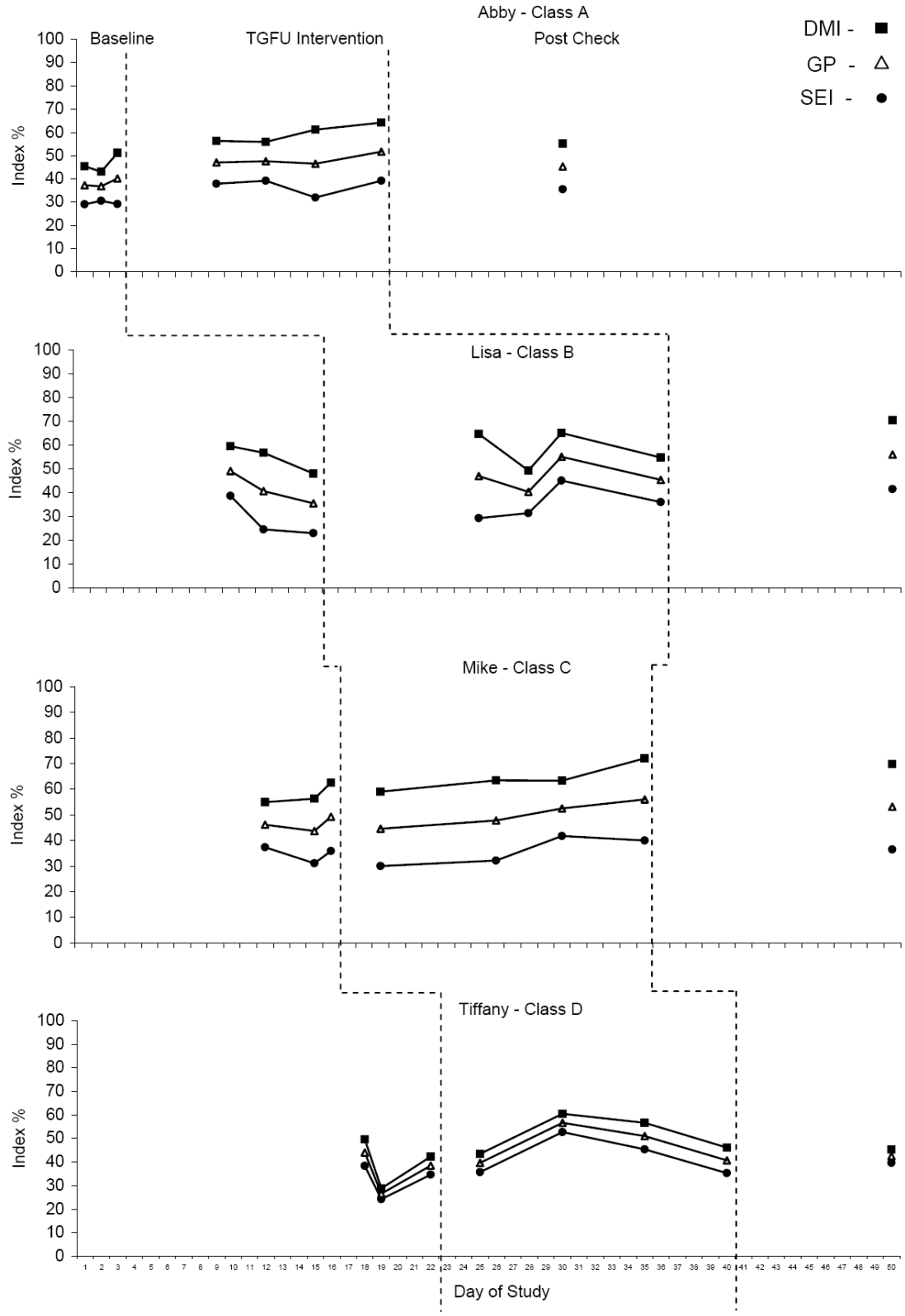


Figure 3b: *Line graphs showing the change in the total amount of appropriate/effective and inappropriate/ineffective game involvement of four moderately skilled participants over the baseline, mid and final assessment periods of a TGFU intervention*

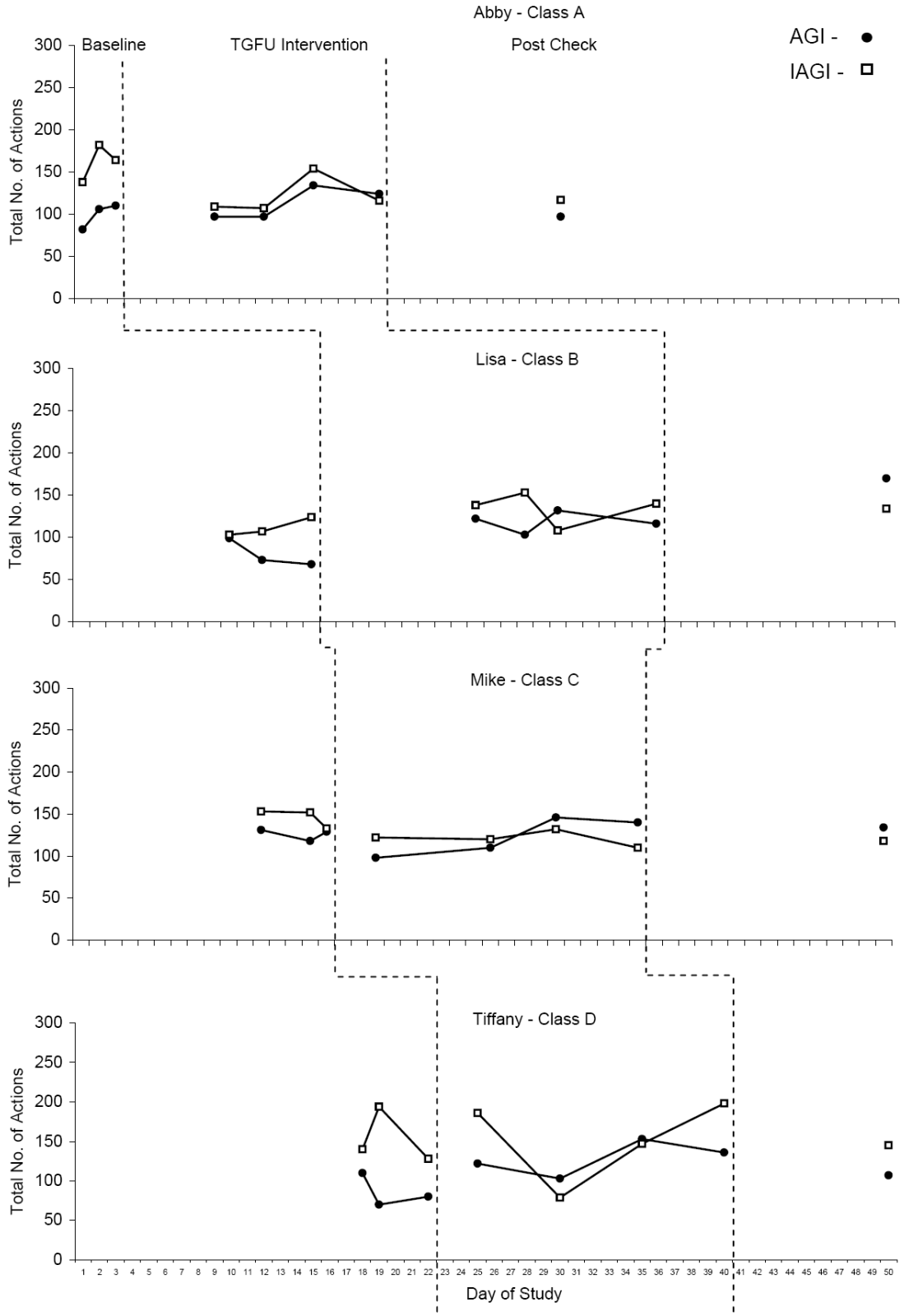


Figure 3c: *Line graphs showing the change in the relative percentage of appropriate/effective on-and off-the-ball game involvement of four moderately skilled participants over the baseline, mid and final assessment periods of a TGFU intervention*

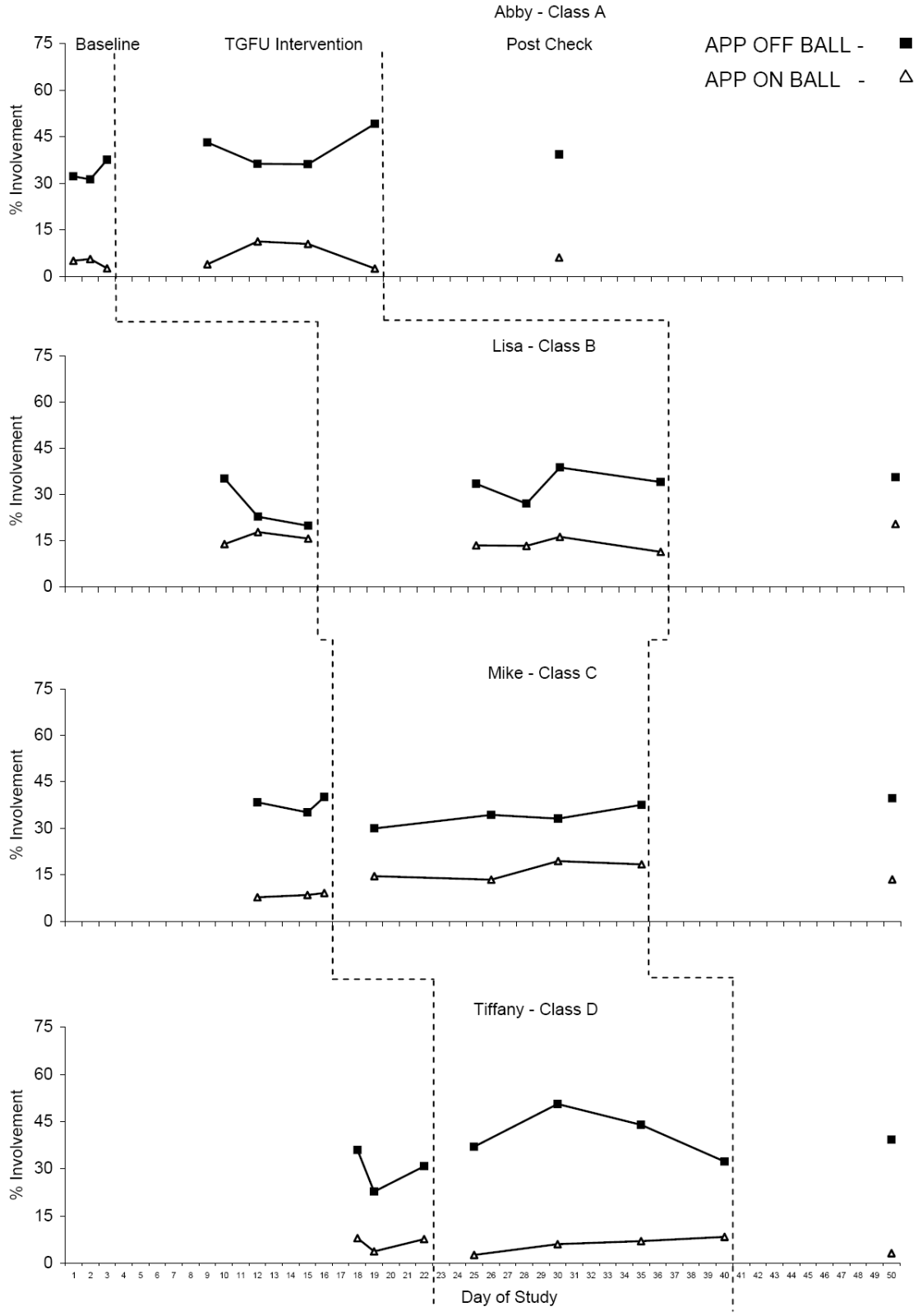


Figure 3d: *Line graphs showing the change in the relative percentage of inappropriate/ineffective on-and off-the-ball game involvement of four moderately skilled participants over the baseline, mid and final assessment periods of a TGFU intervention*

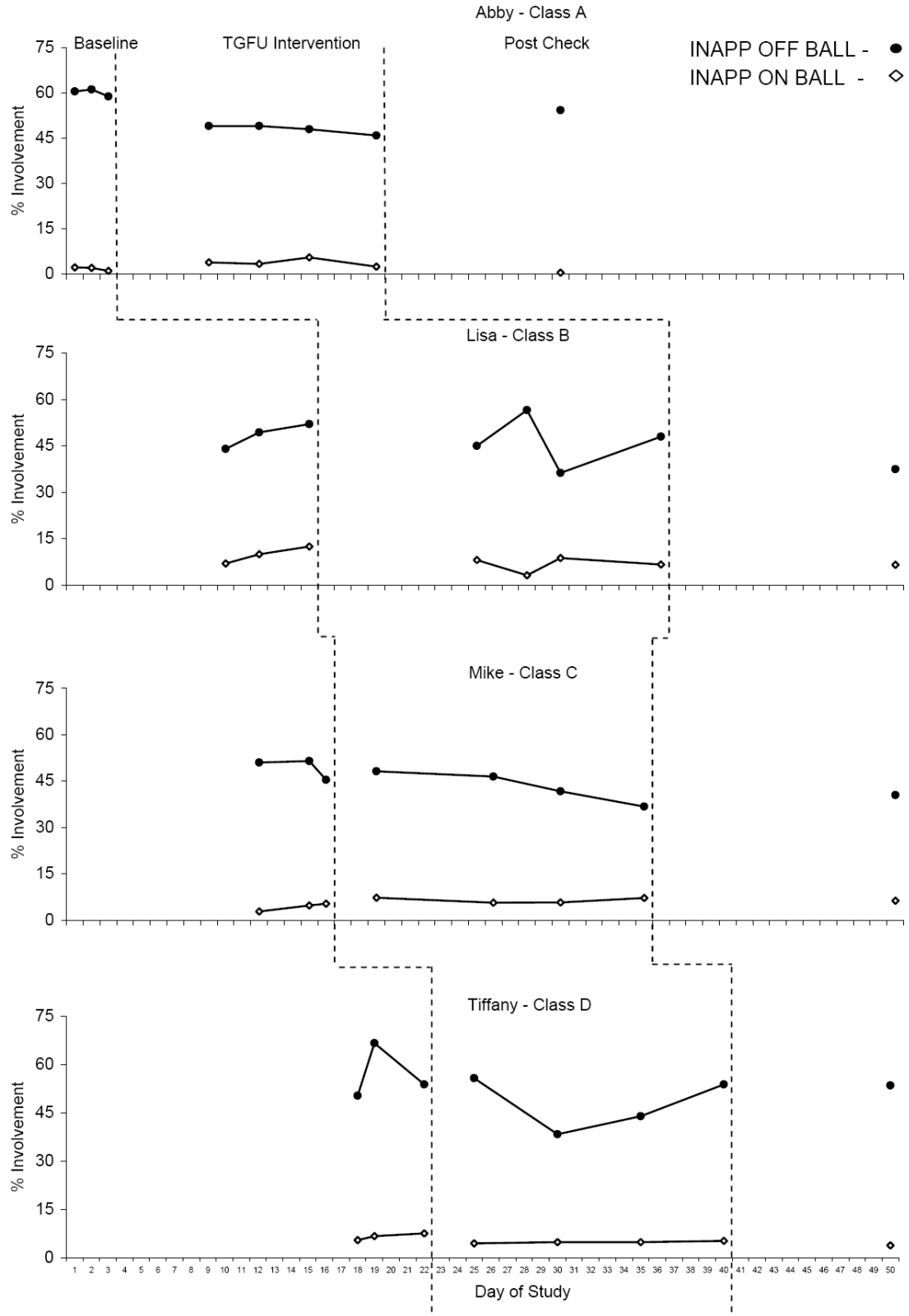


Figure 4a: *Line graphs showing the change in GPAI game performance indices (decision making, skill execution and overall GP) of four lower skilled participants over the baseline, mid and final assessment periods of a TGFU intervention*

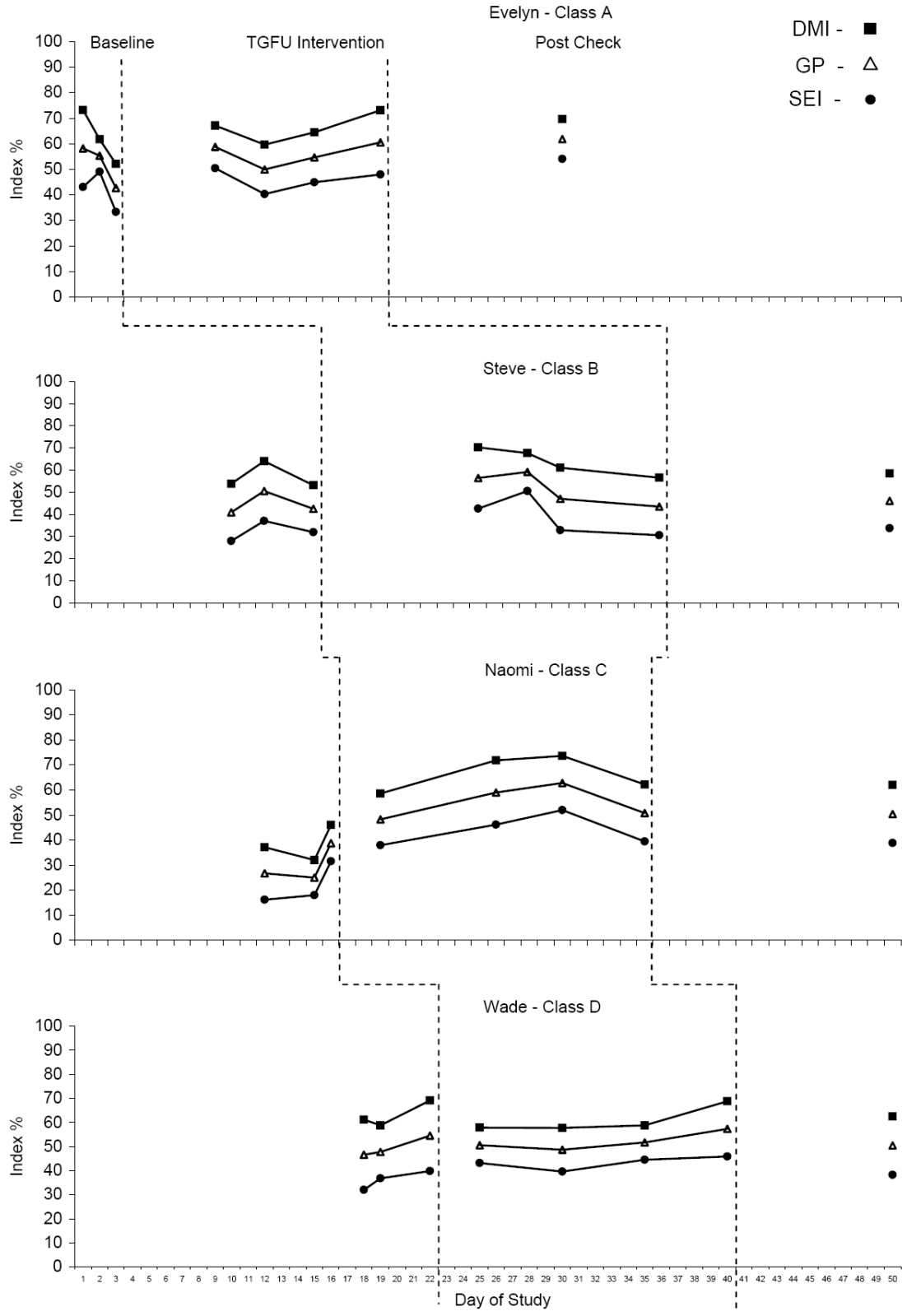


Figure 4b: *Line graphs showing the change in the total amount of appropriate/effective and inappropriate/ineffective game involvement of four lower skilled participants over the baseline, mid and final assessment periods of a TGFU intervention*

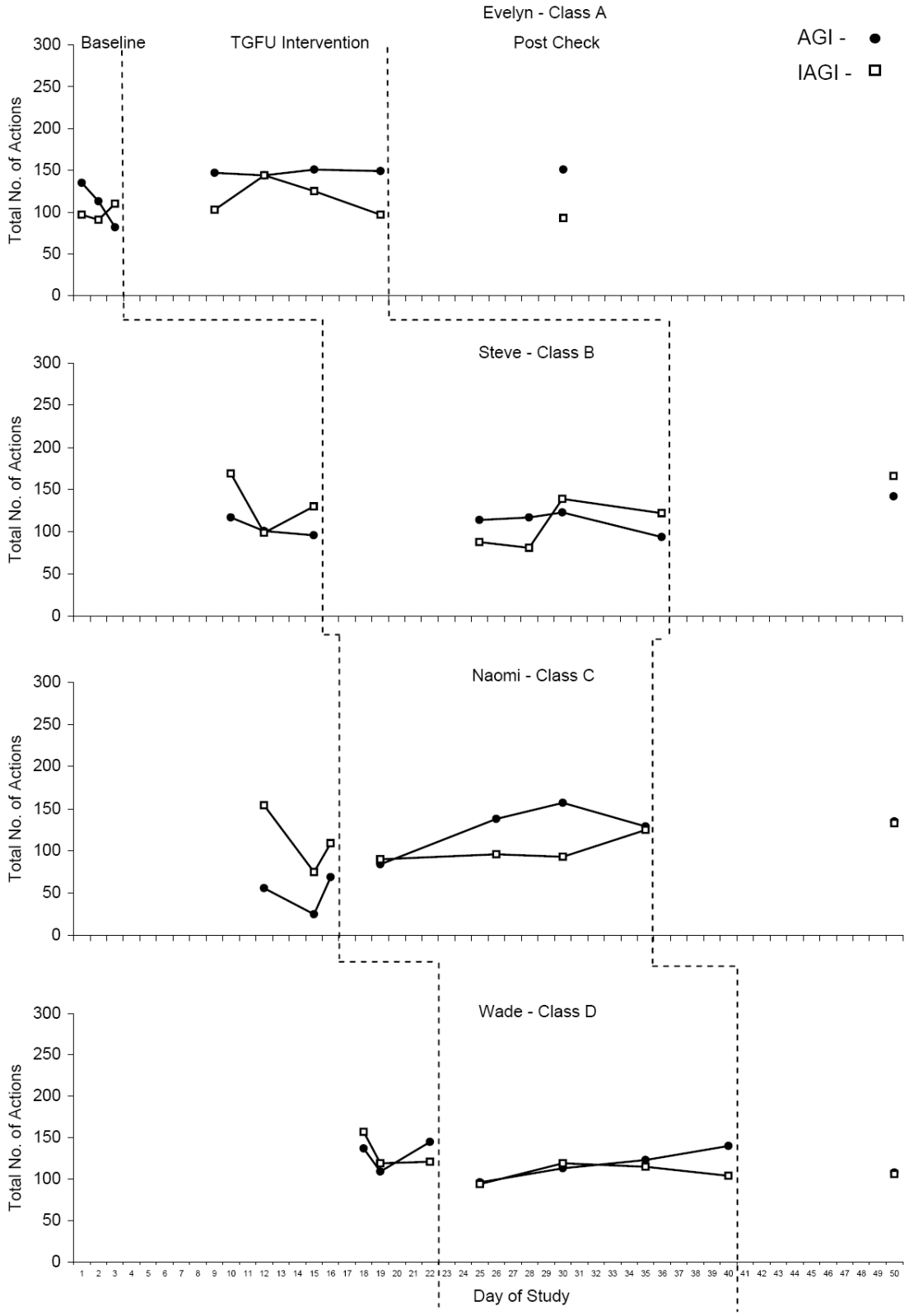


Figure 4c: *Line graphs showing the change in the relative percentage of appropriate/effective on-and off-the-ball game involvement of four lower skilled participants over the baseline, mid and final assessment periods of a TGFU intervention*

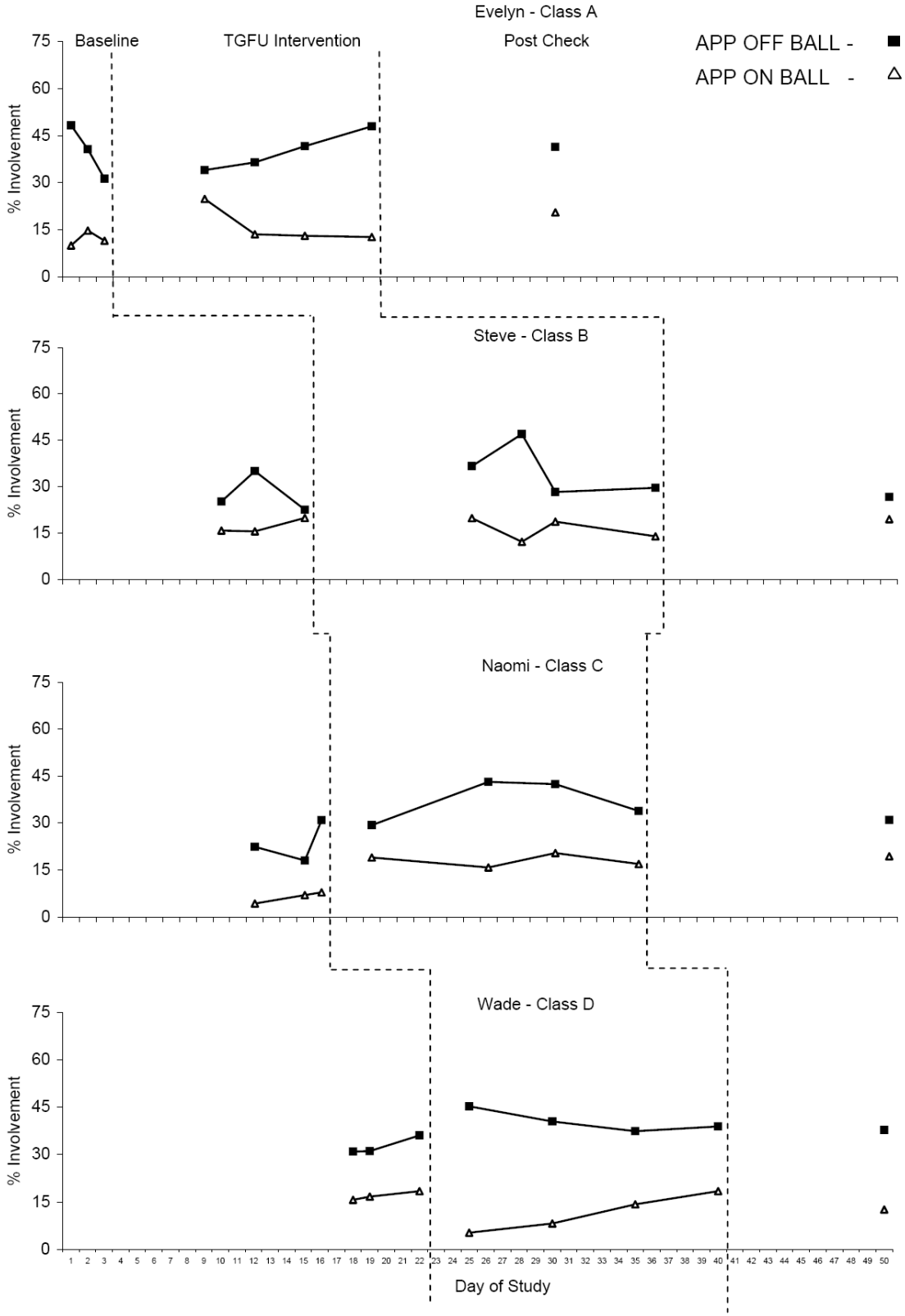
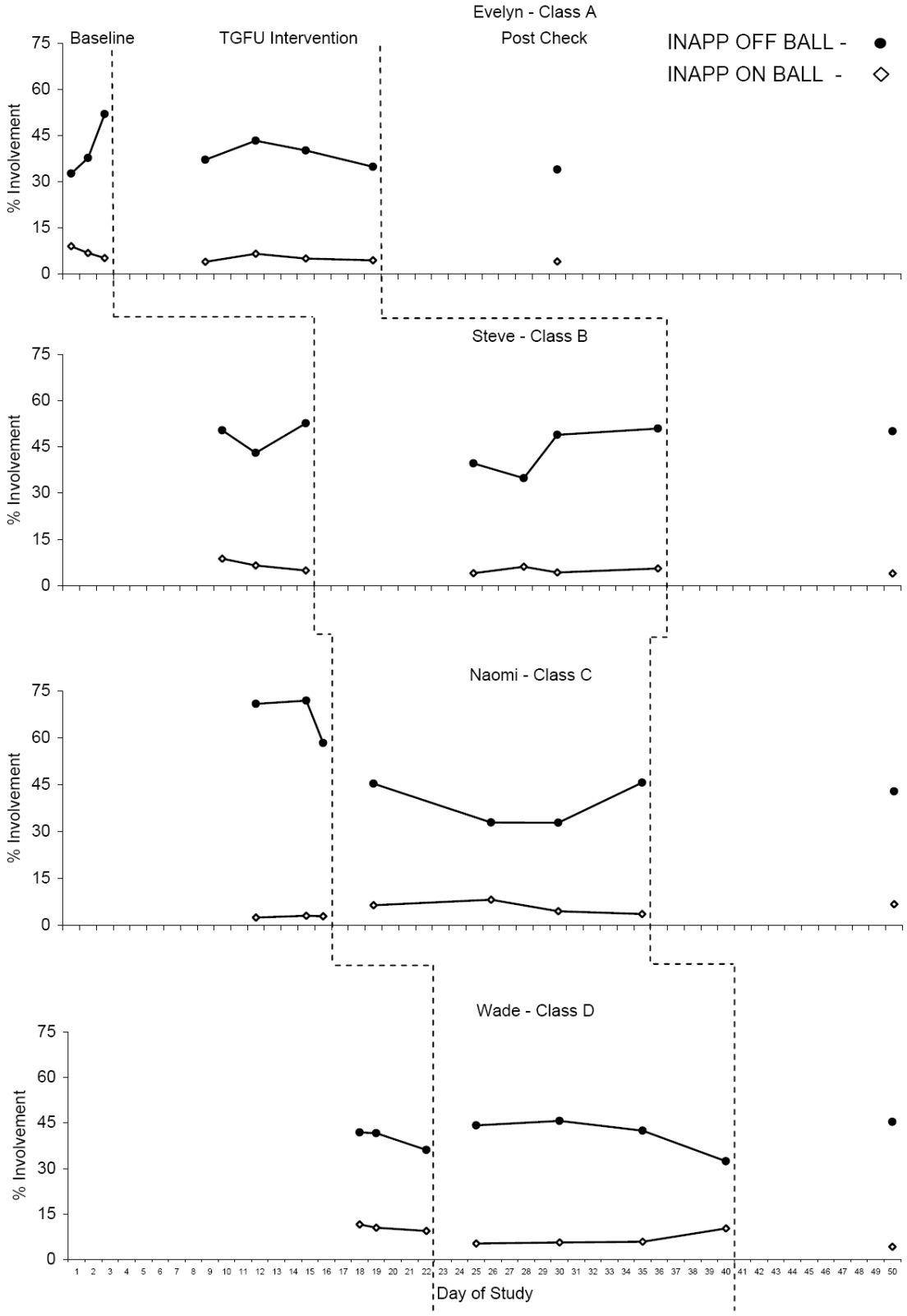


Figure 4d: *Line graphs showing the change in the relative percentage of inappropriate/ineffective on-and off-the-ball game involvement of four lower skilled participants over the baseline, mid and final assessment periods of a TGFU intervention*



Running Head: Effects of TGFU on Game Performance and Understanding in Middle School PE

Effects of Teaching Games for Understanding on Game Performance and Understanding in Middle School Physical Education

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Abstract

Background and Significance: The ultimate development of skilled performers relies on both making the correct response selection as well as executing the correct response. Therefore, in order to better understand how decision making skills evolve in game play and improve the relationship between response selection and response execution, consideration must be given to more than just game play performance (Grehaigne, Godbout, & Bouthier, 2001; Kirk & McPhail, 2002; McPherson, 1994). The ability of the Teaching Games For Understanding (TGFU) approach to teach tactics, strategy and off-the-ball concepts of game play has been forwarded as one of the advantages of utilizing this approach to teaching games in physical education (PE) settings (Kirk, 2005; Light, 2004; Mitchell et al., 2006). However, Rink, French, and Tjeerdsma, (1996) noted that, despite investigations into TGFU finding some positive learning outcomes for students, especially in tests of tactical knowledge, more empirical support for TGFU is warranted. Study **Aims**: The present study was conducted to a) examine whether an 11-13 lesson unit of soccer taught using the TGFU approach improved the Game Understanding (GU) of grade six PE students, across skill levels, and class periods; and b) assess the relationship between Game Performance (GP) and GU. **Experimental Design and Methodology**: Using a single subject, delayed multiple baseline design three students (a higher-, moderate- and lower-skilled student) were randomly selected from four different grade six (11-12 years) PE classes (n=12). Students were followed over an 11-13 soccer unit taught using the TGFU approach. Eight measures of GP (using the Game Performance Assessment Instrument, [GPAI]) and three measures of GU were collected (using a modified version of the Verbal

Protocol Analysis [VPA] technique, McPherson & Thomas, 1989). Elements of GP were formulated into GP indices: Decision Making Index (DMI); Skill Execution Index (SEI); overall GP Index (GPI); and Game Involvement (GI). The latter GI Index was further divided into appropriate/inappropriate on- and off-the-ball actions. Developments in the total, variety (i.e. 'goal', 'condition', action etc), and level of sophistication (i.e. '0', '1', '2' and '3') of coded statements from the VPA GU task were assessed using a series of 12 separate repeated measures ANOVA's. The relationship between the GP and GU was also assessed using a Pearson correlation. **Results:** Participants significantly increased the total number of coded verbal statements, and the use of condition 'if' and 'then' statements. In addition, they significantly decreased their use of affective 'opinion' statements. Participants also demonstrated minimal improvements in their use of more sophisticated descriptions of the game play action. Finally, there appears to be no strong link between the way in which GP and GU emerges and/or develops, at least within the limitations of this study (i.e. such as the small sample size and the short duration of the learning period). **Conclusions:** A TGFU-based unit of soccer, focused on teaching both on- and off-the-ball elements of game play, is associated with developments in participants' GP and GI indices across participants from high, moderate and low skill levels. Moreover, although some improvements in GU were also observed (i.e. in terms of the variety, level of sophistication and total numbers of coded statements), these were less likely to discriminate skill levels than GP measures.

Key Words: Teaching Games for Understanding, verbal protocol analysis, knowledge, game performance, soccer, physical education.

Introduction

The ultimate development of skilled performers relies on both making the correct response selection as well as executing the correct response. Therefore, in order to better understand how decision making skills evolve in game play and improve the link between the response selection and response execution elements of Game Performance (GP), consideration must be given to more than just game play performance (Grehaigne, Godbout, & Bouthier, 2001; Kirk & McPhail, 2002; McPherson, 1994). Furthermore, instruction should specifically target the decision making aspects of play (Blomqvist et al., 2005).

The ability of the Teaching Games For Understanding (TGFU) approach to teach tactics, strategy and off-the-ball concepts of game play has been forwarded as one of the advantages of utilizing this approach to teaching games in physical education settings (Kirk, 2005; Light, 2004; Mitchell et al., 2006). In the last decade, TGFU has received much support from practitioners and the research community alike. However, Rink, French, and Tjeerdsma, (1996) noted that, despite investigations into TGFU finding some positive learning outcomes for students, especially in tests of tactical knowledge, more empirical support for TGFU is warranted.

The main source of collecting data on cognitive developments in the previous studies evaluated by Rink et al., (1996) was through the use of written tests of tactical knowledge (e.g. Allison & Thorpe, 1997; Blomqvist et al., 2001; Griffin, Mitchell, & Oslin, 1995; Harrison et al., 2001; Lawton, 1989; Mitchell, Griffin, & Oslin, 1995; Turner, 2003, 1996; Turner & Martinek, 1992, 1999). More recently, different strategies to assess cognitive development of students in physical education (PE) settings have been

used including structured written questions and video-based tests. When asked about the tactical similarities between badminton and pickelball responses to structured questions showed that students had developed both declarative and procedural knowledge (Mitchell & Oslin, 1999).

Blomqvist et al., (2001) tested knowledge or "Game Understanding" (GU) via a video-based assessment consisting of 15 badminton sequences or "problem representation situations". Treatment groups (both TGFU and technique-orientated) improved their GU (from the video-based test) more than the control group, with the TGFU group improving the most, with the difference between TGFU group and the control group being significant for selected argument options.

Griffin et al., (2001) also used problem representation situations to assess the domain specific knowledge of grade six physical education students in soccer. The authors measured the students' knowledge by asking them to solve game-related situations on a whiteboard using markers. They found that students with more soccer playing experience knew more about the domain of soccer than those with less experience with all children solving attacking problems easier than defensive ones. These problem representation "GU" tests have become more popular with recent research focused on validating number of these tests in modified games such as fistball and hand-tennis (e.g. Takahashi, Nishisaka, Kageyama, Tange, & Yoshino, 2005; Tange, Kageyama, Nishisaka, Takahashi, & Yoshino, 2005).

Grehaigne et al. (2001) argued that verbalization is another means of collecting information about cognitive processes, and that overt verbalization (including VPA techniques) can be used as a) a method to collect information about students thought

processes, and b) be used as a tool for eliciting reflection and critical thinking about performance to bring transformation to action play. In a verbalization settings, the teacher may then hear information such as 'I should have", "I might have" "I did or did not" and so on. Indeed, these statements are similar to 'if" and 'then' statements and condition-action sequences that characterize the development of procedural and strategic knowledge. These may be coupled with more playing experiences of a particular activity (Beilock & Carr, 2004).

In order to assess developments in cognitive understanding and provide more insight into the effectiveness of the TGFU approach in physical education settings Turner (2003) has suggested using the verbal protocol analysis (VPA) technique. The VPA technique has had limited use in studies on invasion type games where game play is more dynamic and less predictable in nature, and has primarily been used in studies focused on net/wall and striking and fielding games where natural breaks in play that can be used to collect verbalization data.

The VPA technique has been used in two previous TGFU studies with high school students playing badminton in PE settings (French, Werner, Rink et al., 1996; French, Werner, Taylor et al., 1996). Findings from these studies revealed that none of the 48 students in the three-week study (French, Werner, Rink et al, 1996) thought in sophisticated ways about their play and/or used condition-action statements, although some students could demonstrate tactical reasoning in game play. In the six-week study (French, Werner, Taylor et al., 1996) only two of 52 players reported plans with condition-action linkages. Since these two studies VPA has had limited use in TGFU research.

However, VPA has been used widely to assess problem representations of sports performers whilst in the act of competing in high strategy sports. As this procedure was originally devised for tennis it has been used with various populations within this sport such as boys tennis (McPherson & Thomas, 1989), youth and adult women's tennis (McPherson 1999a), collegiate women's tennis (McPherson, 2000), and across various youth and collegiate populations during competition (McPherson, 1999b). VPA has also been used with collegiate volleyball blocking (McPherson, 1993b), collegiate baseball batting preparation (McPherson, 1993a), youth baseball performance (French, Spurgeon, & Nevett, 1995; French et al., 1996) and with male youth and high school baseball shortstops using a talk-aloud procedure (Nevett & French, 1997). These studies found expert performers used a greater variety and higher level of sophistication than novices/beginners when talking about the game. Furthermore, adults, college-aged players and even high school players used greater levels of sophistication when compared to youth.

Blomqvist et al., (2005) assessed the link between GU and GP. GU was measured by 14 and 15 year old students (N = 12) students responding to 'problem representation' situations from 3 v 3 soccer video film, and GP was measured using the constructs of decision-making and skill execution though observation of actual performance by the same players in 3 v 3 games. Authors found that a) those players who responded better in problem representation situations were also better in game play situations (i.e. GU is related to GP), b) players made more decisions than skill executions (see also McPherson & Kernodle, 2003), and c) players found actions related to offensive aspects of the game easier than defensive actions (see also Griffin et al., 2001). The

authors concluded that teachers should target their teaching toward a) decision making, as decisions occurred more often than skill executions, and, b) off-the-ball movements in game play as these remain largely are ignored in games teaching. That is, they deserve more attention in games teaching. Therefore, when teaching games, there is a need to raise the students' awareness of the not only on-the-ball skills but off-the-ball skills such as moving to support a teammate and, in addition, raise students awareness of the tactics and strategy associated with game play (i.e. the notions of time, space and risk and safety).

Therefore, in addition to gleaning more information about the cognitive processes students go through during performance an attempt was made to examine whether improvements in cognitive awareness (i.e. GU) were related to GP (i.e. do the better players in terms of GP have higher levels of procedural and/or strategic knowledge of the game and vice versa?). Indeed, little is known about this relationship of knowledge development and performance in PE settings where invasion games are taught, especially from a TGFU perspective.

Thus, the purpose of this paper was to a) examine whether an 11-13 lesson unit of soccer taught from the TGFU perspective improved the GU (i.e. procedural and/or strategic knowledge) of grade six PE students, across skill levels, and, b) assess the *relationship* between GP and GU (i.e. does more knowledge of the game of soccer translate into improved GP, and vice versa?).

Methodology

Participants and Setting

Participants were members of four grade six PE classes (N = 12; 6 male and 6 female) at an urban middle school in the Pacific North Western United States. PE classes met daily with total teaching time available for class instruction being approximately 35 minutes. All students in classes used for the study received the TGFU intervention. Three participants from each class (a higher-, moderate- and lower-skilled student) were randomly selected from the available students to be part of the final data analysis (see Table 1).

Informed consent was received from participants using standardized procedures after they had been approved by the Institutional Review Board for the protection of human subjects. Permission was also gained from the school principal and resident PE teacher to use the schools PE classes for the study. This school was chosen because its students had previously had little exposure to the TGFU approach, either in their present schools, or in previous grade levels. The resident PE also viewed this as a professional development opportunity by "seeing TGFU in action".

Selection of participants for final data analysis

Students in each class had equal chance of selection for the final data analysis, and no participant ever knew they were going to be a subject or not. Due to the fact that class membership far exceeded the amount of subjects needed for the final data analysis, the criteria for selecting participants used in the final data analysis were:

a) Attendance and participation in 100% of TGFU sessions
b) Attendance and participation at **ALL** assessment sessions
c) Completion of assent/informed consent documentation

The resident PE teacher chose names from a hat by skill level that included names of all students who met these criteria. The demographics of the final participants (names are pseudonyms) their class, skill level, previous soccer experience and how much soccer they played during the intervention can be found in appendix 5.

Instruments

Two measurement devices were used in the current study to assess the effectiveness of the TGFU treatment a) The Game Performance Assessment Instrument (GPAI) (discussed in Chapter 2), and b) A modified version of the VPA technique.

The VPA technique has been used to assess problem representations of sports performers whilst competing in high strategy sports (McPherson & Thomas, 1989; McPherson, 1994). This procedure was originally devised for tennis, but has also been used badminton, volleyball, and baseball settings (see appendix 1 for referenced papers previously using this method).

Reliability and Validity of VPA

McPherson and Thomas (1989) and McPherson (1999) have previously shown intra-observer and inter-observer reliability for this data collection method. McPherson and Thomas reported values ranging from 0.93 to 1.00 and 0.95 to 1.00 and McPherson reported values ranging from 0.93 to 1.00 and 0.95 to 1.00 for all categories of the coding system using an intra class correlation. Reliability of using this technique has further been demonstrated with beginning badminton players (French, Werner, & Rink et al., 1996; French, Werner, & Taylor et al., 1996) and advanced youth tennis players (McPherson & Kernodle, 2003). In addition, McPherson and Thomas (1989)

demonstrated that there were no detrimental effects on performance when using this method in training and match play.

Target behaviors

The target behaviors assessed during the VPA task in this study were a) the total number of coded statements, b) the variety of the coded statements, and c) the level of sophistication of the coded statements.

Instructor

The investigator served as the teacher of the TGFU soccer unit. The instructor had extensive previous experience implementing the TGFU model in both coaching and teaching settings in both the USA and England, thus, this gave a potential to see the effects of a TGFU intervention in its fullest sense.

The 'TGFU Intervention'

The intervention consisted of a series of 'teaching sessions' that employed a games based (TGFU) approach to instruction. Each teaching session in the TGFU unit comprised of small-sided game type practices, some used regular goals; other modified goals and rules (see appendix 8 for complete content information for each teaching session for each classes A – D). Teaching sessions focused specifically on *off-the-ball* skills, such as playing in a 'diamond formation' or in 'triangles' in order to be able to pass and move quickly, cutting into open spaces when a team had possession of the ball, and/or guarding players and/or spaces when the other team had possession of the ball. The intervention was centered on increasing participants' decision-making and skill execution *within the game* or the 'what to do' and 'when' and 'how to do it associated with the TGFU model (see appendix 1). Examples of the first two teaching sessions

conducted can be seen in appendix 9. Practice of isolated techniques were kept to a minimum and used only when the instructor felt it was essential in order to help the participants become more aware of certain concepts within game play (Thorpe & Bunker, 1982).

The instructor used various techniques to engage the participants, including the principle of *exaggerating* games (by modifying rules, modifying the size and shape of the playing areas, restricting players to certain zones of the field, altering the number and size of the goals used etc.), as well as the three pedagogical principles outlined by Launder (2001): a) shaping play, b) focusing play, and c) enhancing play, and, using "questioning" as a form of instruction, "coach as a player" and "freeze replays" (Metzler, 2000).

The games approach used was a mixture of play practice (Launder, 2001), games sense (Australian Sports Commission [ASC], 1997), the tactical games approach (Mitchell et al., 2006), and the original proposed TGFU approach (Bunker & Thorpe, 1982). The general format for each of the teaching sessions followed closely the one outlined by Meztler (2000) and the ASC (1997):

a) Introduction to 'tactical problem' and 'initial game form': Make suggestions to, and ask participants 'why' they think the tactical problem is important to them being able to successfully play the game
b) Use of effective communication skills
c) Instruction: Use of effective instructional techniques during game play. Instructor thinks about 'when to ask' and 'when to tell'; 'where and when' to introduce skill practice; 'when' to stop the whole group or small groups for instruction; 'how'

modify ‘initial game form’ by shaping, focusing or enhancing play (Launder, 2001).

d) Review of lesson content and ‘tactical problem’ with questions, and provide an introduction to the next session.

Although each class, A through D, received similar content (see appendix 8), the content was manipulated slightly due to the different needs of each class, class size, facilities available and initial ability levels. How the class was organized for the teaching sessions is detailed in appendices 10, 11 and 12.

Fidelity of TGFU Teaching Session Instruction

To ensure treatment integrity and procedural reliability and control for treatment drift over the course of the TGFU intervention, as well as ensure that this research using TGFU was being undertaken validly as per the guidelines of Metzler (2005), the instructor was observed at each session by a minimum of one independent observer at each teaching session using the validation protocol set out by Turner and Martinek (1992, 1999) (see appendix 13). Results of the training of observers in using this protocol indicated all observers were able to distinguish between the TGFU approach to teaching and ‘traditional’ technique-orientated instruction.

For 42% of the teaching sessions, two observers validated the use of appropriate TGFU instruction. Inter-Observer Agreement (IOA) levels between these two observers were 100%. In addition, for the other 58% of teaching sessions, one observer validated the TGFU approach was being utilized 100% of the time.

Procedures

Apparatus

Participants spoke into mini Radio Shack 33-3013 microphones that were attached to Olympus Pearlcorder J300 micro cassette recorders whilst they were prompted to answer a series of eight pre-recorded questions. Appendix 26 shows an example of the equipment set-up. For apparatus for the GP procedures see Chapter 2.

Procedures for VPA task

Verbal records were created by placing tape recorders at stations around the periphery of the assessment game playing areas. Players sat in pairs (see appendix 26) and each watched another player (not the same player to avoid copying) in their PE class play the assessment game at baseline, mid and final assessment points of the study. This task was couched in the format of them acting like a sports announcer on ESPN, commenting on the play as it happened. Participants were prompted by listening to a previously constructed structured interview cassette tape with pre-recorded questions. Questions related to both on and off-the-ball aspects of game play (see appendix 27 for questions). This ESPN task only occurred on assessment game days (n = 8) and each participant completed the VPA task once in each assessment period of the study (i.e. n= 3; baseline, mid, and final assessment). In order to ensure reliability of the data collection process questions posed to the study participants were the same at each assessment time point. However, the order of the questions was varied at each of the eight data collection points to reduce the risk of the participants answering questions from memory. The author also listened to each recording after each assessment day to ensure the audio records clarity for subsequent transcription. For procedures of collecting GP data see Chapter 2.

Procedures for Data Collection

Participants VPA audio records were transcribed verbatim into Microsoft Word® (2003) by the lead researcher. Samples of these transcriptions were checked by a second coder for reliability of the transcription process. The lead researcher then coded each individual participant's transcriptions for concept content, concept structure variety and sophistication using McPherson and Thomas' (1989) coding protocol. Firstly, the author used appendix 28 to determine the major concept coding category, (i.e. 'goal', 'condition', 'action' etc.) of each of the statements made by the participants. Prompt words in the transcriptions (see appendix 28) aided in the process of coding the participants' statements. Once this process was completed, the author assessed whether the coded statement was appropriate or inappropriate and evaluated the level of sophistication (i.e. level '0', level '1', level '2' and level '3') associated with each coded statement. The total amount of codable statements and their variety and sophistication levels (in terms of hierarchical level, see appendix 28) were ascertained for each individual by summing the terms in each major concept category and sophistication level to assess for changes through the baseline to mid and final assessment time points.

A second coder was trained to determine the reliability of the primary coder. Systematic Inter-Coder Reliability (ICR) checks were made on approximately 30% of the data (Baumgartner & Jackson, 1991). Transcripts subject to ICR were chosen at random from baseline, mid and final assessment time points. In addition, the second coder was blind to the time point of the transcription being coded to control for observer drift and maintain observer objectivity.

Both coders totaled the amount of codes and added these into the coding tables at the end of each transcript in Microsoft Word® (2003) (for an example see appendix 29).

These coding tables for each coder were placed alongside each other in Microsoft Excel® (2003) and were then subject to a reliability analysis which evaluated both the variety of the codes, (i.e. 'goal', 'condition', 'action' statements etc.) and their level of sophistication, (i.e. level '0', level '1', level '2' and level '3').

In stage two of the coding of VPA data, the second coder reviewed and marked areas for change in the remaining 24 transcriptions not used in the reliability analysis. These transcriptions were edited, where needed, by the author. The final transcriptions used in the data analysis were those of the author, with modifications suggested by the second coder. For procedures regarding GP data coding see Chapter 2.

Data Analysis

The total codes at each variety and sophistication level were divided by the total number of codes in each major concept coding category at each time point creating a percentage total (see note in Figure 2). This provides an indication of the 'relative change' at each time point in the study, and controlled for the fact that the participants may have spoken more or less at each time point. Means (standard deviations) of the aforementioned percentage scores were calculated for all variables.

A series of 12 repeated measures ANOVA's were conducted to examine for changes over time for each of the types of variety of coded statements (i.e. 'goal', 'condition', 'action' etc.) and for each sophistication level of these coded statements (i.e. level '0', level '1', level '2' and level '3'), as well as for the total amount of coded statements made by the participants at each time point of the study using the Statistical Package for Social Sciences (SPSS) Version 12.0. Mauchly's test for sphericity was examined for violation in each analysis, with significant violations corrected using the

Greenhouse-Geisser adjusted degrees of freedom and corresponding p values (Greenhouse & Geisser, 1959). Post-hoc paired sample T-Tests were computed to determine specifically which time points of the study significant changes in scores occurred. In all statistical tests an alpha level of $p < .05$ was used to indicate significant differences for a one-tailed test. The changes in the total variety and sophistication of the participant's verbalizations over the course of the study are presented graphically. In order to examine the effects of the TGFU intervention increased in all measures would need to be observed (i.e. total, each individual variety of statement [except 'affective' statements which would be reduced] and at each level of sophistication. For procedures regarding GP data analysis see Chapter 2.

Assessing links between GU and game play performance

The relationship between the GP and VPA data was analyzed at two levels; a) using data from all participants (N = 12) as a whole group, and, b) by separating them into their skill groups (high, moderate and low skill; N = 4). Pearson Product Moment correlations were completed on the data using SPSS Version 12.0.

As there were three GP assessments in the baseline, three in the mid point of the study, one final assessment at the conclusion of the study, and one post check assessment, the results of the VPA data collected in the baseline was correlated with all three baseline GP assessments, VPA data collected in the mid part of the study was correlated with all three GP mid assessments, and the VPA data collected in the final assessment was correlated with the final and post check GP assessments. The rationale behind this was that the GP was variable over both the baseline, mid, final and post check assessments,

and evaluating the correlations in this way it allowed a more holistic assessment of the relationship at each time point in the study.

Results

Results of the VPA data are presented in Figures 1 through 3, and in Tables 2 and 3. First, the ICR of the data will be presented, followed by descriptive statistics with statistical analyses of changes over the course of the study for a) the total amount of coded statements, b) the variety of coded statements, and c) the levels of sophistication.

Inter-Coder Reliability

Reliability coefficients were computed using the agreements/ (agreements + disagreements) x 100 method (van der Mars, 1989). The results of this analysis revealed an average ICR above the minimum level of 80% ICR (see appendix 29).

Descriptive Statistics & RM ANOVA Results

Total Coded Statements

The total number of coded statements increased at each time point in the study, demonstrating that the participants verbalized more about the player they observed as the study progressed (see Figure 1). The increase in the variability of scores also suggests that while some participants improved, some remained low on the amount they talked about the participants they were observing.

There was a significant main effect for the TGFU treatment for the total amounts of coded statements used over the course of the study (see Table 2 and Figure 1). Post-hoc paired sample T-Tests also revealed significant increases between both the baseline and mid assessment ($t [11] = -2.28$, *M (baseline)* = 27.33±10.33, *M (mid)* 31.92±11.63, p

<.05) and baseline and final assessment (t [11] = -3.30, *M (baseline)* 27.33±10.33, *M (final)* 35.33±12.38, p <.01), but not between the mid and final assessment.

Variety of Statements

When viewed from the whole group, the variety of coded statements used changed mainly due to an increase in the use of 'condition' statements and the simultaneous reduction in the use of 'affective' statements (see Figure 2). The baseline data shows that 'action' and 'affective' statements made up the largest proportion of the total coded statements at that time point (49%), with 'do' statements being the next largest contributor (17%). In the mid assessment 'action' statements remained a high contributor to the total percentage of coded statements, and alongside 'condition' statements, these made up the largest proportion of the coded statements (46%). 'Goal' and 'do' statements contributed the next most (15% and 16%, respectively) whilst 'affective' statements were reduced (14%). In the final assessment 'condition' and 'action' statements remained the highest contributor to the total amount of coded statements (44%), alongside 'do' statements (20%). 'Affective' statements continued to decline (12%).

For both the 'condition' and 'affective' statements there was a significant main effect for the TGFU treatment (see Table 2). Post-hoc paired sample T-Tests revealed a significant increase in the use of 'condition' statements occurred between the baseline and final assessment (t [11] = -2.37, *M (baseline)* 14.35%±15.80%, *M (final)* 21.09%±14.63%, p <.05). A significant decrease in the use of 'affective' statements occurred between both the baseline and mid assessment time periods (t [11] = 2.09, *M (baseline)* 22.26%±13.75%, *M (mid)* 14.01%±9.00%, p <.05) and the baseline and final

assessment time periods (t [11] = 3.30, *M (baseline)* 22.26%±13.75%, *M (final)* 11.76%±9.40%, p <.01) (see Figure 2). No other significant differences were found.

Sophistication levels

During all sections of the study participants used mostly level '1' and level '2' statements (see Figure 3). The use of level '2' and '3' statements increased from baseline to final assessment (26% to 33% and 4 to 7%, respectively) while the use of level '0' and '1' statements declined (15% to 8% and 58 to 52%, respectively).

There was a significant main effect for the TGFU treatment for the amount of level '3' statements used (see Table 2). Post-hoc paired sample T-Tests revealed this significant improvement in the use of level '3' statements occurred between the baseline and mid assessment (t [11] = -4.01, *M (baseline)* 3.53%±5.29%, *M (mid)* 7.93%±3.84%, p =.001) (see Figure 3). No other significant differences were found.

Relationships between GP and VPA Data

The relationship between the GP and VPA data is presented at two levels; a) using the 12 players as one whole group (see Table 3a), and, b) by separating them into their three skill groups (high, moderate and low – see Tables 3b through 3d).

Whole Group Correlations

No significant relationships between GP and VPA were noted possibly due to the inclusion of scores from participants across all three skill levels (see Table 3a). At the beginning of the study, before the TGFU intervention was introduced, the whole group correlation between GP and VPA was moderately negative. However, at the third baseline assessment, this relationship was reversed, and a weak positive relationship was observed. In the mid assessment section of the study the relationship remained positive,

(weak to moderate in the first and second mid assessments and weak the final assessment). In the final assessment, the relationship of GP to VPA returned to a weak to moderate negative relationship, and a weak positive relationship was observed in the post check assessment (see Table 3a).

However, of note were the increased mean scores of the group, in both GP and VPA during the intervention, suggesting that both GP and GU improved over the course of the study (see Table 3a). At the same time, variability of GP decreased, but increased for the VPA task, suggesting the variability between the participants in all three skill levels GP scores decreased while the variation in their ability to verbalize about the game increased. When considering the effects of skill level, further interesting relationships were noted.

Correlations by Skill level

High Skilled Participants

Descriptively, the variability of GP scores decreased during the intervention, but for the VPA task they increased (see Table 3b). For the higher skilled participants no significant relationships between GP and VPA were noted (see Table 3b). A high positive correlation between GP and VPA data was observed in the first and third baseline assessment, the first and third mid assessment, and in the post check assessment. Weak positive correlations were observed at the second baseline assessment, and in the second mid assessment. In the final assessment a low negative correlation was observed.

Finally, the mean scores for GP at the first mid assessment, third mid assessment, and final in the final assessment were higher than those in the baseline assessments and higher for the VPA task at each assessment stage (baseline, mid and final – see Table 3b).

Moderate Skilled Participants

For the moderate skilled participants no significant relationships between GP and VPA were noted (see Table 3c). High, negative relationships between GP and VPA existed at the first and second baseline assessment, and in the third mid and post check assessments. A weak negative and weak positive relationship was observed in the second baseline assessment and the final assessment, respectively. In contrast, at the second mid assessment a high, positive relationship was observed (see Table 3c). Higher mean GP scores were observed during the intervention when compared to baseline and the same was true for the VPA scores (see Table 3c).

Low Skilled Participants

Participants in the low skilled group had consistently higher mean scores for GP over the course of the intervention in relation to baseline GP scores. They also increased their mean VPA scores over the course of the intervention, although the change was minimal over the final part of the study. The variability of GP scores was consistently lower in the intervention and the variability of VPA scores became progressively lower at each assessment (see Table 3d).

The low skilled participants demonstrated a high, significant, negative relationship of GP to VPA in the first and second baseline assessments, and a moderate, negative correlation was maintained in the third baseline assessment and in the first mid assessment. By the second mid assessment a high, significant, positive relationship was observed and this positive relationship was maintained at the third mid assessment, although the relationship was weak/moderate. In the final and post check assessment this

positive relationship was not maintained, and a high, negative relationships were observed (see Table 3d).

Discussion

The hypothesis that a unit of TGFU instruction developed the participants' GU (i.e. procedural and strategic knowledge) as reflected in the use of greater variety and higher levels of sophistication in their coded statements in the VPA task, is only partly supported, and further studies are needed to determine the exact nature of the association between the TGFU approach to teaching and changes in the cognitive aspects of performance.

The biggest single contributor to the coded statements in all three assessment periods was 'action' statements with, on average, 25% of the coded statements. 'Do' statements also remained a high contributor to the total coded statements across the study (between 16% and 20%). This may be explained by the nature of the task which asked the participants to commentate on the game play action. Neither of these two statements significantly changed over the course of the study. In a previous study McPherson (2000) also found that action statements made up the largest proportion of coded statements alongside 'condition' and 'goal' statements. 'Goal' statements also contributed somewhat in this study (between 10 and 15%) but this was not as high as 'condition' statements whose contribution rose significantly over the course of the study. McPherson and Kernodle (2003) showed that novices and professionals both had high levels of goal statements. However, the difference between the two skill levels was that the higher skilled players generated more solutions to their goals. The only indication that the students in this study generated more solutions to the goals they made was the

increase in the use of condition statements and the reduction in affective 'opinion' statements.

The higher use of 'condition' statements, alongside the maintenance of high 'action' and 'do' statements is a sign that participants higher levels of 'condition', 'action' and 'do' statements could be associated with the development of 'if', 'then', 'do' links (i.e. if X occurs then I will perform Y action). These types of statements have previously been seen as reflective of developments in procedural and strategic knowledge development as well as decision making skill, (Beilock and Carr, 2004; Williams & Ford, 2006).

Furthermore, the high contribution of 'condition', 'action' and 'do' statements may also be associated with of nine of the 12 participants developing either their decision making or skill execution (or both) in the GP aspect of this study, i.e. both the 'what to do' and 'when and how to do it' dimensions of the TGFU model. Thus, this possibly points toward the fact that the increased playing experiences (Beilock and Carr, 2004; Nevett et al., 1997; Williams & Ford, 2006) or "legitimate peripheral participation" in the small-sided games in the study (Kirk & McPhail, 2002) in addition to providing the students' with the opportunity to verbalize about the game (Grehaigne, et al., 2001) was associated with developments in the cognitive and motor execution components of the information processing model. However, the exact nature of this relationship between GP and GU still needs to be delineated (see later section in discussion on 'assessing the relationship between GP and GU).

Furthermore, the TGFU soccer unit was based around the concept of teaching not just on-the-ball but also off-the-ball movements, and the tactics and strategies for

effective game play. Since most participants used more 'condition' statements, this may point toward the fact that the TGFU unit helped students develop their critical thinking and reflection on the game. However, it was disappointing these developments were not found in the use of greater levels of all the varieties of commentary (i.e. 'goal', 'do', 'predict' (anticipatory), and 'regulatory' statements) by the students. Further research is needed to ascertain specifically what the impact of a TGFU unit is on the development of participants' knowledge, what it is about the VPA task and/or TGFU unit that aided in developing certain types of statements and not others (i.e. was it the game play experiences, the VPA task on its own, the pedagogical skill of the instructor etc.), and ultimately, how and in what way does this cognitive development effect GP. Indeed, the use of an alternative task, alongside or instead of the VPA task may be needed to ascertain this information. This notion will also be forwarded later in the discussion.

A further indication that the TGFU approach could possibly be associated with developments in participants' knowledge was their significant reduction in the use of 'affective' (or 'opinion') statements over the course of the study. 'Affective' statements were coded when the participants gave opinion about the player they were watching. For example, "she's a team player (Affective, 1)" or "she's a good defender (Affective, 1)". The fact that these were replaced for increased amounts of 'condition', 'action', and 'do' statements points towards some association between TGFU being able to develop participants knowledge of the game of soccer , (i.e. its rules and procedures), (Beilock & Carr, 2004).

In addition to only two of the seven types of the 'variety' e.g. 'goal', 'condition', 'action', etc. of coded statements changing significantly over the course of the TGFU

intervention, there were also minimal changes in the 'levels of sophistication' used by the participants. Only level '3' statements changed significantly and this was only over the first part of the study. However, the results also showed some trends for the TGFU unit being associated with increased use of level '2' statements and reductions in level '0' and '1' statements. Findings from this study align with those of two previous high school studies by French, Werner, Rink et al, (1996) and French, Werner, Taylor et al., (1996) where although their students did begin to think and talk more tactically about the game, there was little development in sophistication levels of students' description of the game play action. One difference in this study to the two previous studies using VPA when teaching using TGFU may have been the age of the participants (11-12 years).

Nevett and French (1997) concluded from their study of youth baseball players, that the younger players (younger than 12 years of age; an age akin to participants in this study) production and quality deficits in sport-specific strategy may have been related to their lack of highly developed knowledge representation and the type of previous practice and game experiences playing baseball. Similarly, in this study it may be concluded that the participants have not yet developed higher knowledge representations. The type of activity in this study, soccer, is more complex in terms of the games curriculum (Butler & McCahan, 2005), and, thus, this may be a factor in the fact that they had not yet begun to think more deeply about the game. Indeed, before this particular unit of soccer, the students also had various levels of previous experience of soccer, and if they had played soccer previously it is not known how often they had been prompted to think more tactically about the game. Furthermore, it may be that expecting students to develop high level knowledge representations over just one unit may be asking too much, and it may

be that this knowledge needs to be built over a longer period of time, and over various units of invasion games teaching.

Although there were minimal developments in both the 'variety' and 'sophistication' of the coded statements over the course of the TGFU intervention, there was a significant improvement in the participants' codable items over the duration of the study; however, there was no significant change during the latter part of the study. This is supported by the fact that participants only increased their level '3' over the first part of the study and most of the increases in 'condition' and reductions in 'affective' statements also occurred in the first part of the study. These findings suggest that the participants' development in knowledge was associated with the information gained from the first part of the TGFU intervention more than the information gained from the second part of the intervention. This may have been due to the fact that much of the information over the second part of the study consisted of similar information supplied in the first part of the intervention. Furthermore, the participants may have become bored with the actual VPA task due to the fact that they had to perform it a minimum of three times over the duration of the study, and at least once in the familiarization phase of the study.

Grehaigne et al., (2001) proposed a debate of ideas setting as an instrument to elicit reflection and critical thinking about performance in order to bring about transformations to GP in PE settings. In this method, data are collected when students meet as a team and evaluate their team's use of tactics and strategies. As in the VPA method, developments in knowledge are characterized by greater use of 'if' and 'then' statements, 'condition-action' or 'condition-do' (if-then-do) statements, and 'predict' (or 'anticipatory') statements. Similar to the VPA task, these conversations would be either

video or audio-taped and then transcribed for later analysis. Thus, future studies may consider using debate of ideas settings instead of or alongside the VPA task to evaluate the participants' development in GU (i.e. procedural and strategic knowledge). Use of the two methods simultaneously, or the debate of ideas setting on its own may help in preventing student boredom and data can also be collected during 'tactical time-outs' given by the instructor which are common when teaching using the TGFU approach.

Furthermore, a protocol similar to the announcer task could be used, but in a semi-structured interview format where the interviewer could explore in more depth, by prompting students, the students thinking, and see if this is associated with and/or as a consequence of the TGFU intervention.

Relationships between GP (GP data) and GU (VPA data)

Overall, the examination of the relationships of GP to GU by skill levels revealed little in terms of significant relationships between GP and GU. However, a positive relationship existed for the high skilled participants between GP and VPA except in the final assessment, and, except for the mid assessment period, a negative relationship existed for the low and moderate skilled participants. Indeed, this was possibly why negative relationship for the whole group was observed at these time points (N=12). However, the positive relationships seen with all skill groups at the mid assessment time point suggests that the cognitive and behavioral aspects of performance were more aligned across the skill levels during the mid assessment part of the study, and a parallel process was occurring, (i.e. scores on both measures were improving). This is supported by the fact that the GP and VPA relationship for the whole group of participants was also positive in this part of the study.

The fact that the moderate and low skill groups had a negative relationship of GP and VPA in the baseline and final assessment time points, and the high skill group having a negative relationship in the final assessment suggests that GP and VPA were not moving in unison. For example, in the final assessment, the low skilled groups VPA scores stagnated whilst their GP scores improved; the opposite was true for the high and moderate skill groups, where their GP declined somewhat whilst their VPA scores continued to improve.

Blomqvist et al., (2005) found that 14 and 15 year old students (N = 12) who responded better in problem representation situations (i.e. on a cognitive GU task) were also better in game play, (i.e. GP was related to GU). Whilst this was certainly true for the high skilled participants in this study (at least for the majority of the study), the negative relationship found with the moderate and low skilled participants in the baseline and final assessment stages of the current study demonstrates this was not the case. The difference in the findings of Blomqvist et al., and this present study may due to the fact that the participants used in the study of Blomqvist et al., were all one skill level (possibly high skilled) rather than participants selected across all skill levels, as in this study.

French et al., (1995) examined the relationships between cognitive and behavioral aspects of play in seven to 10 year old baseball players. Findings from this study, albeit with a smaller sample, confirm the findings that cognitive components did not discriminate skill levels, whilst GP scores did. Higher GP scores were found with the higher skilled, followed by the low skilled and moderate skilled in this study (see Chapter 2). Moderate skilled participants GP scores were lower due to playing in games with

other higher skilled players. VPA scores were variable across all skill levels, with one of the high skilled players registering the poorest VPA scores in all time points of the study. Participants in the Blomqvist et al., study were also older than those who participated in the present study and the study of French et al., and it may be that the relationship between skill performance and cognition only develops with age. This contention needs further research.

In sum, there appears to be no strong link between the way in which GP and GU emerges and/or develops, at least within the limitations of this study (i.e. such as the small sample size and the short duration of the learning period. Therefore, it is difficult for us to generalize about the results to other settings, context and participants. However, these findings do indicate that more research on the relationship between GP and GU is warranted to establish how, specifically, TGFU helps students in developing/forming relationships between GP and GU. It further needs to establish if the same relationship exists across different skill levels, different ages, developmental levels, and in different contexts/settings, (i.e. PE versus coaching settings). Specifically, does the same relationship exists at various time points during TGFU unit of instruction or does this change, and, if the relationship changes, which parameter changed and why. Finally, future research needs to examine the impact of the instructor on improvements in both GP and GU.

Conclusion

A TGFU-based unit of soccer, focused on playing small-sided games while teaching the tactical and strategic elements of game play is associated with developments in certain elements of participants' GU, specifically, the amount that participants

verbalize about the game play actions and by using more ‘condition’ (or ‘if’ and ‘then’) statements, fewer ‘affective’ (or ‘opinion’) statements and more ‘level 3’ statements.

However, more research is needed in order to specifically assess the nature of the relationship between GP and GU, and examine how TGFU aids in helping this relationship emerge/develop.

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Table 1: *Class Numbers and lesson time in school day, boys/girls in class, and total numbers (and percentages) of Informed Consent/Assent forms received from members of classes A – D used in the study*

CLASS	N	Lesson Time	GIRLS	BOYS	IC (%)	NUMER OF PARTCIPANTS AVAILABLE AFTER SESSIONS	FINAL PARTICIPANT GROUP PER CLASS (N)
A	23	1.09 – 1.54pm	9	14	14 (61)	8	3
B	36	1.57 – 2.41pm	20	16	28 (78)	7	3
C	26	2.45 – 3.30pm	12	14	14 (54)	6	3
D	42	10.49 – 11.33am	22	20	21 (50)	10	3
TOTAL	**127**	**n/a**	**63**	**64**	**76 (61)**	**31**	**12**

Table 2: *Results of RM ANOVA Comparing the Variety, Sophistication Levels and Total Numbers of Coded Statements over the three time points of the study*

Type	Code Type	df	F value	Significance level	Effect Size (Ω)	Power
Total Statements	Total	2, 10	4.98	0.02[a,b]	.50	.68
Variety of Statements	Goal	2, 10	1.02	0.20	.17	.18
	Condition	2, 10	2.95	0.05[b]	.37	.45
	Action	1.32, 14.56^	.36	0.31	.03	.09
	Do	2, 10	.89	0.22	.15	.16
	Regulatory	2, 10	.27	0.39	.05	.08
	Affective	1.36, 14.99^	6.17	0.01[b]	.36	.72
	Predict	2, 10	1.10	0.19	.18	.19
Sophistication level of statements	Level 0	2, 10	1.03	0.20	.17	.18
	Level 1	2, 10	.46	0.33	.08	.11
	Level 2	2, 10	.70	0.26	.12	.14
	Level 3	1.36, 14.99^	2.97	0.03[a]	.21	.52

Note: [a] T-Tests revealed a significant difference in means between baseline and mid assessment periods of the study; [b] T-Tests revealed a significant difference in means between baseline and final assessment periods of the study; ^degrees of freedom differ due to violation of the sphericity assumption.

Table 3a: *Whole group correlations (with means and ranges) between GP and Verbal Protocol Analysis (VPA) data at different time points across the study*

	BA1	BA2	BA3	MA1	MA2	MA3	FA	PCA	VPA M	RANGE
VPA1	-0.22	-.40	.08	n/a	n/a	n/a	n/a	n/a	27.33	31
VPA2	n/a	n/a	n/a	.19	.36	.09	n/a	n/a	31.92	34
VPA3	n/a	n/a	n/a	n/a	n/a	n/a	-.21	.07	35.33	35
GP M	49.26	47.14	49.53	54.83	54.13	58.74	55.16	55.08		
RANGE	46.66	45.68	42.55	41.25	30.64	32.39	34.75	39.44		

Table 3b: *High Skilled participant's correlations (with means and ranges) between GP and Verbal Protocol Analysis (VPA) data at different time points across the study*

	BA1	BA2	BA3	MA1	MA2	MA3	FA	PCA	VPA M	RANGE
VPA1	.69	.18	.49	n/a	n/a	n/a	n/a	n/a	28	22
VPA2	n/a	n/a	n/a	.85	.06	.90	n/a	n/a	30.25	31
VPA3	n/a	n/a	n/a	n/a	n/a	n/a	-.10	.60	36	32
GP M	60.60	59.85	63.17	66.45	60.16	70.91	64.00	63.81		
RANGE	28.17	21.93	32.02	29.98	17.50	14.25	27.32	35.27		

Table 3c: *Moderate Skilled participant's correlations (with means and ranges) between GP and Verbal Protocol Analysis (VPA) data at different time points across the study*

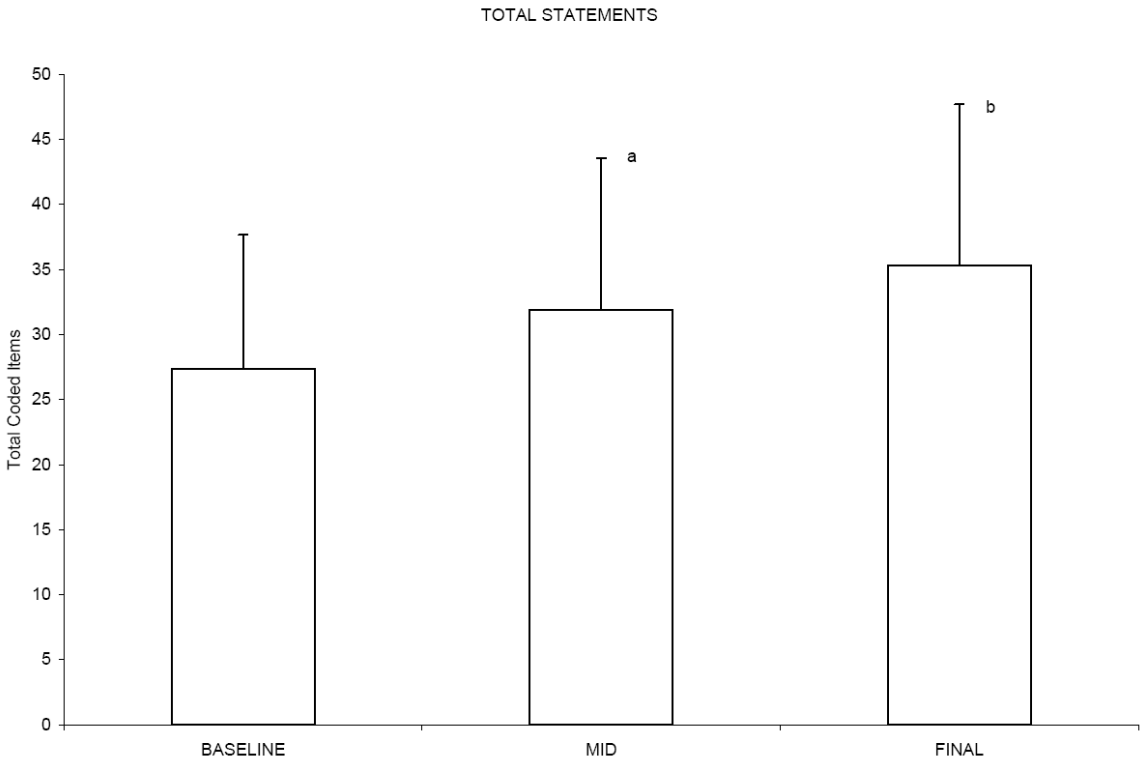
	BA1	BA2	BA3	MA1	MA2	MA3	FA	PCA	VPA M	RANGE
VPA1	-.90	-.65	-.02	n/a	n/a	n/a	n/a	n/a	29.75	20
VPA2	n/a	n/a	n/a	-.34	.60	-.75	n/a	n/a	30	18
VPA3	n/a	n/a	n/a	n/a	n/a	n/a	.05	-.70	33.25	22
GP M	44.10	36.90	40.82	44.54	48.05	51.26	48.43	49.22		
RANGE	11.74	17.18	13.82	7.48	16.36	8.47	15.28	13.46		

Table 3d: *Low skilled participant's correlations (with means and ranges) between GP and Verbal Protocol Analysis (VPA) data at different time points across the study*

	BA1	BA2	BA3	MA1	MA2	MA3	FA	PCA	VPA M	RANGE
VPA1	-.99**	-.96*	-.45	n/a	n/a	n/a	n/a	n/a	24.25	31
VPA2	n/a	n/a	n/a	-.42	.97*	.20	n/a	n/a	35.5	28
VPA3	n/a	n/a	n/a	n/a	n/a	n/a	-.93	-.74	36.75	29
GP M	43.09	44.68	44.62	53.51	54.19	54.04	53.07	52.21		
RANGE	31.52	30.39	15.75	10.52	10.38	15.85	17.05	15.79		

VPA1 = Verbal Protocol Analysis at baseline assessment phase; VPA2 = Verbal Protocol Analysis at the mid assessment phase; VPA3 = Verbal Protocol Analysis at the final assessment phase; BA1 = Baseline Assessment 1, BA2 = Baseline Assessment 2, BA3 = Baseline Assessment 3, MA1 = Mid-Intervention Assessment 1, MA2 = Mid-Intervention Assessment 2, MA3 = Mid-Intervention Assessment 3, FA = Final Assessment, PCA = Post-Check Assessment; VPA M = VPA Scores Mean; GP M = GP Score Mean. * - correlation is significant ($p < .05$); ** - correlation is significant ($p < .01$)

Figure 1: *Bar Graph Showing the Development in Total Numbers of Coded Statements over the course of the study*



Note: [a] T-Tests revealed a significant difference in means between baseline and mid assessment periods of the study; [b] T-Tests revealed a significant difference in means between baseline and final assessment periods of the study.

Figure 2: *Bar Graphs Showing the Development in Variety of Coded Statements over the course of the study*

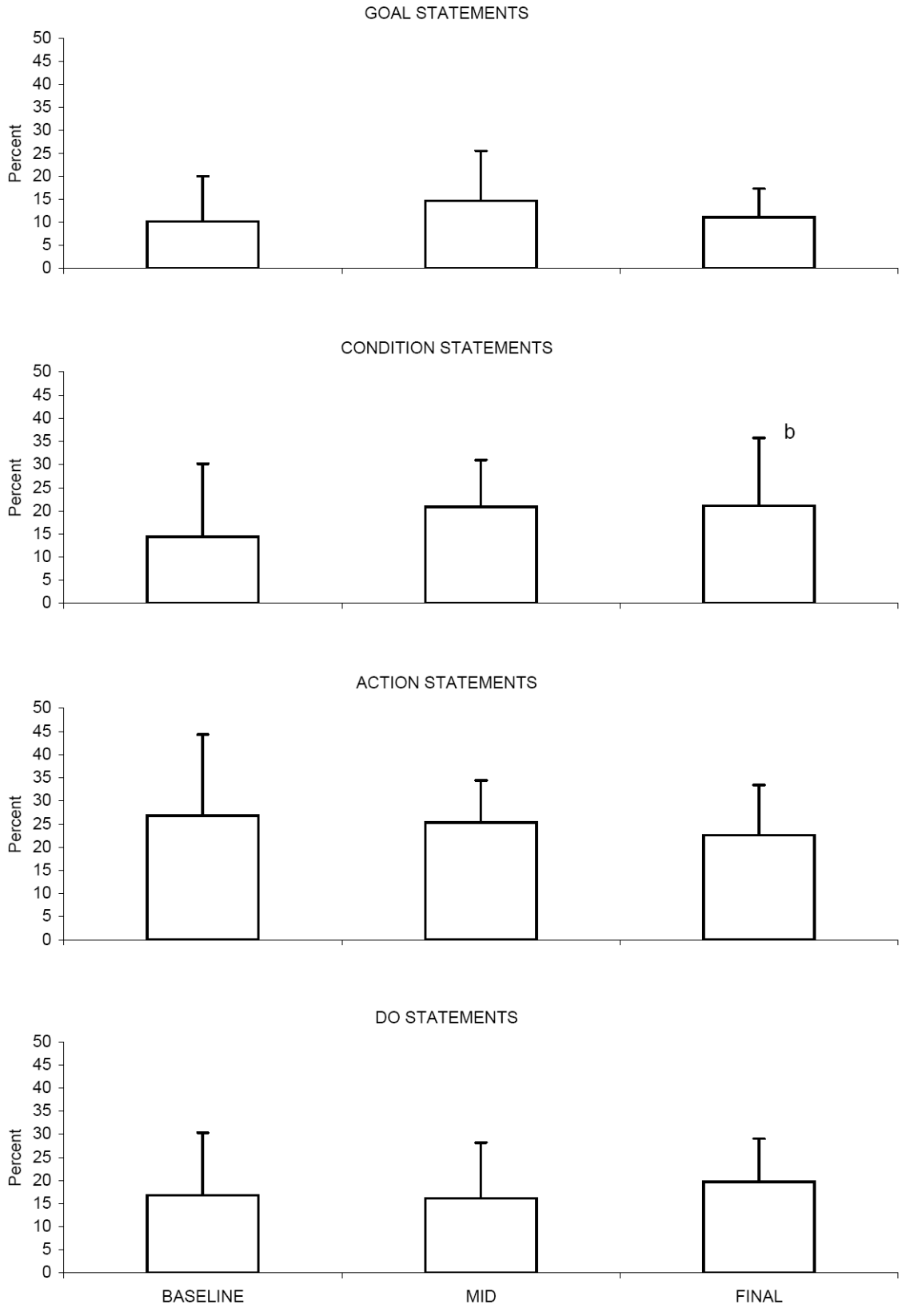
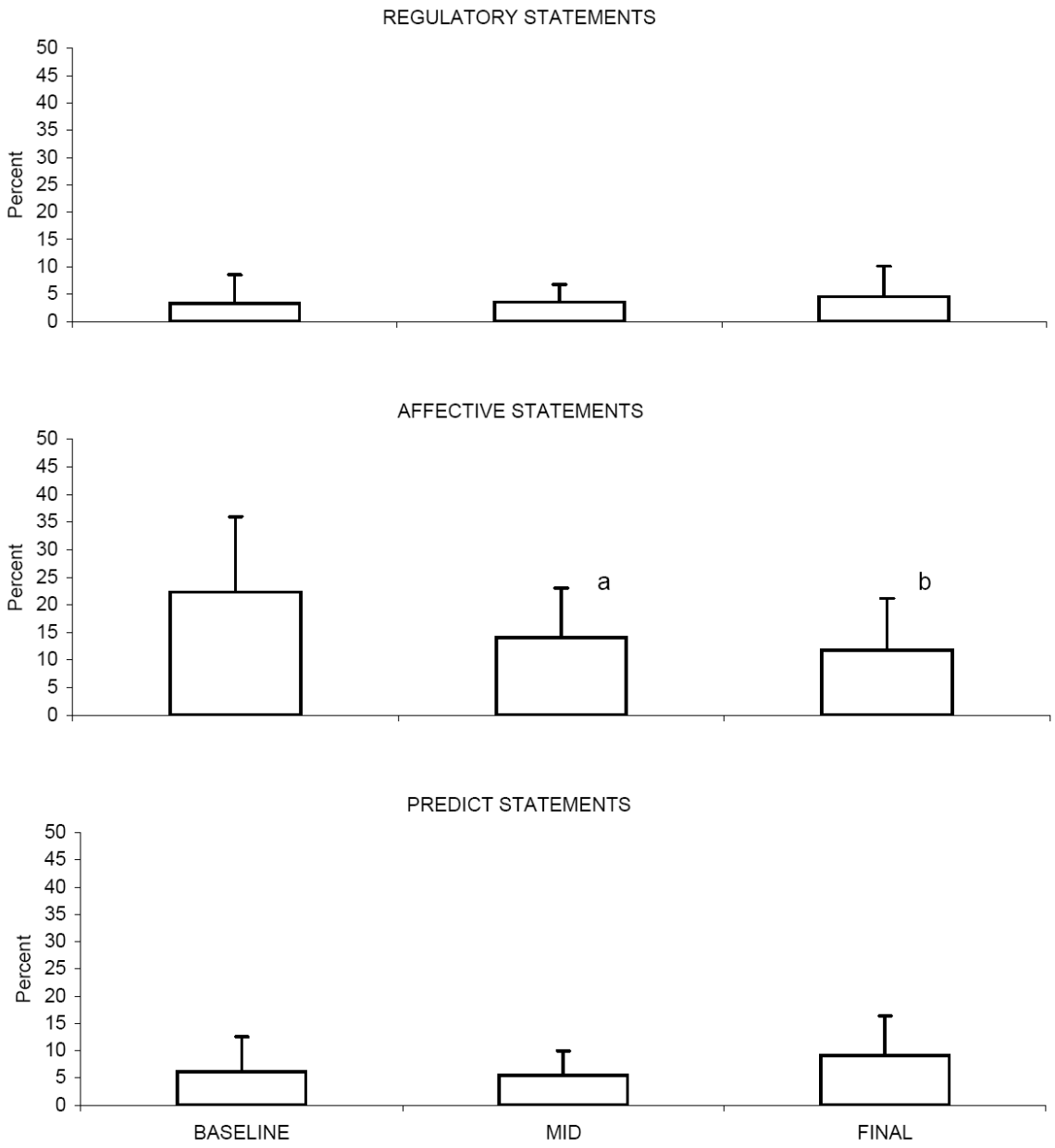
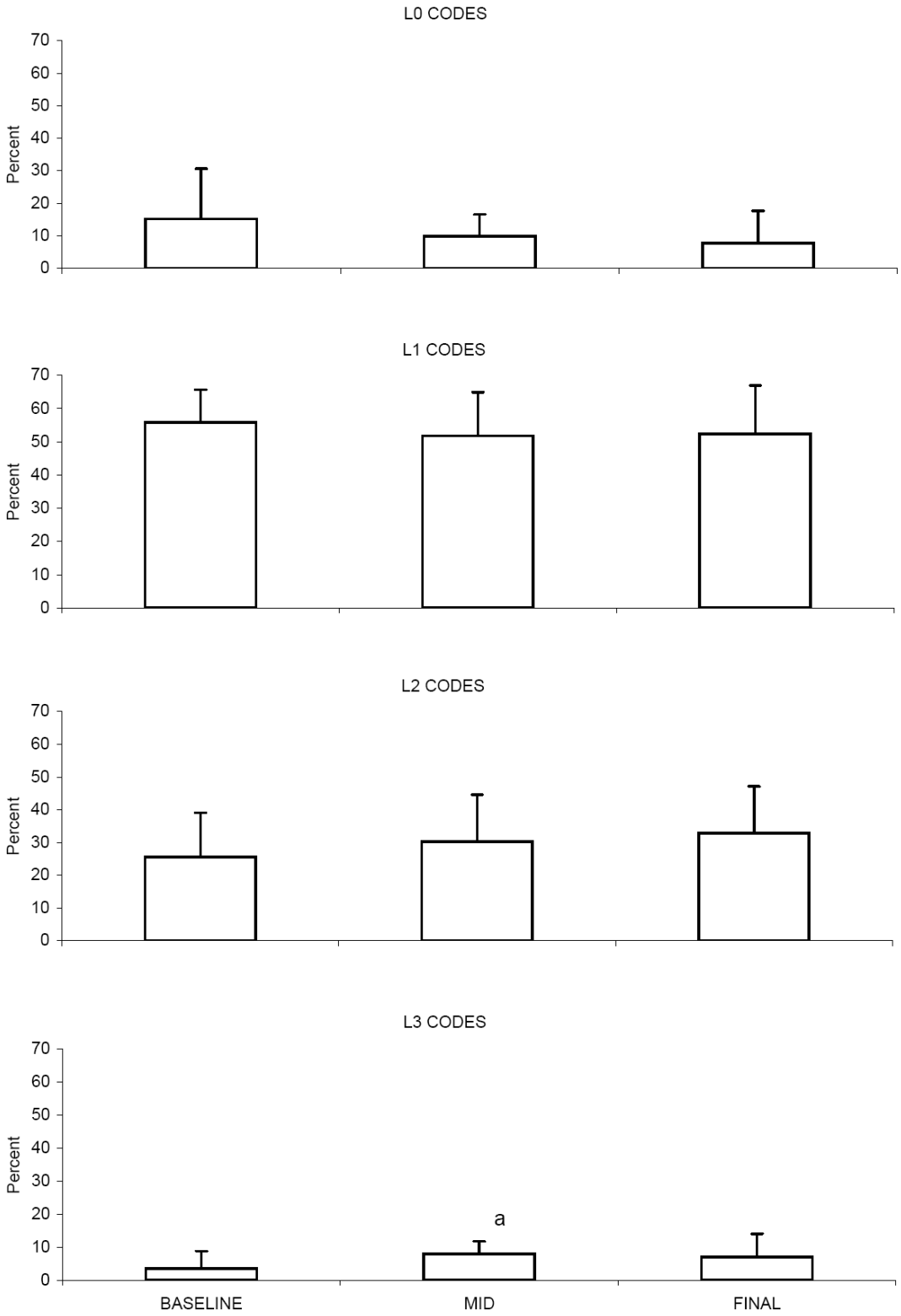


Figure 2: *Bar Graphs Showing the Development in Variety of Coded Statements over the course of the study continued*



Note: [a] T-Tests revealed a significant difference in means between baseline and mid assessment periods of the study; [b] T-Tests revealed a significant difference in means between baseline and final assessment periods of the study.
To evaluate more realistically the degree of change, the total codes at each sophistication level was divided by the total number of codes at each section. For example if in the baseline there were 15 level 0 statements out of 35 overall total statements 15 was divided by 35 and multiplied by 100. If, again in the final assessment, the participant used 15 level 0 statements, but had 50 overall statements, then 15 was divided by 50 and multiplied by 100. This allowed the evaluation of the 'relative change' at each time point in the study.

Figure 3: *Bar Graphs Showing the Development in Levels of Sophistication of Coded Statements over the course of the study*



Note: [a] T-Tests revealed a significant difference in means between baseline and mid assessment periods of the study; [b] T-Tests revealed a significant difference in means between baseline and final assessment periods of the study.

To evaluate more realistically the degree of change, the total codes at each sophistication level was divided by the total number of codes at each section. For example if in the baseline there were 15 level 0 statements out of 35 overall total statements 15 was divided by 35 and multiplied by 100. If, again in the final assessment, the participant used 15 level 0 statements, but had 50 overall statements, then 15 was divided by 50 and multiplied by 100. This allowed the evaluation of the 'relative change' at each time point in the study.

Chapter 4 – General Conclusions

This study examined a) whether an 11-13 lesson unit of soccer taught from the TGFU perspective improved the GP and GU of grade six PE students, across skill levels, and classes, and b) assessed the relationship between GP and GU (i.e. does more knowledge of the game of soccer translate into improved GP, or vice versa?).

All GP indices and GI remained somewhat variable between the baseline and intervention phases of the study and no individual participants improved on all GP and/or GI indices. However, 10 of the 12 participants improved at least one aspect of their GP, with seven improving on their SEI, four on their DMI and six on their GPI when compared to baseline.

Analysis of GI showed that higher-skilled participants were already highly involved in game play, although one higher-skilled participant did reduce his inappropriate GI. All moderate and lower-skilled participants either improved/reduced their appropriate/inappropriate game involvement with 10 of the 12 participants improving their on-the-ball GI and five of 12 their off-the-ball GI upon the introduction of the intervention. All participants' GP improved when higher amounts of appropriate than inappropriate GI were present. Further analysis revealed that inappropriate off-the-ball involvement was the biggest cause of poorer GP scores.

GP scores declined toward the end of the intervention for seven of the 12 participants. Though speculative, this may be attributed to the duration of the TGFU intervention, which was twice the length of the regular PE teaching units they receive at the school. The greatest improvements in GP were observed in the two classes that received the least amount of teaching sessions and that had fewer total participants. A

concern was the amount of on-the-ball involvement of two moderate skilled female participants who played alongside higher-skilled participants, especially higher-skilled males. This intimates that careful consideration must be given to organizing and grouping teams for game play in PE.

In sum, results from this study show that a TGFU-based unit of soccer, focused on teaching both the on- and off-the-ball elements of game play, is associated with developments in participants' GP and GI across middle school students of higher-, moderate- and lower-skill levels.

Further research on what specific features of TGFU instruction are responsible for creating learning is needed. For example, such research could focus on (a) which small-sided games are appropriate for teaching in the game, (b) what types of pedagogy/instructional techniques are best used in which game contexts (e.g., questioning, freeze replays, focusing play, etc.), (c) how many teaching sessions are required to demonstrate an effect on student learning, and (d) what are the appropriate ways of structuring the wider PE curriculum to maximize learning and create student meaning during TGFU instruction, etc. These future research questions could be answered using single subject (N=1) research designs (Holt et al., 2006) where instruction and assessment are conducted simultaneously to continually monitor and evaluate the potential reasons for the variability in GP and involvement (i.e., during the process of learning).

Findings from Chapter 3 indicated that participants increased verbalizations about the game may be associated with the TGFU intervention. The participants predominantly used 'action' and 'do' statements to describe the game play action, but significantly

increased their use of 'condition' statements over the course of the study whilst making significantly fewer 'affective' opinion statements. Participants demonstrated minimal improvements in their use of sophisticated descriptions of the game play action using mostly level '1' and '2' statements, although they significantly increased their use of higher level '3' statements, and decreased their use of level '0' statements.

In terms of the relationship between GP and GU (assessed via the VPA), results revealed that cognitive components of play were less likely to discriminate between skill levels compared to GP measures (French et al., 1995). Positive relationships between GP and GU were found for high skilled participants and negative relationships for moderate and low skilled participants. However, although the majority of the relationships were not significant, all participants showed positive relationships between GP and GU during the mid assessment period of the study, indicating greater alignment of GP and GU during this part of the study. In other words, participants' performance on the two measures was associated with taking part in the TGFU intervention. Finally, there appears to be no strong link between the way in which GP and GU emerges and/or develops, at least within the limitations of this study (i.e. such as the small sample size and the short duration of the learning period. The use of a larger participant sample would have enabled comparison of VPA scores by skill level which would have resulted in a stronger comparison of GP and VPA scores using a factorial ANOVA technique (see French et al, 1995).

The present study has demonstrated that verbalization, through the use of a talk-aloud procedure (i.e. the VPA technique), is tenuously associated with developments in the cognitive outcomes associated with GP. In future research, different ways to

measure developments in GU (other than VPA) when teaching using the TGFU approach should be examined (e.g., debate of ideas settings, interviews, questioning and prompting within the game), to ascertain which of these instruments is sensitive enough in detecting changes in GU, and GP, when participants are being taught with the TGFU approach.

In the future researchers must give careful consideration to both cognitive (i.e. GU) and behavioral (i.e. GP) outcomes (Mandigo et al., 2004; Werner et al., 1996) when evaluating the effectiveness of the TGFU approach in fostering the learning of on- and off-the-ball components associated with game play in PE and coaching settings (Blomqvist et al., 2005; Grehaigne et al., 2001). This would allow researchers to examine for example at which point in time developments in cognitive outcomes result in increased levels of GP, and whether the time point differs for performers of different skill, age and/or developmental levels. Finally, future research needs to examine the impact of the instructor on improvements in both GP and GU.

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Appendices

Appendix 1

Extended Literature Review

Introduction

An inspection of physical education curriculums indicate that as much as 65% of curriculum time in the United Kingdom (Werner, Thorpe, & Bunker, 1996), and over 50% of curriculum time in Canadian schools consisted of games (Mandigo et al., 2004) with a study of Finnish high schools reporting that 60% of this time is spent in invasion type ball games (Peltomaki, 2003). With such an emphasis on games there is a need to identify effective ways to instruct students to play these games, and focus not only on the behavioral outcomes such as technique or skill development, but also the cognitive and social aspects of game play (Mandigo & Holt, 2004). Hopper (2002) noted that in order to develop all of the aforementioned outcomes students must be not only "just playing games" (Meltzer, 2000) but also receive *skillful and progressive instruction*. One such instructional strategy or model of instruction is Teaching Games for Understanding (TGFU) (Bunker & Thorpe, 1982; Butler, 1997; Hopper, 2002; Griffin, Mitchell, & Oslin, 1997; Kirk, 2005; Turner & Martinek, 1995).

Historical Foundations of TGFU

The TGFU movement originated at Loughborough University 20 years ago by two former practitioners turned researchers, David Bunker and Rod Thorpe, (1982) who became tired of watching teachers teach techniques only for them to break down in game play. They believed that students could have a good game without much technical expertise, although they never stated that technical skill was unimportant for successful game play. To support this view they argued that the focus of instruction should be based on cognitive outcomes such as *'what to do' and 'when to do it'* as well as the actual *'how*

to do it' associated with motor performance that had long been the focus of many teacher's instruction.

They further argued that games fostered more achievement motivation for the students. With playing games students were placed in a less intimidating environment than isolated technique practice as participants could make mistakes in the game that may go unseen to the naked eye, whereas is row line practices or 'drills' they would be singled out as poor performers. Finally, Bunker and Thorpe believed that a lot of children left school not knowing how to play a game because they were not taught how to in terms of strategy and tactics. Therefore, this led to students leaving school and not continuing to play games that teachers had spent so much time teaching them. By teaching "through the game and in the game" Launder (2001, p.55) at least students would know the game set up, the rules and strategies/tactics so they could play them on their own. The traditional technical-orientated approach which focused on a 'technique' orientation did not teach them this knowledge. This further has implications today where the physical education profession is encouraging the promotion of active lifestyles outside of school and into adulthood.

TGFU Theoretical framework

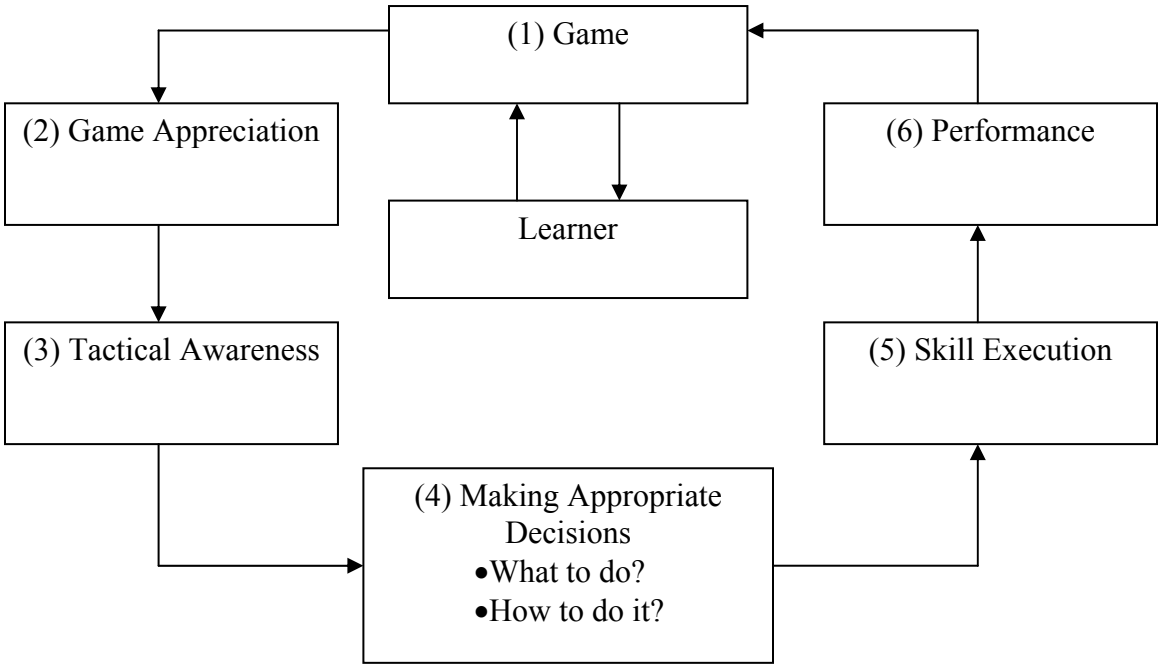
TGFU is aimed at getting the participants to understand the strategies and tactical complexities of the game as well as knowing when and where to utilize and apply the techniques of the game (skilled performance). Technique is actually described as the ability of "controlling and directing of the ball" (Launder, 2001, p.33). A 'skillful' player is one who is effective in not only controlling and directing the object, i.e. technique but one who includes other critical aspects of skilled play in their practices, e.g.

supporting a team-mates with the ball in an open passing lane and at the correct angles and distances, or covering for team-mates at the correct angles and distances in defense. Skilled performers in game play have also been referred to as possessing "game sense" (Australian Sports Commission [ASC], 1997) and Kirk (1983) has also referred to this concept as "intelligent performance". Skillful play is required in games as the percentage of time an individual actually is *'on-the-ball'* is limited (Launder 2001; Bee cited in Light, 2005). Launder and Bee therefore argue that practice should be focused around developing skillful play (what to do and when to do it). That is, *'off-the-ball'* play such as supporting a team-mate who has the ball, or covering for a team-mate who is tackling for the ball when on defense, rather than just technique (the "how to do it"). Kirk (2005) also suggested using TGFU if the aim of the lesson is to teach game play and strategy. If the aim is safety and control he suggests using the traditional technique-orientated approach.

In terms of the actual TGFU model (see Figure 1), the learner is placed at the center of the learning process, which immediately affords the learner a more holistic view of the game. When playing games or a *game form*, it is hoped that players then develop an *appreciation* for the game and learn the rules alongside the tactics/strategies needed so they can develop *tactical awareness* in order to make effective *decisions* to solve certain problems the game poses. Once decisions (what to do) have been made (e.g., which technique to use), players would then *execute the technique* (when and how to do it) in the game context (*skill*). If they *execute* the appropriate technique(s) effectively and at/in the correct time frame, they *elevate their Game Performance (GP).*

Figure 1

Originally proposed TGFU model



Thus, pedagogically, TGFU stands in contrast to the traditional "technique-orientated" approach to teaching sport and games (Butler & McCahan, 2005). The two contrasting pedagogical approaches to teaching a games-based lesson (TGFU vs. the technique-orientated approach) are highlighted alongside each other in Table 1. When using TGFU, the teacher or coach starts the session with a game (stage c) and d) of the technique-orientated lesson) and only when the teacher/coach and/or students see the need for the themselves to learn the skills of the game are they introduced to them (stages 5 and 6 in Figure 1). At this stage, players do practice control of the object and complex control and a combination of skills, but it is done when there is a need, thus heightening the value to the player of these skills (Rink, French, & Tjeerdsma, 1996). TGFU is

therefore a teaching strategy that encourages more implicit learning (McMorris, 1998), although the role of the instructor as a facilitator does not end up being one where s/he 'rolls out the ball' and lets the students "just play games" (Metzler, 2000).

Table 1

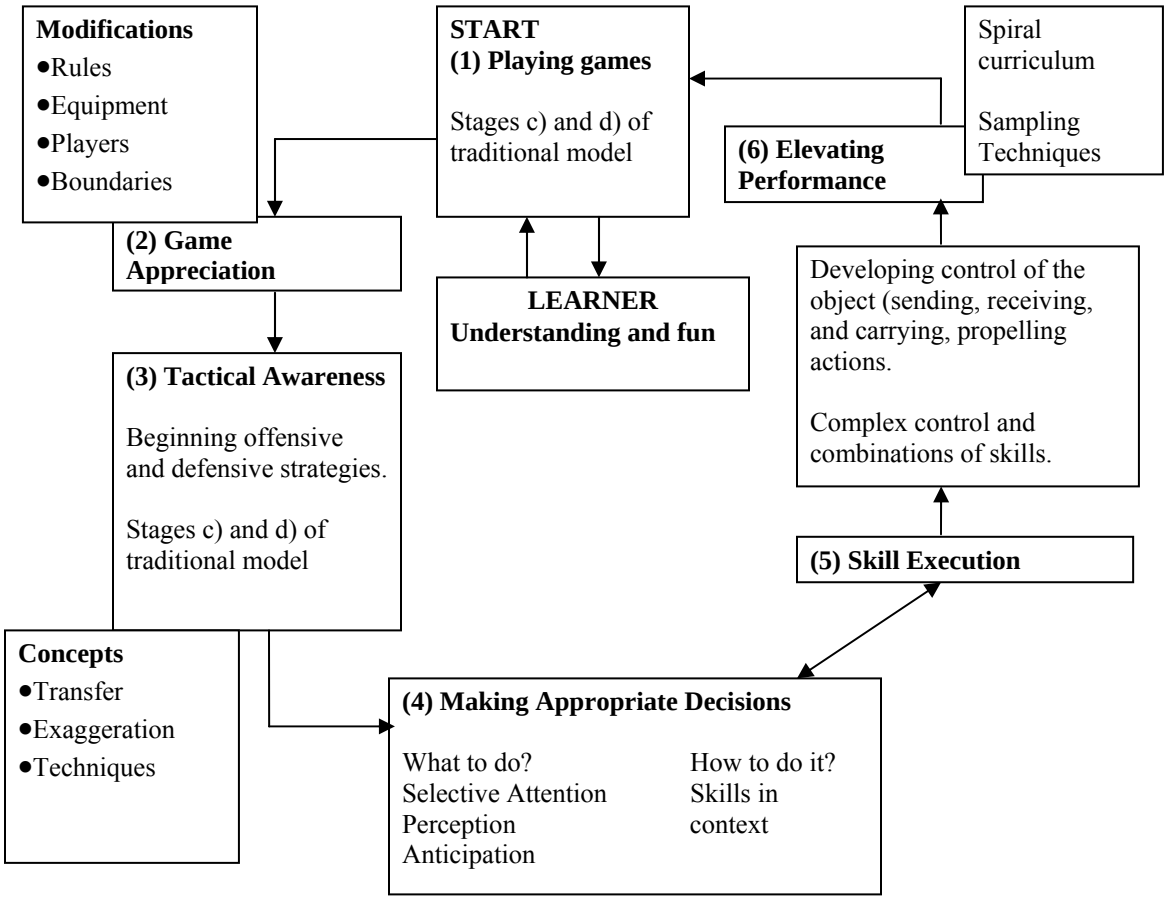
Comparison of the pedagogical processes involved in TGFU and traditional technique-orientated physical education lesson sequences (ASC, 1997)

Format of a TGFU Lesson Sequence	**A traditional Lesson Sequence**
a) Warm-Up	a) Warm-Up
b) Game (Always Start with a game form)	b) Technique
c) Questions & **Challenges**	c) Modified Game
d) Game	d) Game
e) Further Questions & **Challenges**	
f) Progression of Game	
g) Repeat Cycle	

Butler & McCahan's (2005) recent modification to the original TGFU model seen in Figure 2 attaches some mediating processes that were not previously highlighted in the original TGFU model related to the four pedagogical principles of *sampling, modification representation, modification exaggeration* and *tactical complexity* (see also Holt, Strean, & Benegochea, 2002). Within their model, Butler and McCahan also compare the stages highlighted in the TGFU model with that of the technique-orientated approach seen in Table 1.

Figure 2

Butler & McCahan's (2005) recent modification to the original TGFU model



The TGFU model emphasizes using the tactical orientation first rather than the technique-orientated approach, but at the same time recognizes the need for individual technical mastery in the control of the object (Rink, French, & Tjeerdsma, 1996; Rink, French, & Graham, 1996) at some point before elevated GP can take place. This process is seen in Figure 2 between the skill execution and elevating GP phases (phases 5 & 6 respectively). Thus, the TGFU approach focuses on the development of thinking players and therefore does not place the performance of motor skills first (Butler & McCahan, 2005). Development of skill comes second after the teacher and students see the need for skill within the game. This skill development can be applied within the game that is ongoing by adding *exaggerations* (such as 'no-go zones' or using multiple goals) or by using *skill drills* (Metzler, 2000), a policy advocated by Griffin, Mitchell and Oslin (1997) in their adapted version of the TGFU model, the Tactical Games Model. This is a challenging twist for most teachers and/or coaches (see Barrett & Turner [2000] for a detailed case study), as it stresses their pedagogical content knowledge. That is, they have to come out of the "comfort zone" (Howarth, 2005), to see the big picture, and to learn when to ask and when to tell (Rovegno, 1998).

The TGFU framework is also different from other approaches associated with developing tactical knowledge in physical education such as the Tactical Games Model (Griffin et al., 1997), game sense (ASC, 1997), play practice (Launder, 2001) and problem-based learning (Hubball & Robertson, 2004). TGFU is different in that it is less prescriptive than the other approaches and gives the knowledgeable teacher freedom to adapt to the needs of the learner (Light, 2004).

Research Background of TGFU

Since its inception most of the research in this domain has compared TGFU to the traditional technique-based approach in order to decide "which method is best" argument. These comparative studies have assessed skills, knowledge, and game play with elementary school students (Tallir, Musch, Lenoir, & Valcke, 2003), middle school students (Allison & Thorpe, 1997; Griffin, Mitchell, & Oslin, 1995; Lawton, 1989; Mitchell, Griffin, & Oslin, 1995; Turner & Martinek, 1992, 1999; Turner, 1996a), high school students (French, Werner, Rink, Taylor, & Hussey, 1996; French, Werner, Taylor, Hussey, & Jones, 1996), college aged students (Blomqvist, Luhtanen, & Laasko, 2001; Harrison, et al., 2004) and adults (McPherson & French, 1991).

However, since the current study is concerned with the assessment and development of game play in authentic physical education settings, and the constructivist processes that are associated with this, the research discussed below will focus first on the comparative research that has assessed changes in skill, knowledge and game play development as a result of these interventions. Secondly, some of the more current research in the TGFU field which has used a *practice-referenced approach* to the teaching process and a more holistic study of learning in the naturalistic environment (accompanied by learning theories such as constructivism, constraints theory, situated learning, and finally those associated with affect and emotion) will be addressed. Thirdly, the review will turn to the previous research associated with the instruments to be used in the present study for which this review is being written. Therefore, research using verbal protocol techniques will be discussed, then the studies that have tried to develop valid, reliable and authentic instruments for game play assessment. Finally, the

review ends with some concluding comments and links to the rationale for the current study.

Early Comparative Research into the effectiveness of TGFU

As stated above, early research into the effectiveness of TGFU centered on a comparative "which method is best" approach. This research considered three main domains of learning, a) skill, b) knowledge, and c) game play development. These three domains will be addressed in turn.

Skill

Research into the effectiveness of TGFU as an instructional approach began with Lawton's (1989) study in badminton. The TGFU group showed a greater degree of improvement of techniques than the technique-orientated group, although this difference was not statistically significant. Similar improvements on badminton skills tests were also evident in the TGFU, technique-orientated and combination of the two aforementioned methods groups (over the control group) in six week and three week studies in badminton (French, Werner, Rink, et al., 1996; French, Werner, Taylor et al., 1996). A 20 lesson badminton intervention (Blomqvist et al., 2001) also found that both treatment groups (one technique-orientated and one technique-orientated plus video based training) did better than the control group with both the TGFU group and technique-orientated groups also showed a significant improvement over time on serving skill.

Earlier, McPherson and French (1991) had noted that the forehand and backhand tennis stroke improved for groups taught using a technique-orientated approach while the volley improved more in the TGFU group. Also, in a 10 lesson tennis unit Turner (2003)

noted a trend to better control, decisions and execution for the group taught by the TGFU method.

Allison and Thorpe (1997) noted that the skills of the two groups taught using a TGFU approach were as good if not better than those taught by a technique-orientated approach, in a 12 week, six lesson intervention (male groups was taught basketball and the female groups were taught field hockey). Turner and Martinek (1999) also found that the technique-based group was significantly faster than the control group on the skills test in field hockey. In an earlier study, Turner and Martinek (1992) found no significant differences in skill levels when the two approaches were used to teach field hockey. No significant differences between groups were found either in an eight lesson soccer unit (Mitchell et al., 1995) and in a nine lesson unit of volleyball (Griffin et al., 1995).

A more recently published study by Harrison et al., (2004) showed that *both* the TGFU and technique-orientated groups showed significantly different scores on pre and post test measures of volleyball skills using the American Alliance for Health Physical Education, Recreation and Dance (AAHPERD) skills tests.

These studies lend support to the notion that playing games do not make techniques worse, which also may be a concern to a physical educator or coach who is worried about students/players losing skills by playing too many games, but does not lend conclusive support to TGFU's ability to heighten technique. However, the nature of the tests used may have hampered the contextual nature of the skillful play noted in the original idea of the TGFU model by Bunker and Thorpe (1982). Therefore, it is interesting to note that recent research by Fenoglio (2003) has demonstrated that small-sided soccer games can increase the amount of technical actions made by Manchester

United Academy U9 soccer players. This study found that 4 V 4 small sided games provide 585 more passes, 481 more scoring attempts, 301 more goals, 525 more 1 V 1 encounters and 436 more dribbling tricks when compared to 8 V 8 games. A further study by Owen, Twist and Ford (2004) with older players (mean age of 17) revealed that technical actions increased as the game size reduced. Similarly, as the pitch size increased the frequency of technical actions also decreased. Thus, the smaller games gave players increased opportunities to respond i.e., make decisions, and implement motor execution patterns, also gaining feedback (internal) from poor decisions and poor skill executions (implicit learning in the game context).

Although these studies did not document how may of these technical actions such as passes, dribbles etc. were appropriately/inappropriately made it does lend support to the notion that giving student a large number of opportunities to respond in game play, supported by timely and appropriate feedback from a knowledgeable and well-qualified instructor may aid in developing the not only the game play but also the technical abilities of the players (see Harrison et al., 2004). However, this notion does need further empirical support and is discussed later in this review (turn to p.20).

Knowledge

The main sources of assessing development of knowledge of study participants in TGFU research has been through the use of written knowledge tests (Allison & Thorpe, 1997; French, Werner, Rink et al., 1996; French, Werner, Taylor et al., 1996; Jones & Farrow, 1999; Turner & Martinek, 1992, 1999). Two main concepts, declarative and procedural knowledge have been measured using these tests. Turner, Allison, Pissanos and Law (2001) advocated that declarative knowledge (i.e., factual information such as

rules) is a precursor to procedural knowledge (i.e., how to apply the rules in the context and constraints of the game). Previously, Thomas and Thomas (1994) highlighted this point.

The research employing these aforementioned knowledge tests produced equivocal findings with some authors observing a change in knowledge and others not. Indeed, Harrison et al., (2004) found no significant differences between pre- and post knowledge test of the rules, strategies and techniques of volleyball. Previously, Lawton (1989) found no significant differences in declarative and procedural knowledge development over time. Lawton concluded that a low level of improvement by the group being taught badminton using a technique-orientated approach over the course of the six 1-hour sessions indicated that technique-orientated approaches to teaching games did little in developing intelligent performance. Indeed, the TGFU group made more progress in understanding tactics and strategies than the technique based group.

Turner and Martinek (1992) found no relationship between knowledge and decision making and found no significant differences in declarative and procedural knowledge development over time. However, Turner (1996a) replicated his 1992 field hockey study with a longer intervention and found that the TGFU group did improve significantly on declarative knowledge. More recently, Turner and Martinek (1999) also found that the TGFU group scored significantly higher than the control group on both declarative and procedural knowledge. A further study of tennis (Turner, 2003) revealed higher skill knowledge for the TGFU group but not a better understanding of rules and tactics for the TGFU group as against a technique-orientated group.

Using field hockey and basketball, Allison and Thorpe (1997) found greater increases on knowledge and understanding tests for the TGFU group. Studies by Mitchell et al., (1995) in soccer and Griffin et al., (1995) in volleyball also found declarative knowledge to be higher in the TGFU group than the technique-orientated group. These studies therefore lend support to the notion of declarative knowledge development before procedural and that contextual game play contexts may aid in this knowledge development.

Indeed although Tallir, Musch, Lenoir, et al., (2003) found higher memory scores in non-TGFU group in basketball contexts, they concluded that this was just a result of the focused nature of this particular teaching strategy. In the TGFU condition, Tallir, et al. found more efficient acquisition of decision making knowledge and they explained this was due to the complex nature of the learning context. They further stated that players have to sink or swim with the TGFU approach. However, results for the study indicated no statistically significant impact of the two instructional approaches on a decision making and memory test.

Due to questions regarding the authenticity of written tests (i.e., the likely transfer of this written knowledge to practical performance), Blomqvist et al., (2001) used not only a written knowledge test, but also tested Game Understanding (GU) in badminton using problem representation *'situations'* they felt would occur in the game. The results indicated that the treatment groups did better than the control group on tests of both knowledge and GU in badminton but only the TGFU group showed a significant improvement over time in these tests. In the study methodology the TGFU group and technique-orientated groups received the same on-court instruction but the TGFU group

participated in additional video-based problem representation situation training (tactical instruction). The authors concluded that the cognitive aspects of GP were limited to the TGFU group, i.e. those who received separate tactical instruction.

Although results of findings into development of knowledge also remain equivocal, it may once again be due to poor measurement and/or study design. However, Rink, French and Graham (1996) have noted that students taught by the TGFU approach seemed to perform better on tests of tactical knowledge than those taught from a technique-orientated approach. But to aid in advancing the empirical base of evidence TGFU researchers need to decide on one methodological design and/or instrument to measure knowledge development and construction if it is to contribute more to the development of motor learning research, cognition and learning theory (McMorris, 1998). Studies using an alternative approach of ascertaining knowledge construction and development of individuals in high strategy sports, verbal protocol analysis (McPherson & Thomas, 1989), will be discussed in a later section in this review. This is a relatively new tool that has had limited use in TGFU research to date.

Game Play

In this section the comparative research to date will be introduced, but the actual instruments themselves will be addressed in this later section of the review (with the exception of one to be introduced in this section),. Most of the studies in this section have used a game play protocol technique (McPherson & French, 1991; Thomas & McPherson, 1989). In this technique, descriptors are formed for items such as decision-making and skill execution and coded 1 if they are successfully achieved and 0 if the students in the context of the game are unsuccessful in achieving these descriptors.

Using this technique, McPherson and French found that a group that followed a technique-orientated approach in tennis improved technique execution during practice and game play but did not continue to improve when strategies were introduced. Those who followed a TGFU approach improved their ability to execute techniques only after the introduction of direct teaching of technique. Again using game play protocols, Turner (2003) found that the TGFU group was significantly better in game play at contacting the tennis ball, permitting better selection of an action stroke. TGFU students were also better at putting the ball back into play and this group showed a trend to better decision making in games.

In an earlier study also using the aforementioned technique with field hockey Turner (1996a) found that the TGFU group did improve significantly on decision making in game play. More recently, also in field hockey, Turner and Martinek (1999) also found that the TGFU group scored significantly higher on passing decision making, control and passing execution in post-test game play and Allison and Thorpe (1997) showed that in the TGFU group that pupils in this group had a better understanding of game concepts in both field hockey and basketball.

Using the same game play protocol in badminton French, Werner, Taylor et al., (1996) established that the TGFU and technique-orientated groups performed better than the combination and control groups on important measures of game play at the mid-point assessment but the combination group caught up by the sixth and final week. In their previous study French, Werner, Rink et al., (1996) found no differences between the groups in terms of game play. Blomqvist et al., (2001) used video analysis to assess similar game components in badminton and findings indicated there was a trend in higher

GP for favoring treatment groups (both technique-orientated and TGFU) in the amount of forceful shots. Earlier Lawton (1989) found that the TGFU group made more progress in understanding tactics and strategies of badminton than the technique-orientated group by playing games, although results were not statistically significant.

Using the GP Assessment Instrument (GPAI) in soccer Mitchell et al., (1995) found that the TGFU approach was effective in improving GP, particularly in respect of off-the-ball movement and decision-making. In volleyball Griffin et al., (1995) found GP was also improved particularly in the areas of court positioning and decision-making.

Harrison et al., (2004) found no significant differences between approaches in terms of game play in 6 v 6 volleyball games. They assessed the amount of *successful* (legal and tactically appropriate) hits, *legal* (successful but not tactically appropriate) hits and *unsuccessful* (none of the aforementioned) hits. They found that although there were no differences between treatment groups, better skills from the students in both treatment groups were the precursors to higher percentages of successful and legal hits. Those, in turn, produced more contacts per serve and longer, more exciting rallies. Having already separated the players into high and low skilled groupings the authors noted that the low-skilled student's learning curve did get closer to that of the higher skilled students over the course of the study, but higher-skilled students remained higher contributors to more successful and legal hits per serve than the low-skilled students.

These studies have shown that game play can be improved by using tactical instruction. Indeed Rink, French and Tjeerdsma (1996) argued that skill is not fully developed until incorporated with game play. More recently, McPherson and Kernodle (2003) have also forwarded the notion that there may be a need to target tactical skills

with more direct instruction as these skills may take as long to develop as technical skills. Thus, there is a need to develop the cognitive aspects of performance as they also contribute to skillful play in games at all levels as well as the technical aspects of play such as the control of an object (for the review of authentic game play assessment instruments see later section).

Current Research

The equivocal findings of research into the effectiveness of the TGFU methodology so far suggest more research is warranted. This research must try and assess both cognitive and skill components, including those associated with how GP can be improved, and what types of curricular are developmentally appropriate in order to achieve these outcomes. In addition, valid and reliable instruments must be available to detect the success of these curricular, and assessment tools that can be used by teachers whilst undertaking their instructional duties must also be developed so teachers can assess and teach at the same time.

Previously, Rink, French and Graham (1996) have suggested that the aforementioned conflicting findings of TGFU versus technique-orientated approaches may be explained, at least in part, by the different research designs employed by the researchers. They examined six studies and noted differences in relation to the game, the age of the players, the length of the intervention, the variables chosen for the investigation (such as declarative and procedural knowledge, and technique execution) and how these variables were measured. This is a key point because it suggests that it may not be possible to make valid comparisons of the results of some studies if their research designs are too different and this creates difficulties in building on the findings

from these studies. In fact some of the aforementioned studies have failed to correctly apply the TGFU teaching methodology correctly (French, Werner, Rink et al., 1996; French, Werner, Taylor et al., 1996 [see Turner et al., 2001]; Harrison et al., 2004).

In addition, studies that have compared TGFU to other teaching approaches to determine "which method is best" may have hampered the growth of and acceptance of TGFU by both research and teaching communities (Kirk & McPhail, 2002; McMorris, 1998; Rink, French & Graham, 1996). As Rink (2001) contended "when you spend all your effort proving that a particular type of teaching is better than another kind of teaching, you limit what you can learn about the very complex teaching/learning process" (p. 123).

Therefore, recent research studies in middle school environments have endeavored to use more contextualized surroundings eliminating comparative designs (Allison, Pissanos, & Turner, 2000; Griffin, Dodds, Placek, & Tremino, 2001; Turner et al., 2001) and when assessing GP using more authentic instruments (Blomqvist, Vanttinen, & Luhtanen, 2005; Tallir, Musch, Lannoo, & van der Voorde, 2003).

Harvey (2005b, 2003) has conducted two studies using the aforementioned practice-referenced approach in order to assess how effective TGFU is based on its own outcomes. These studies took place in the context of high school soccer and addressed the notion of using TGFU in coaching contexts, rather than in physical education settings (see also Light, 2004). Other studies reflecting the use of a more practice-referenced approach, also framed around learning theories such as constructivism, have also considered the role of the teacher/coach in this process (Barrett & Turner, 2000; Brooker,

Kirk, & Brauika, 2000; Butler, 1996; Harvey, 2005a; Howarth & Walkuski, 2003; Light 2003a, 2003b, 2003c; Randall, 2003; Turner, 1996b).

Since more recent research studies have been framed around various learning theories it seems pertinent here in the review to a) introduce some of these theories and b) discuss briefly the findings of some of these studies. Therefore, in the next section these two objectives will be achieved by firstly discussing constructivist learning perspectives and then moving onto to briefly introduce situated learning, constraints theory and affective approaches to studying the teaching and learning process when using TGFU.

Constructivism Theory

Butler (1997) is an advocate of the "Socratic" teaching method and has stated that "a constructivist physical educator can help students with their construction of understanding by focusing on the essential components" (p.43). These "essential components" are related to the tactical problem chosen by the instructor to be the focus of the lesson. The use of effective questioning by the instructor allows the students to build complex networks within the brain by scaffolding new information on top or alongside older information learned previously. This is also referred to as chunking (Tenenbaum, 2003). Butler concluded that TGFU is a whole-part-whole approach to teaching where the learner is exposed to the whole game then sees it parts. Constructivism lends itself nicely to the theory of information processing. Dodds, Griffin and Placek (2001) placed information processing theory at the forefront of TGFU researchers agendas by reviewing the literature associated with the development of domain specific knowledge. That is learners bring with them previous experiences and learning to the lesson, base their learning experiences around these occurrences and negotiate the meaning of these

experiences from their existing schema by revising and creating understanding out of existing ones (Applefield, Huber, & Moallem, 2001, p.37). Grehaigne and Godbout (1995) have used these concepts to drive forward their rationale and ideas for the development of strategy and tactics in complex team sports, e.g. soccer. They describe the cognitivist perspective and constructivism as:

> The cognitivist perspective is intended for teachers who place their students at the center of the teacher-learning process and is based on constructivism (Piaget, 1967). Constructivism recognizes that awareness, although first focused on the results of an activity, must reach the inner mechanism of such activities for true learning to occur. This transformation of learners, in team sports, takes place when they meet and solve a number of problems related to the configuration of the game and to motor performances by themselves. Players "construct" their knowledge from a strong subject-environment interaction. The game-centered perspective lends itself to a more learner-based rather than content-based teaching style (Grehaigne & Godbout, 1995, p.491).

Grehaigne, Godbout and Bouthier (1999) discussed how strategy and tactics are linked in complex team sports with the fundamental difference between the terms being that strategies tend to be based on reflection without time constraints (discussed in advance) while tactics operate under strong time constraints (a punctual adaptation to play). They also discussed the notion of the "rapport of strength" that is built upon the opposition relationship of two teams confronted by the virtue of certain rules of the game that determine the pattern of interaction. Set below this there are numerous relationships between players within the team that make up one or many "competency networks" (small units and/or individual level tactics). The competency network is a dynamical concept that is ever changing in response to the conditions of play and the environment. The rapport of strength is a more static concept based on the overall team strategy (such as formations of play) whereas the competency network depends on individual or small

group tactics employed within the environmental context. Within this overall aforementioned schema Grehaigne et al., devised nine principles of play that could be used as required to expand student's game knowledge. In an earlier paper Grehaigne and Godbout (1995) also developed 'action rules' for attack and defense that related to specific aspects of play. While it is not appropriate to detail these principles and action rules in this review, Turner et al., (2001) used these notions to assess nine children's (aged 11 – 13 years) concepts of skillfulness in games from three classes taught field hockey using a TGFU approach. They discovered that these children assessed performance of games skills based on the full context of the game and in relation to the action rules and principles of play outlined by Grehaigne et al., and Grehaigne and Godbout. In another study, this time from the instructor's perspective, Allison, Pissanos and Turner (2000) discovered that pre-service teachers found meaning in skillfulness when the whole pattern of performance was considered and not just its parts, supporting aforementioned findings from the Turner et al. study.

In another non-comparative study, Griffin et al., (2001) assessed the domain specific knowledge of middle school children in soccer. The authors measured the students' knowledge by asking them to solve game-related *situations*, similar to those used by Blomqvist et al., (2001) in their study of badminton, but on a whiteboard using markers. They found that students with more soccer playing experience knew more about the domain of soccer than those with less experience, and all children solved attacking problems easier than defensive problems. The same problem representations were used by Howarth & Walkuski (2003) who assessed changes in pre-service teachers' knowledge after a unit on using more TGFU approaches to teaching. They found that

this unit did not succeed in closing the gap between those teachers who started with less knowledge at the beginning of the course and those who had more knowledge.

Other Theories of learning and TGFU

Nevett et al., (2001) and Rovegno et al., (2001) adopted a constructivist and situated constraints approach (Newell, 1986) to the study of learning tactics associated with passing and cutting in elementary aged children. This framework includes three constraints, a) individual (functional and structural), b) task and c) the environment. In these studies the curriculum activities and pedagogical approaches to teaching this content was constantly adapted to the needs of the students. Conclusions from the Rovegno et al., study revealed that the three aspects of the situated constrains theory were indivisible when teaching and were relational when trying to develop motor skills and tactical play in students. They further noted from their observations that the students tended to offload some of their cognition onto the environment in order to pick up meaning from participation in an activity. One example of they gave was the need for defense in order to pupils to understand the need to pass and cut effectively. However the level of this defense also made the practice meaningful (they called this is the 'Goldilocks principle' – not too hot, not too cold, just right). A second example was the use of environmental constraints such as placing a passer in a hula-hoop and saying they could not move. An example of these types of constraints in TGFU lessons would be to *exaggerate* aspects of the game by placing 'no-go zones' of 'channels' on the sides of the fields in soccer where wingers were placed to emphasize getting the ball wide and crossing and finishing.

Horn and Williams (2004) also noted the role of the instructor and their impact on the three aspects of Newell's model. In terms of technical skills (also within game play) children minimized the complexity of a task by 'freezing' or constraining the number or range of elements referred to as *degrees of freedom*. Initially, these constraints are controlled to minimize the difficulty of the task. In terms of understanding the game the authors stated that spatial and directional awareness are more likely rate limiters to player's performance. The suggest using visual aids to overcome these issues. However the most likely rate limiter is the player's knowledge of the game, such as their declarative and procedural knowledge (McPherson & Kernodle, 2003). Poor performance of a skill may be due to a weakness in either one of these knowledge bases. Although Turner et al., (2001) and Thomas and Thomas (1994) would argue that the limit would be declarative before procedural. Instructors should then attempt to understand what the likely rate limiter to performance is, teach to that rate limiter, not allow their instruction to be the rate limiter and remember that good teaching strategies such as combining demonstration with practice and giving feedback are essentially rate enhancers. Thus, instructors need to choose/use their pedagogical techniques wisely, i.e. know when to ask and when to tell (Rovegno, 1998).

Kirk and McPhail (2002) adopted Lave and Wenger's (1991) situated learning theory, which has been transposed from constructivist orientations. Here they consider a number of elements such as integrating the perception and action sequences associated with TGFU. However, their main perspective is how the concept of playing games fits in with the child's cultural conceptions of games (i.e., that what they do in school physical education is aligned with the real game they see either live or on television and in other

forms of the media). One example how situated theories have been applied to learning was in a study by Brooker et al., (2000) who focused on how the physical education teacher dealt with the implementation of a game centered approach to teaching in a five week basketball unit in a naturalistic setting. Akin to the Rovegno et al., (2001) study, lesson content was planned and adapted to the needs of the students. Reflecting on the teaching process through teachers journals, videotaping of the lessons and informal interviews with the students, the authors noted that games centered approaches a) offer a new way of thinking about physical education in terms of conceptualizing understanding of skills and tactics; b) challenge teacher's pedagogical expertise and knowledge of the activity leading to frustration; c) teachers need to overcome contextual constraints such as facilities, equipment, time and support from other staff and d) game approaches to teaching challenged institutionalized physical education, e.g. the students perceptions of physical education and how games presented in the media to children again giving rise to frustration.

Recent research has also modified the original TGFU model to incorporate more affective components to the pedagogical teaching processes involved in TGFU (for a review see Holt, et al., 2002). Finally, Light and Fawns (2003) have assented for the need to consider the links between mind and body associated with games (the embodied mind). They feel that behaviors exhibited in games are a verbalization of the inherent knowledge that an individual possesses about games.

As previously mentioned, researchers have gone beyond using simple paper and pencil tests to assess knowledge construction and development when students perform in game play settings. One such technique was the use of problem representation *situations*

(Blomqvist et al., 2001; Griffin et al., 2001; Howarth & Walkuski, 2003). Another technique that has been used is the verbal protocol analysis technique. Selected research using this technique with players whilst in the act of performing in their sports will be detailed in the next section.

Verbal Protocol Analysis Technique Research

The Verbal Protocol Analysis (VPA) technique has been used to assess problem representations of sports performers whilst in the act of competing in high strategy sports. This procedure was originally devised for tennis and has been used with various populations within this sport such as boys tennis (McPherson & Thomas, 1989), youth and adult women's tennis (McPherson 1999a), and collegiate women's tennis (McPherson, 2000). VPA has also been used in physical education settings with high school badminton students (French, Werner, Rink et al., 1996; French, Werner, Taylor et al., 1996), with collegiate volleyball blocking (McPherson, 1993b), and with collegiate baseball batting preparation (McPherson, 1993a) and with male baseball shortstops using a talk-aloud procedure (Nevett & French, 1997). However, little research exists in invasion games such as soccer with this procedure. Grehaigne, Godbout, and Bouthier (2001) suggested that in order to better understand how decision making skills evolve, consideration must be given to more than just game play performance. Grehaigne et al, (2001) stated that verbalization was considered observable information about cognitive processes, and overt verbalization including VPA techniques can be used as a tool for teachers and students to collect information about their thought processes, and be used as a tool for eliciting reflection and critical thinking about performance to bring transformation to action play. In a verbalization settings, the teacher may then hear

information such as 'I should have", "I might have" "I did or did not" and so on. Indeed, these statements are similar to the 'if' and 'then' statements and condition-action sequences that characterize the development of procedural knowledge associated expert performance.

One benefit of using VPA in previous contexts was that it allowed researchers to interview players between points/pitches (called *immediate recall interviews* and *planning interviews*) by asking them "what were you thinking about in the last point/pitch" and "what are you thinking about now" respectively.

Logistically, McPherson and Thomas (1989) reported that they placed tape recorders at the back of each court for the players whilst they played, and in between points players approached the tape recorder, pressed record and then answered the prompts in the quotation marks above that were placed next to the tape recorder

An example follows of data coded from player's verbalizations is provided below for both a novice tennis player and a professional tennis player in competition. A novice player's statements have previously been coded using this format. They primarily generated goals in response to game situations:

> "I just have to keep making him make mistakes as I go through" (Goal, Level 1) and "I gotta just keep putting the ball in play (Goal, Level 0) and making him make mistakes throughout the match (Goal, Level 1)".

In contrast professionals formed solutions in response to their goals. One player stated:

> "Ok, so far my plan is working (Condition, their strength, 1 feature), just let Dan make the mistakes here (Goal, Level 1), keep everything in play (Goal, Level 0), once he starts to fold a little bit (Condition, opponents weakness, 1 feature), I'm going to put some pressure on him (Goal, Level 1) and start coming in (Condition, position type, 1 feature)" (McPherson & Kernodle, 2003, p. 150).

McPherson and Kernodle (2003) characterized these statements into a macro-level profile stating that novice players had poor problem representations and only used working memory to plan their performance on points in tennis. Weaker players usually tried and accomplished basic execution goals. At the intermediate levels, players started to use some problem representations as well as working memory to develop "action plan profiles". At the advanced level of performance players used problem representations that they had stored in their Long Term Working Memory (LTWM) from previous performances and constantly update their action plan profile to develop a "current event profile". Results of the various studies mentioned above show that those players with more experience have more advanced problem representations due to developments in LTWM. For example youth experts have more advanced representations than youth novices but less advanced representations than older youth or adult players. Experts also plan, regulate and monitor their performance better.

An advancement to this research was to try and link problem representation situations, i.e. GU and decision making, (what to do) to execution, i.e. GP, (when and how to do it) (Blomqvist et al., 2005; McPherson, 1999a, 2000; also see McPherson & Kernodle, 2003; Nevett & French, 1997). Specifically these studies have assessed whether players with better problem representations, i.e. memory and cognition are better at seeing the pictures in the game as they unfold, enabling them to perform better actions (execution).

Nevett and French (1997) tackled this problem particularly well by using a talk-aloud procedure with male baseball shortstops. They found that shortstops 12 years or younger did not produce advanced defensive plans, active rehearsal of plans and updating

of plans was also poor. High school shortstops produced all these qualities with advanced quality. Similarly in tennis, McPherson (2000, 1999a) showed that experts generated more total, varied and sophisticated goal, condition, action and do concepts than novices. Experts planned for actions based on elaborate action plan and current event profiles whereas novices rarely planned and lacked these knowledge structures. Novices therefore had weak problem representations. Similar findings were also noted in high school students (who were novices) when playing badminton. None of the students in the three-week study (French, Werner, Rink et al, 1996) thought in sophisticated ways about their play and/or used condition-action statements, although some students could demonstrate tactical reasoning in game play. In the six-week study only two players reported plans with condition-action linkages (French, Werner, Taylor et al., 1996).

McPherson and Kernodle (2003) published data that demonstrated that both experts and novice player's response selections were much higher than executions, with professional players selecting both a higher number of correct response selections, and having higher numbers of positive executions than novice players. Blomqvist et al., (2005) have also reported discrepancies between response selection and response execution in 3 v 3 soccer game play.

Grehaigne, Godbout, and Bouthier (2001) recently discussed the teaching and learning of decision making in team sports in physical education settings and proposed an operational teaching model based around the concurrent use of three types of settings, a) action play, b) observation settings, and c) debate-of-idea settings. They state that:

> Besides the actual experience of play action, students should be asked to perform two other tasks that are likely to ultimately enhance their decision-making skills, namely observation and verbalization (p. 69)

Therefore, in addition to the verbal protocol instrument that attempts to assess knowledge development and construction there is also a need to assess players decision-making and skill execution (and other constructs associated with GP) using a behavioral measure, and to do this authentically within the actual game framework. While there may be some issues regarding measuring the development of cognition using behavioral outcomes (Holt et al., 2002), there have been a number of developments in this line of research and these will be addressed in the following section.

Instruments Designed to Authentically Assess Game Play

Light and Fawns (2003) have called for more authentic assessment of game play in physical education settings. Indeed McMorris (1998) stated in his review of the games for understanding literature that it showed evidence of implicit learning of techniques and decision-making when researchers had measured participants using authentic game play experiences. McMorris further acknowledged that the research in TGFU has shown that investigations into motor learning can move away from classical laboratory studies to more ecologically valid field based experiments.

Authentic assessment takes advantage of real situations. Siedentop and Tannehill (2000) have characterized authentic assessments as those that reflect real life, are performed in realistic settings and mirror what students do outside of school. This type of assessment is also regular, formative and ongoing (Veal, 1992). The ecological validity of assessment instruments used in applied settings allow researchers and teachers

to assess what is actually occurring in the actual teaching and learning process (Rink, French, & Graham, 1996). Thus, if you are teaching through the game, a system for assessment should have all the inherent qualities that allow you to assess students in actual game play. Similarly, the instruction (e.g. games-based instruction such as TGFU) should reflect the nature of the assessment tool that you are using (e.g., the GPAI), and it should further reflect children's cultural views of the 'real game' (i.e. it should at least *represent* the full sided version of the game children see outside of school) (Brooker et al., 2000; Kirk & McPhail, 2002).

Apart from the game play protocols previously used in various earlier TGFU studies (McPherson & French, 1991; McPherson & Thomas, 1989) there have been a number of instruments that have been developed in recent years to aid in the effective assessment of authentic game play situations. Most of these tools have been designed for use in both research and physical education settings. The two most prominent instruments in the published literature are a) the Game Performance Assessment Instrument (GPAI) (Griffin et al., 1997) and b) the Team Sport Assessment Procedure (TSAP) (Grehaigne & Godbout, 1997; Grehaigne, Godbout & Bouthier, 1998).

A preliminary validation paper for the GPAI was published by Oslin, Griffin and Mitchell (1998). Validity and reliability data for the GPAI instrument for use in soccer contexts was published in this aforementioned paper. The authors assessed content validity and construct validity using the known-groups method. The GPAI was able to significantly discriminate between high and low skilled performers in soccer for decisions made, skill execution and support. The authors also reported ecological validity for the instrument as its ability to encompass what is taught in terms of game

play in physical education settings. The GPAI's stability reliability coefficients ranged between 0.84 and 0.97. Inter-observer reliability values ranged from 0.73 – 0.93 (overall average range pre and post 0.81 – 0.86). Validity and reliability of the instrument was demonstrated in basketball and volleyball contexts (Oslin et al., 1998).

The instrument itself assesses seven aspects of GP: (a) decision making (response selection – *what to do*); (b) skill execution (response execution – *when and how to do it*); (c) support; (d) adjust; (e) guard/mark; (f) cover and (g) base. This is then translated into an *index* based on the ratio of appropriate to inappropriate actions in each construct. Two overall indices, the GP Index (GPI) and the Game Involvement Index (GII), can also be computed based on the amounts of appropriate and inappropriate actions in each construct category. Examples of computations and GP behaviors that are used in soccer for five of the seven constructs can be seen in Table 2.

Table 2

GP behavior descriptions and calculation of overall performance indices

Game Component	**Criteria**
Decision Making (DMI = appropriate decisions made/inappropriate decisions made)	Players make appropriate choices about what to do when in possession of the ball: • Players pass to an open team mate, pass the ball through an open goal or dribble into space. Players make appropriate choices about what to do when not in possession of the ball: • In defense players close attackers down to win possession and use the correct angles and distances to

	so this depending on the area of the field they are situated in and if they have got support from team-mates. • In attack players look to get possession of the ball from team-mates by cutting into open passing lanes, knowing appropriate times to cut, doing so at the correct angles and distance from the player in possession of the ball and they also communicate (verbal/non-verbal) when and where they want the ball.
Skill Execution (SEI = efficient skill executions made/inefficient skill executions made)	Technique in the context of the game situation. When not in possession of the ball: • Correct movement to or away from the ball, altering body position etc. When in possession of the ball: • Appropriate execution of motor movement. For example, was the push pass successful? Did the player help the team maintain possession of the ball and/or move the ball into a position to allow them to make an attack on their opponent's goal.
Support (SI = appropriate supporting	This construct is only assessed when a group of three players are attacking, i.e. WHEN THEY ARE IN POSSESSION OF THE BALL.

movements/inappropriate supporting movements)	Players not on-the-ball provide support to the player with the ball, i.e. they are moving, or attempting to move into an open passing lane and/or get free from their mark.
Adjust (AI = appropriate adjusts/inappropriate adjusts)	This construct is only assessed when a group of three players are defending, i.e. WHEN THEY ARE NOT IN POSSESSION OF THE BALL. The players move keeping their distances from each other as the ball moves. Must remain a maximum of ten yards apart.
Cover (CI = appropriate cover movements/inappropriate cover movements)	This construct is only assessed when a group of three players are defending, i.e. WHEN THEY ARE NOT IN POSSESSION OF THE BALL. The two players not involved "on-the-ball" provide support for the 1st defender who travels to the ball.
Guard/Mark (GMI = appropriate guarding/marking movements/inappropriate guarding/marking movements)	This construct is only assessed when a group of three players are defending, i.e. WHEN THEY ARE NOT IN POSSESSION OF THE BALL. ***Player moves into a position to guard/mark an open player and/or space when the opposition team has the ball.***
GP Index (GPI)	An overall index of each of the appropriate and/or inappropriate actions for each target behavior, e.g. DMI+SEI+SI+AI+CI+GMI/6
Game Involvement Index	Sum of all appropriate and inappropriate actions.

(GII)

In terms of the TSAP Grehaigne, Godbout and Bouthier (1998) validated the use of this instrument. They assessed content validity, concurrent validity (using two experts a ranked correlation coefficient of 0.74 was reached) and ecological validity. Reliability was examined from two perspectives, inter-observer reliability (0.82 – 0.99) and stability reliability (0.87 intra-class correlation). The value of this instrument is that it can be used in physical education classrooms with reliable *peer assessment* (reliability statistics for this can be found in Grehaigne & Godbout, 1997).

The TSAP has various forms but it mainly assesses how many times players receive and conquer the ball from their opponents, and then what they do with it after they have received it (i.e., turn it over to the other team [loss of ball], retain possession with a neutral [neutral ball] or successful pass [offensive ball] or have a shot on goal [successful shot]). From the results of these observations a *'volume of play index'* (VPI) and *'efficiency index'* (EI) are then formulated into an overall GP score.

Tallir, Musch, Lannoo, et al., (2003) and more recently Blomqvist et al., (2001; 2005) also attempted to devise valid and reliable game play assessment instruments. Tallir, Musch, Lannoo, et al., reported findings of a preliminary study examining a video based method similar to the GPAI. They assessed a variety of constructs (such as decision, pass, cutting, leading, dribble, scoring attempt, and creating space) in small sided game play (soccer and handball). They found high observer agreement using kappa (K), with K ranging from 0.73 – 1.00 for soccer, and 0.71 – 1.00 for handball across the range of constructs. Validation for this protocol was by agreement in constructs from

various experts. Tallir et al. concluded from their study that some of their definitions for their constructs were too general and the nature of the game led to ineffective results in terms of separating out developmental levels of players (see van der Mars, 1989 for a review of defining constructs for behavioral assessment).

Blomqvist et al., (2001) devised a method for assessing badminton play using problem representation situations in order to assess GU. They provide reliability and validity information in their study report. Blomqvist et al., (2005) then endeavored to assess the link between GU and GP. GU was measured by participants responding to problem representation situations given from 3 v 3 soccer video film, and GP was measured using the constructs of decision-making and skill execution though observation of actual performance by the same players in 3 v 3 games. The authors found that a) those players who responded better in problem representation situations were also better in game play situations, suggesting that GU is related to GP, b) players made more decisions than skill executions (McPherson & Kernodle, 2003), and c) players found actions related to offensive aspects of the game easier than defensive actions (Griffin et al., 2001). Although only a small sample was utilized, such studies are warranted to ascertain how and what students learn when playing games, and how instructors can implement teaching methodologies to help students develop both on-the-ball as well as off-the-ball movements.

Using the GPAI Harvey (2003) found that all aspects of GP (including defending aspects) improved markedly, especially in the latter part of the study when assessing U19 academy soccer player's playing as small units of three players. He attributed these improvements mainly to the use of a spiral curriculum design, but also due to the

previous playing experiences of the players and the effective role of the coach in his adoption of TGFU as a model to guide his instruction. In a replication of the 2003 study, Harvey (2005b) has also observed improvements in the defending aspects of GP in American high school soccer players, with younger players showing greater improvements in GP than older players These two studies emphasized the ability of being able to deliberately target interventions on concepts such as defending in small groups of three players, thus allowing players to develop the "competency networks" (Grehaigne et al., 1999).

Concluding this section on assessment instruments it seems that the use of more than one measure of GP is preferable for researchers to better evaluate the impact of their interventions on student learning authentically (Thomas and Thomas, 1994) and across different domains, e.g. behavioral, cognitive and social (Mandigo & Holt, 2004).

Furthermore, this section intimates that only by developing these assessment instruments further will researchers be able to ensure teachers are assessing student learning authentically and using valid and reliable instruments to undertake this task. Future developments in authentic assessment tools need provide teachers will the capability to teach and assess students simultaneously in the classroom.

Concluding Comments and Link to Rationale for Current Study

TGFU is, therefore, aimed at getting the participants to understand the strategies and tactical complexities of the game in order to select an appropriate response (i.e. making decisions) before making an effective motor execution task (response execution). A 'skillful' player is one who is effective in not only controlling and directing the object but one who includes other critical aspects of skilled play in their practices such as

decision making. Skillful play is required in games as the percentage of time an individual is on-the-ball is limited (Bee, cited in Light, 2005; Launder, 2001). Therefore, authors such as Bee and Launder argued that practice should be focused around developing skillful play rather than just technique. Thus, there is a need to actually ascertain how players construct and develop knowledge when playing games and what types of modified games help in this process (Harvey, 2003). Hence the need for the current study that will implement a TGFU intervention and assess improvements in GP, as well as development in knowledge over the course of this intervention.

Appendix 2

Assent Form for IRB Approved Project 12-08-05

Nutrition & Exercise Sciences
Oregon State University, 214 Langton Hall, Corvallis, Oregon, 97331-3303
Phone 541-737-2643 | **Fax** 541-737-6613

ASSENT DOCUMENT

Project Title: **Teaching Games for Understanding in Youth Soccer**
Principal Investigator: **Dr. Hans van der Mars, Exercise and Sport Science**
Research Staff: **Stephen Harvey, Heidi Wegis, Ada Massa Gonzalez, Michael. W. Beets**

WHAT IS THE PURPOSE OF THIS STUDY?

This is a research study. A research study is a special way to find out about something. We are trying to find out if the use of mini-game situations during soccer classes can help you improve your soccer play and your knowledge of the game of soccer. In this study you will therefore gain knowledge into new techniques, tactics and strategies of the game of soccer and the results will be used to inform us how good the approach we use is to help other also get better when they play soccer.

WHAT IS THE PURPOSE OF THIS FORM?

This form is about the study, so you can learn about the study and decide if you want to be in the study or not. You can ask any questions. After all of your questions have been answered, you can decide if you want to be in this study or not. If, after reading this form, you have any questions or concerns about the research project you may contact the research staff (see contact information on p. 4). When all of your questions have been answered, you can decide if you want to help us by participating in the study. This process is called "assent". Once signed by you and the investigators, you will be provided a copy of this form for your records.

WHY ARE YOU BEING INVITED TO TAKE PART IN THIS STUDY?

We are inviting you to be in this study because you are a student in the Linus Pauling Middle School physical education program. If you have any injuries/illnesses or personal objections to participate then please feel free to not be in this study. You will be in one of four physical education classes to participate in this study from the school.

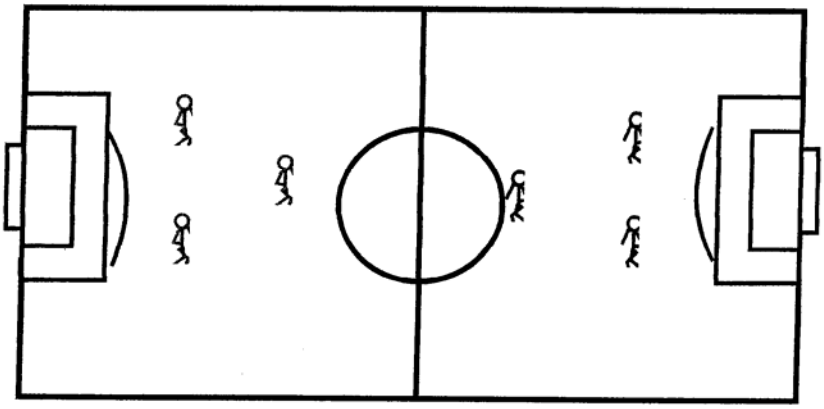
WHAT WILL HAPPEN DURING THIS STUDY?

In this study your physical education class will play several mini-soccer games which will be similar to the one seen below in Figure 1 called "The Assessment Game". The nature of these

OSU IRB Approval Date: 12-8-05
Approval Expiration Date: 12-7-06

games will be similar to "The Assessment Game". But some of the games you play will be to help you defend and some will help you attack your opponent's goal. You may even do the same game twice to help you better understand it. Examples of games you may play in addition to "The Assessment Game" may be numbers up scrimmages, (i.e. 3 v 2, 4 v 3 games), line soccer, channel soccer, etc. You will therefore learn skills associated with tactics in the game of soccer.

Figure 1: "The Assessment Game" – 3 v 3 mini-soccer game with 2 small goals



As you play "The Assessment Game" we will film these games to see if the people in your class get better by playing this game and other games we do with you. The filming of this game will occur a few times before we start to teach you about soccer and then at regular intervals throughout the duration of the teaching unit (once every 3 to 4 lessons). So we are able to tell on the video footage which team you are on you will wear a training bib with a number on it (we will not use your name or face later). All the lessons we do with you to help you better understand the game of soccer will also be filmed.

During "The Assessment Game" sessions you will also be asked to speak into a cassette recorder so we can find out what you were thinking when you were playing the game. These recordings will be typed up and used at a later date, and you will be asked to read what you said and check this is correct before we can use it. Again we will keep your identity safe so no-one will know it was you who said what you did.

Before the study starts you will also be asked to complete a soccer background form to let us know how much soccer experience you have had. Also each week you will be asked to write a short soccer diary letting us know how much soccer you have played outside of physical education class that week. In addition after each class period you be asked will complete a short 8–item questionnaire to let us know what you thought about the lesson you just participated in. The instructor will not see the results of this questionnaire until *after* the soccer unit has been completed and the instructor will not be present in the room when this process is completed.

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WHAT GOOD THINGS MAY HAPPEN TO ME AND OTHER STUDENTS IN MY CLASS BY BEING PART OF THIS STUDY?

If you decide to be in this study, some good things might happen to you as you will get to experience a set curriculum of coaching to help you in your soccer skills and game play. You will gain in-depth knowledge of the tactics for the game of soccer from a very experienced and United States Soccer Federation (USSF) National 'B' licensed soccer coach. Other people may benefit from having you involved in this study as researchers may find out more about what children like you like about playing these games and how it helps make you a better soccer player. They will then be able to use the same games and practice sessions with other children like you. But we don't know for sure that these things will happen and that is why we are doing this study.

HOW LONG WILL THIS STUDY TAKE?

Your involvement will last for approximately 4 weeks (about 18-20 regular physical education lessons). We will use all of your weekly PE lessons to teach you soccer games whilst we are at the school, and we will come back 3 – 4 weeks later to check if you have kept your skills and knowledge.

WHAT ARE THE POSSIBLE RISKS OF THIS STUDY?

We want you to know that there is no greater risk to you that are any greater than any normal physical education lesson.

WHO WILL SEE THE INFORMATION YOU GIVE?

When we are done with the study, we will write a report about what we found out but we won't use your name in the report (we also keep all of the information we collect safe and locked away at the University so no-one else can find out who you are). We will though write a brief statement about what we find out and send it to you via your physical education teacher.

DO I HAVE A CHOICE TO BE IN THIS STUDY?

You don't have to be in this study if you don't want to be **so feel free not to participate if that is what you want**. If you say okay now, but you want to stop later, that's okay too. All you have to do is tell us.

WHAT IF YOU HAVE QUESTIONS?

Questions are encouraged. If you have any questions about this research project, please contact: Dr Hans van der Mars, Tel: (541) 737-4649, Email: hans.vandermars@oregonstate.edu or Stephen Harvey, Tel: (541) 737-5932, Email: harveyst@onid.orst.edu. If you have questions about your rights as a participant, please contact the Oregon State University Institutional Review Board (IRB) Human Protections Administrator, at (541) 737-3437 or by e-mail at IRB@oregonstate.edu.

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If you want to be in this study, please sign your name.

I, _____, want to be in this research study.
(Print your name here)

_____ _____
(Sign your name here) (Date)

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Appendix 3

Informed Consent Form for IRB Approved Project 12-08-05

OSU
Oregon State
UNIVERSITY

Nutrition & Exercise Sciences
Oregon State University, 214 Langton Hall, Corvallis, Oregon, 97331-3303
Phone 541-737-2643 | **Fax** 541-737-6613

INFORMED CONSENT DOCUMENT

Project Title: **Teaching Games for Understanding in Youth Soccer**
Principal Investigator: **Dr. Hans van der Mars, Exercise and Sport Science**
Research Staff: **Stephen Harvey, Heidi Wegis, Ada Massa Gonzalez, Michael. W. Beets**

WHAT IS THE PURPOSE OF THIS STUDY?

The purpose of this study is to see how the use of mini-game situations during soccer practices will help your child improve his/her soccer play. S/he will gain knowledge into new techniques, tactics and strategies of the game of soccer and the results will be used to inform us how well this approach to teaching things about soccer are in improving their game play.

WHAT IS THE PURPOSE OF THIS FORM?

The purpose of this consent form is to give you the information you will need to help you decide whether you will allow your son/daughter to be in the study or not. Please read the form carefully as it will explain what your son/daughter will be asked to do, the possible risks and benefits, his/her rights as a volunteer, and the overall procedures of the study. If, after reading this form, you have any questions or concerns about the research project you may contact the research staff (see contact information on p. 4). When all of your questions have been answered, you can decide if your son/daughter will participate in the study. This process is called "informed consent". Once signed by you and the investigators, you will be provided a copy of this form for your records.

WHY IS MY SON/DAUGHTER BEING INVITED TO TAKE PART IN THIS STUDY?

We are inviting your son/daughter to participate in this research study because you are the parent/guardian of the student in the Linus Pauling Middle School physical education program. If your son/daughter has any injuries/illnesses or personal objections to participate then please feel free to be excluded from this study. We are expecting four physical education classes to participate in this study from the school.

WHAT WILL HAPPEN DURING THIS STUDY?

In this study your son/daughter's physical education class will play several mini-soccer games which will be similar to the one seen below in Figure 1 called "The Assessment Game". These

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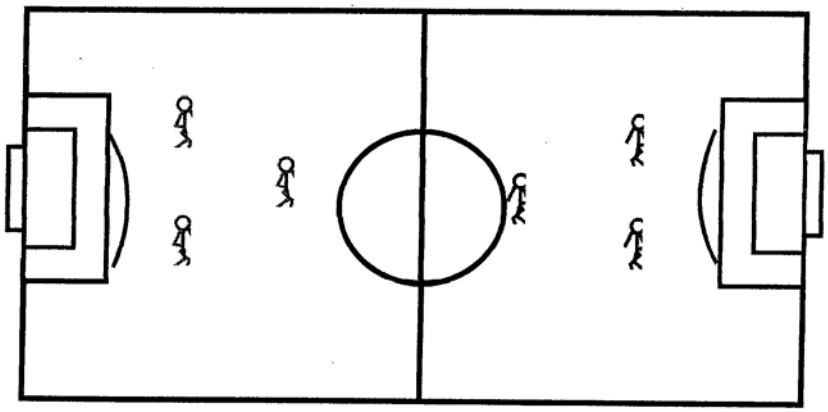
games will be ones that are commonly used activities in soccer teaching and possibly physical education such as numbers up scrimmages, (i.e. 3 v 2, 4 v 3 games), line soccer, channel soccer, etc, and they will be similar to "The Assessment Game". Some of the games they play will be to help them defend and some will help them attack their opponent's goal in the game of soccer. They may even do the same game twice to help them better understand it. They will therefore learn skills associated with tactical play in the game of soccer.

Figure 1: "The Assessment Game" – 3 v 3 mini-soccer game with 2 small goals



As your son/daughter plays "The Assessment Game" we will videotape these games to see if their class gets better at playing this game by having played some of the other games we do with them. The filming of "The Assessment Game" will occur at least three times before we start to teach your son/daughter about soccer and then at regular intervals throughout the duration of the soccer unit (once every 3 or 4 lessons). So we are able to tell on the video footage which team your son/daughter is playing on in "The Assessment Game" s/he will wear a training bib with a number on it. We will keep their identity safe by using a false name in any reports and cover the face, where appropriate, on any video footage where they can be identified (also see later section on "WHO WILL SEE THE INFORMATION OF MY SON/DAUGHTER"). In addition to "The Assessment Game" all the lessons we do with your son/daughter to help them better understand the game of soccer will also be videotaped so that the investigators can hear the coach's verbal interactions with your son/daughter during the lessons (as he will be wearing a wireless microphone) and so we can verify the instructor uses a specific type/method of teaching. PLEASE PLACE YOUR INITIALS ON P. 6 (APPENDIX A) IN THE SECTION ON "CONFIDENTIALITY" AFTER YOU READ THAT SECTION TO CONFIRM THAT YOU APPROVE THIS.

During "The Assessment Game" sessions your son/daughter will also be asked to speak into a cassette recorder so we can find out what s/he was thinking when s/he was playing the game. These recordings will be typed up and used at a later date, and your son/daughter will be asked to

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read what they said and check that this is correct before we can analyze it. Again we will keep your son/daughter's identity safe by using a false name so no one will know it was them who said what they did (also see later section on "WHO WILL SEE THE INFORMATION OF MY SON/DAUGHTER").

Finally your son/daughter will also be asked to complete a soccer background form to let us know how much soccer experience s/he has had and s/he will also write a short diary each week letting us know how much soccer s/he has played outside of physical education class that week In addition after each class period s/he will complete a short 8–item questionnaire to let the researchers know what they thought about the lesson they just participated in. The instructor will not see the results of this questionnaire until *after* the whole soccer unit has been completed and the instructor will not be present in the room when this process is undertaken.

HOW LONG WILL THE STUDY TAKE?

The study will last for approximately 4 weeks, (18-20 regular physical education lessons). Data collection will occur in all of the weekly class periods for the 4 weeks. We will also need one more class period about 3-4 weeks later to complete a follow-up assessment.

WHAT ARE THE POSSIBLE RISKS OF THIS STUDY?

The possible risks associated with participating will not be any greater than those present during regular/typical physical education lessons. As such, there are no other foreseeable risks to your son's/daughter's participation in this study.

WHAT ARE THE BENEFITS OF THIS STUDY?

The potential personal benefits that may occur as a result of your son/daughter's participation in this study are to experience a set curriculum of soccer teaching for 18-20 regular physical education lessons and have exposure to a modern teaching method. The school physical education staff will also benefit by observing a specialist USSF National 'B' licensed soccer teacher work with your son/daughter. The staff will therefore learn more about the game soccer and learn about new methods of how to teach your son/daughter games like soccer.

The researchers anticipate that society will benefit from this study by finding out more about what children of your son/daughter's age learn when instructors use different methods of teaching and how it helps in developing their knowledge and performance in games such as soccer.

WILL THERE BE ANY COST FOR PARTICIPATING IN THIS STUDY?

Your son/daughter will not have any costs for participating in this research project.

WILL MY SON/DAUGHTER BE PAID FOR PARTICIPATING IN THIS STUDY?

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Your son/daughter will not be paid for their participation but will be compensated for participating by being provided with free soccer teaching from a highly experienced and licensed soccer coach. We will also send you a brief report about the findings of this study in the mail via the school, or via the school email list serve.

WHO WILL SEE THE INFORMATION OF YOUR SON/DAUGHTER?

Records of participation in this research project will be kept confidential to the extent permitted by law. However, federal government regulatory agencies and the Oregon State University Institutional Review Board (a committee that reviews and approves research studies involving human subjects) may inspect and copy records pertaining to this research. It is possible that these records could contain information that personally identifies your son/daughter. Your son/daughter will not be referred to directly by name in any of the results or interview tapes as these will be changed to protect his/her anonymity (as previously stated false names will be used) and **only** the researchers working on this present study will have access to video records and interview transcripts **if** permission is granted by the principal investigator.

All resulting data, as well as video records and interview transcripts will be kept on file in a secure location in the Sport Pedagogy Laboratory at Oregon State University (interview transcripts will be transcribed by one of the researchers) as they may be used in future research studies that focus on related research questions. In the event of any report or publication from this study being published, your son's/daughter's identity will not be disclosed. Results will be reported in a summarized manner in such a way that he/she cannot be identified.

WHAT IF MY SON/DAUGHTER WAS INJURED WHEN PARTICIPATING IN THIS STUDY?

In the event of research related injury, compensation and medical treatment is not provided by Oregon State University.

DO I HAVE A CHOICE FOR MY SON/DAUGHTER TO BE IN THIS STUDY?

If you decide that your son/daughter will be a part of this study, it should be because s/he really wants to volunteer. S/he will not lose any benefits or rights s/he would normally have if s/he chooses not to volunteer. Your son/daughter can also stop at anytime in the study and still keep the benefits and rights s/he had before volunteering.

Your son/daughter will not be treated differently if s/he decides to stop taking part in this study. If s/he chooses to withdraw from this project before it ends the researchers may keep information collected about your child and this information may be included in study reports.

WHAT IF I HAVE ANY QUESTIONS?

Questions are encouraged. If you have any questions about this research project, please contact: Hans van der Mars, Ph.D., Tel: (541) 737-4649, Email: hans.vandermars@oregonstate.edu or Stephen Harvey, MS., Tel: (541) 737-5932, Email: harveyst@onid.orst.edu. If you have

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questions about your rights as a participant, please contact the Oregon State University Institutional Review Board (IRB) Human Protections Administrator, at (541) 737-3437 or by e-mail at IRB@oregonstate.edu.

POTENTIAL FOR FOLLOW-UP STUDIES

There is a chance your son/daughter may be contacted in the future to participate in an additional study related to this project. If you would prefer not to be contacted, please let the researchers know at any time. IF YOU ARE CONTACTED YOU CAN CHOOSE WHETHER OR NOT TO PARTICIPATE.

Your signature BELOW indicates that you have read the above information about this research study, that your questions have been answered, and that you offer consent for your son/daughter to take part in this study. You will receive a copy of this form.

Your son's/daughter's name (printed):

_____

_____ _____
(Signature of Participant) (Date)

_____ _____
(Signature of Parent/Guardian or Legally Authorized Representative) (Date)

RESEARCHER STATEMENT

I have discussed the above points with the participant (or, where needed, with the participant's legally authorized representative, using a translator when necessary). It is my opinion that the participant understands the risks, benefits, and procedures involved with participation in this research study.

_____ _____
(Signature of Researcher) (Date)

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APPENDIX A

STANDARD LANGUAGE FOR SPECIFIC ISSUES

If the project involves any of the following circumstances, add this language to the appropriate section(s) of the basic Informed Consent Document.

CONFIDENTIALITY

AUDIO OR VISUAL RECORDING

By initialing in the space provided, you verify that you have been told that audio / visual recordings will be generated during the course of this study. The recordings are being made to allow us to find out information on how your son/daughter's amount of knowledge changes throughout the course of the study, your son/daughter will be identified by a false name in any playback or reference to you in the written text, only staff who have permission of the PI will have access to the recordings, and they will be stored in a secure location in the Sports Pedagogy Laboratory at Oregon State University. The audio tapes provided by interviews with your son/daughter will be transcribed by authorized research staff at Oregon State University.

_____ Parent's/Guardian's initials

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Appendix 4

IRB Approval Form for Project 12-08-05

Institutional Review Board • Office of Sponsored Programs and Research Compliance
Oregon State University, 312 Kerr Administration Building, Corvallis, Oregon 97331-2140
Tel 541-737-8008 | Fax 541-737-3093 | http://oregonstate.edu/research/osprc/rc/humansubjects.htm
IRB@oregonstate.edu

TO: Hans van der Mars,
Nutrition and Exercise Sciences

RE: Teaching Games for Understanding in Middle School Physical Education
(Student Researcher: Stephen Harvey)

IRB Application No. 3086

The referenced project was reviewed under the guidelines of Oregon State University's Institutional Review Board (IRB). The IRB has **approved** the application. This approval will expire on 12/7/2006. This new request was reviewed at the Expedited level. A copy of this information will be provided to the full IRB committee.

Enclosed with this letter please find the approved informed consent information for this project, which has received the IRB stamp. This information has been stamped to ensure that only current, approved informed consent statements are used to enroll participants in this study. All participants must receive the IRB-stamped informed consent document.

- **Any proposed change to the approved protocol, informed consent form(s), or testing instrument(s) must be submitted using the MODIFICATION REQUEST form.** Allow sufficient time for review and approval by the committee *before* any changes are implemented. Immediate action may be taken where necessary to eliminate apparent hazards to subjects, but this modification to the approved project must be reported immediately to the IRB.
- In the event that a human participant in this study experiences an outcome that is not expected and routine and that results in bodily injury and/or psychological, emotional, or physical harm or stress, it must be reported to the IRB Human Protections Administrator within three days of the occurrence using the ADVERSE EVENT form.
- If a complaint from a participant is received, you will be contacted for further information.
- Please go to the IRB web site at: http://oregonstate.edu/research/osprc/rc/humansubjects.htm to access the MODIFICATION REQUEST form and the ADVERSE EVENT form as needed.

Before the expiration date noted above, a Status Report will be sent to either close or renew this project. It is imperative that the Status Report is completed and submitted by the due date indicated or the project must be suspended to be compliant with federal policies.

If you have any questions, please contact the IRB Human Protections Administrator at IRB@oregonstate.edu or by phone at (541) 737-8008.

Date: 12/8/05

Drs. Courtney Campbell and Wayne Kradjan
Institutional Review Board Co-Chairs

pc: 3086 file

Appendix 5

Table Showing Participant Demographics

Player	Class Period	Skill Level	Soccer Experience (Years)	Type of Experience, e.g. club soccer, AYSO etc.	Outside play during weeks 1 – 4 of study (hours)		
					WEEK 1 – 2	WEEK 2 – 3	WEEK 3 – 4
Neal	A	H	7	AYSO/Youth School PE Club	0	0	0
Nancy	B	H	2 4	AYSO/Youth Club	1.5	2	2
Lane	C	H	5	AYSO/Youth	0	0	0
Harry	D	H	7	Other School PE	0	0	1
Total	**n/a**		**25**	**n/a**	**1.5**	**2**	**3**
Average	**n/a**		**6.25**	**n/a**	**.38**	**1.00**	**.75**
Abby	A	M	2	AYSO/Youth	0	0	0
Lisa	B	M	2 1 week	YMCA School PE	0	0	ND*
Mike	C	M	4 1 week	Youth School PE	0	0	0
Tiffany	D	M	3 3 weeks	AYSO/Youth School PE	0	0?	0
Total	**n/a**		**11**	**n/a**	**0**	**0**	**0**
Average	**n/a**		**2.75**	**n/a**	**n/a**	**n/a**	**n/a**
Evelyn	A	L	2	AYSO/Youth	0	0	0
Steve	B	L	0	None	0	0	ND*
Naomi	C	L	2	AYSO/Youth	0	0	0
Wade	D	L	3	Club	0	0	0
Total	**n/a**		**7**	**n/a**	**0**	**0**	**0**
Average	**n/a**		**1.25**	**n/a**	**n/a**	**n/a**	**n/a**

*ND = No Data Available; H = High Skill, L = Low Skill, M = Moderate Skill

Appendix 6

Explaining the GP Assessment Instrument (GPAI)

The GP Assessment Instrument (GPAI; Oslin et al., 1998) was developed to measure "GP behaviors that demonstrate tactical understanding, as well as the player's ability to solve tactical problems by selecting and applying appropriate skills" (p.231). In order to characterise game play performance in invasion games it is necessary to identify non-specific observable components of GP (Mitchell et al., 2006; Memmert, in review). These are crucial in various games, such as soccer, basketball, softball, rugby or field hockey. To measure single components of GP, Mitchell et al., (2006), together with experts with knowledge across all four game categories (invasion, net/wall, striking and fielding, and target), indicated seven tactical components (base, adjust, decision made, skill execution, support, cover, guard/mark) associated with effective GP (see Table 2 in appendix 1 for descriptions these elements of game play).

Depending on the game and game category, teachers, coaches and/or researchers can select one of several elements of game play (decision making, skill execution, support, adjust, cover, guard/mark and base) to evaluate the performance of individuals in a game. Indeed, the benefit of using the GPAI to assess performance in this study is that it can be adapted to various sports, such as soccer and it has the ability to not only measure on-the-ball skills but, in addition, off-the-ball skills (Mitchell et al., 2006). For example, in an invasion game a researcher may choose to assess on-the-ball components of play such as *skill execution and decision making*, as well as off-the-ball components such as how well a player *supports* team-mates when their team has possession of the ball. Similarly, when their team does not have the ball, a researcher may assess how well a player *adjusts* to the changing position of the ball as it is circled by the opposition's

offence or how well the player *covers* to provide defensive help to team mates or *guards/marks* players from the opposing team. However, in this study, observers coded these on and off-the-ball actions as decisions, and then evaluated the participant's decision with a skill execution component. Thus, these were the only two behaviours used in this study, but, they encompass a holistic view of performance, 'on' and 'off' the ball. These individual observable behaviours were assessed as appropriate/efficient or inappropriate/inefficient responses. The amounts of appropriate/effective and inappropriate/ineffective actions were totaled; an individual component index can be constructed for each behavior, and two overall performance indices. For example, we may make two individual indices, one for decision making and one for skill execution and two overall indices, GP and game involvement (see Table 1 below).

Table 1: *Calculating GP indices. GPAI assessment using tallies for 'John'*

	Decision Making		**Skill Execution**	
Name	**A**	**IA**	**E**	**IE**
John's Raw Score	20	0	0	20
Indices (%)	Index = 20/ (20+0) = **1.0 (100%)**		Index = 0/ (0+20) = **0.00 (0%)**	
John's GP (%)	(1 + 0)/2 **= 0.5 (50%)**			
John's GI	GI = 20 + 0 + 0 + 20 = **40**			
	(Appropriate GI = 20 and Inappropriate GI = 20)			

Key: A – Appropriate, IA – Inappropriate, E – Effective, IE – Ineffective, GP = GP, GI = Game Involvement

Calculating individual and overall GP Indices

When observing play, a player starts with a score of 0, and gains 1 point per appropriate decision or effective skill execution and 1 per inappropriate decision or ineffective skill execution. For example, to calculate the decision making index, our

player 'John' (see Table a above) has made 20 appropriate decisions and no inappropriate decisions. These scores are formulated into a Decision Making Index (DMI). In the example 'John' would score 20/ (20 + 0) = 1. For skill execution, John did not execute any of his appropriate decisions successfully, thus, for the Skill Execution Index (SEI) would score 0/ (0 + 20) = 0. In this way the players score always ranges from 0 – 1, and, as suggested by Mitchell et al., (2006) this score can be multiplied by 100 to additionally reveal a percentage. In Table 1 this score is 100% for DMI and 0% for the SEI. In sum, a lower score (i.e. nearer to 0 or 0%) would therefore reflect a player who had more areas of improvement than a player who scored closer to 1 or 100%. Indeed, "these scores on the GPAI are relative to each other and there is no maximum score" (Griffin et al., 1997, p. 222).

Two overall indices of performance, Game Performance (GP) and Game Involvement (GI) can then be calculated from the aforementioned scores on decision making and skill execution (see Table 1) to analyze performance improvements and assess overall involvement in the game. GP is calculated by adding the two individual indices together and diving by the actual number of indices used (in our example there are 2, DMI and SEI). GI is the sum of all the behaviors, so we simply sum the numbers of appropriate/effective and inappropriate/ineffective actions (see Table 1). In this study these appropriate/effective and inappropriate/ineffective actions are considered separately in terms of involvement.

Appendix 7

Table Explaining Game Behavior Descriptions

Please code a behavior 'every time the ball moves' for:

When player/player's team has the ball

On-the-ball Decision Making	• *Player traps ball on 1st touch when appropriate and attempts to pass to an open team-mate.* • *Player plays ball on 1st touch when appropriate (does not just boot it anywhere)* • *Player traps and dribbles when appropriate.* • *Player attempts to score by trapping ball when in the end zone.*
Off-the-ball Decision Making or Support	• *Player is in or is moving into space to become available to receive pass – this may be accompanied by a call/gesture they want the bal*
On-the-ball Skill Execution	• *Reception - controls pass with ball set-up for dribble, pass or shot.* • *Passing – Ball reaches target with appropriate weight.* • *Scores in end zone by putting foot on-the-ball to stop ball when opportunity is available.* • *Players dribble move allows player to move into a better position and player's team to maintain possession of the ball.*
Off-the-ball Skill Execution	• *When supporting teammates who have the ball, player's body position allows teammate to be able to pass them the ball, i.e. player is facing teammate who is trying to p[ass them the ball.*

When player's team does not have the ball

Off-the-ball Decision Making Adjust	• *Player attempts to win ball back from the other team if they are the nearest defender or move into a position to help teammates regain possession of the ball.*
Off-the-ball Decision Making Cover	• **Player provides defensive help (at the appropriate angle and distance) for team-mate making a play on-the-ball.**
Off-the-ball Decision Making Guard/Mark	• **Player moves into a position to guard/mark an open player and/or space when the opposition team has the ball.**
Off-the-ball Skill Execution	• *Player is successful in winning the ball back for their team or in helping the team win the ball back or closing off open passing lanes and /o guarding players so the opposition team cannot advance the ball.*

Appendix 8

Table of Content for Assessment and Teaching Sessions for Class A

Day of Study	Session	Session Content
0	n/a	Familiarization Session
0	n/a	Familiarization Session
1	BA1	Baseline Assessment 1
2	BA2	Baseline Assessment 2
3	BA3	Baseline Assessment 3
4	TS1	Handball Game
5	TS2	Zones Game
6	TS3	Types of Defense
7	TS4	4 goals game
8	NS	No Session
9	MA1	Mid-Assessment 1
10	TS5	2 wide goals game
11	TS6	End Players Game
12	MA2	Mid-Assessment 2
13	TS7	Handball Game
14	TS8	Zones Game
15	MA3	Mid-Assessment 3
16	TS9	2 diagonal goals game
17	TS10	2 v 1 goals game
18	TS11	Tournament
19	FA	Final Assessment
30	PCA	Post-Check Assessment

Key: TS = Teaching Session, BA1 = Baseline Assessment 1, BA2 = Baseline Assessment 2, BA3 = Baseline Assessment 3, MA1 = Mid-Intervention Assessment 1, MA2 = Mid-Intervention Assessment 2, MA3 = Mid-Intervention Assessment 3, FA = Final Assessment, PCA = Post-Check Assessment, NS = No Session.

Table of Content for Assessment and Teaching Sessions for Class B

Day of Study	Session	Session Content
0	n/a	Familiarization Session
0	n/a	Familiarization Session
10	BA1	Baseline Assessment 1
11	NS	No Session
12	BA2	Baseline Assessment 2
13	NS	No Session
14	NS	No Session
15	BA3	Baseline Assessment 3
16	TS1	Handball Game
17	TS2	Zones Game
18	TS3	End Line Game – 3 passes before score
19	TS4	End Line Game – Introduction to player to player marking game
20	NS	No Session
21	NS	No Session
22	TS5	Player to Player Marking game
23	TS6	Introduction to 4 goals game
24	TS7	4 goals game
25	MA1	Mid-Assessment 1
26	TS8	Overload players game
27	TS9	2 wide goals game
28	MA2	Mid-Assessment 2
29	TS10	Diagonal goals game with mats
30	MA3	Mid-Assessment 3
31	TS11	Tournament – Diagonal Goals
32	NS	No Session
33	TS12	Minesweeper – 3 goals
34	TS13	Crossfire – 4 goals
35	FA	Final Assessment
36	FA	Repeat of Final Assessment
50	PCA	Post-Check Assessment

Key: TS = Teaching Session, BA1 = Baseline Assessment 1, BA2 = Baseline Assessment 2, BA3 = Baseline Assessment 3, MA1 = Mid-Intervention Assessment 1, MA2 = Mid-Intervention Assessment 2, MA3 = Mid-Intervention Assessment 3, FA = Final Assessment, PCA = Post-Check Assessment, NS = No Session.
Note: Final Assessment was repeated due to organizational issues.

Table of Content for Assessment and Teaching Sessions for Class C

Day of Study	Session	Session Content
0	n/a	Familiarization Session
0	n/a	Familiarization Session
12	BA1	Baseline Assessment 1
13	NS	No Session
14	NS	No Session
15	BA2	Baseline Assessment 2
16	BA3	Baseline Assessment 3
17	TS1	Handball Game
18	TS2	End Line Game
19	MA1	Mid-Assessment 1
20	NS	No Session
21	NS	No Session
22	TS3	Zones Game
23	TS4	4 goals game
24	TS5	2 wide goals game
25	MA2	Mid-Assessment 2
26	MA2	Repeat of Mid-Assessment 2
27	TS6	End Players Game
28	TS7	Overload players game
29	TS8	Numbers Game
30	MA3	Mid-Assessment 3
31	TS9	Regular Game – Mini-Tournament
32	NS	No Session
33	TS10	Minesweeper Game – 3 goals
34	TS11	Crossfire Game – 4 goals
35	FA	Final Assessment
50	PCA	Post-Check Assessment

Key: TS = Teaching Session, BA1 = Baseline Assessment 1, BA2 = Baseline Assessment 2, BA3 = Baseline Assessment 3, MA1 = Mid-Intervention Assessment 1, MA2 = Mid-Intervention Assessment 2, MA3 = Mid-Intervention Assessment 3, FA = Final Assessment, PCA = Post-Check Assessment, NS = No Session.
Note: Final Assessment was repeated due to organizational issues.

Table of Content for Assessment and Teaching Sessions for Class D

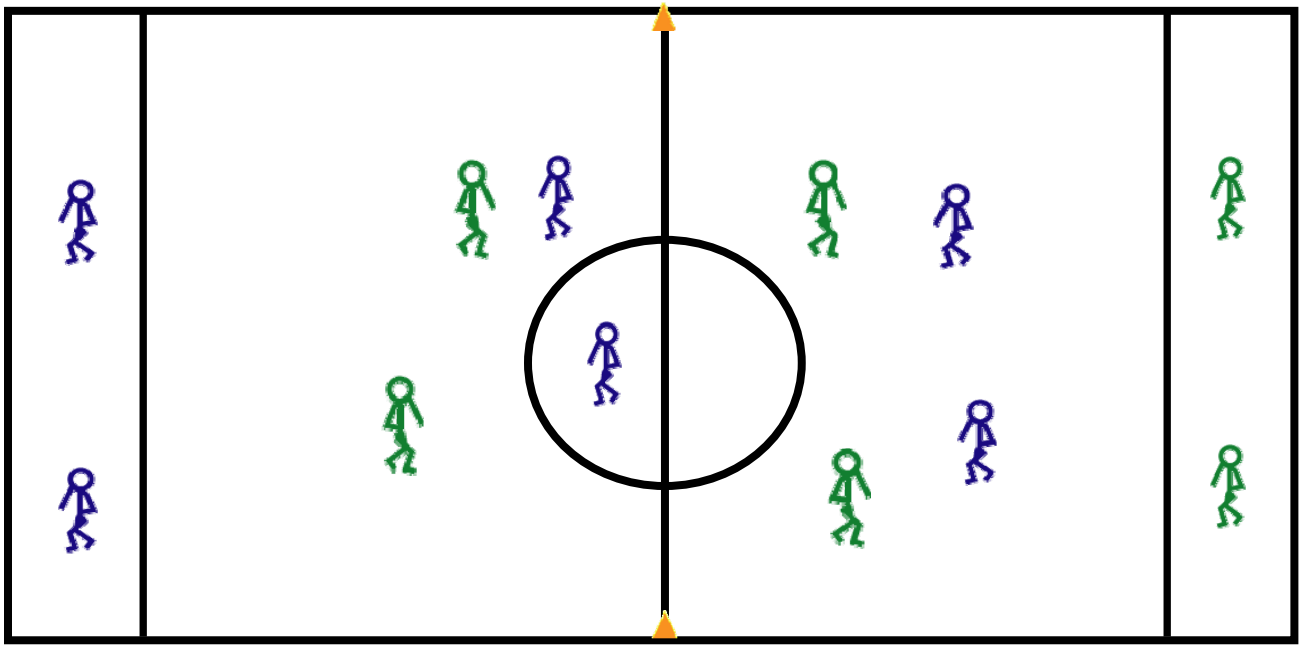
Day of Study	Session	Session Content
0	n/a	Familiarization Session
0	n/a	Familiarization Session
18	BA1	Baseline Assessment 1
19	BA2	Baseline Assessment 2
20	NS	No Session
21	NS	No Session
22	BA3	Baseline Assessment 3
23	TS1	Handball Game
24	TS2	End Line Game
25	MA1	Mid-Assessment 1
26	TS3	Zones Game
27	TS4	Diagonal goals game – Skills practice ("getting free")
28	TS5	Player to player marking game
29	TS6	4 goals game – with trapping ball skills practice
30	MA2	Mid-Assessment 2
31	TS7	Tournament – Using mat goals
32	NS	No Session
33	TS8	Minesweeper - 3 goals
34	TS9	Crossfire – 4 goals
35	MA3	Mid-Assessment 3
36	TS10	2 wide goals
37	TS11	2 diagonal goals
38	TS12	Tournament
39	TS13	Tournament
40	FA	Final Assessment
50	PCA	Post-Check Assessment

Key: TS = Teaching Session, BA1 = Baseline Assessment 1, BA2 = Baseline Assessment 2, BA3 = Baseline Assessment 3, MA1 = Mid-Intervention Assessment 1, MA2 = Mid-Intervention Assessment 2, MA3 = Mid-Intervention Assessment 3, FA = Final Assessment, PCA = Post-Check Assessment, NS = No Session.

Appendix 9

Sample Teaching Sessions: Sessions 1 and 2

Session 1: Handball Game



Aim of the Game: 4 v 4 (+2 end line players). Green attempts to score a goal by getting the ball to one of the players of the same color situated over the end line. If purple win the ball back from green they also try and score by getting the ball to one of the players of the same color situated over the end line at the opposite end of the field. Although this is a soccer unit this game is played with the hands to help players get their head up and look for their supporting players and get used to each other off-the-ball movement and support.

Rules:

1. Play with ball in the hands
2. No running with the ball (only allowed pivot step as in basketball)
3. No contact, can only intercept the ball by batting it down (as in Ultimate)
4. Must get ball to the players in the boxes who are on the same team.
5. Swap with player when you score.

Tactical Awareness:

Space

Q – How do we move to get into space?

A - More spread out, not bunching up, and therefore gives more passing options and space to run the ball into.

Q – How do we communicate with team-mates to let them know we are in open space?

A – Verbally by calling and non-verbally by pointing or gesturing (lead pass)

Q - How is my movement when I try and get open?

A – Slow, then explode and be ready to receive the ball.

Time

Q – How does the time restriction (only 3 seconds on-the-ball) affect the speed of play and the movement off-the-ball?

A – It increases both as players have less time to support the team-mate so must raise their awareness and sharpen their movement.

Risk/Safety

Q – Which direction do we want to go when we get the ball?

A – Forward.

Q – But what happens if everyone runs forward?

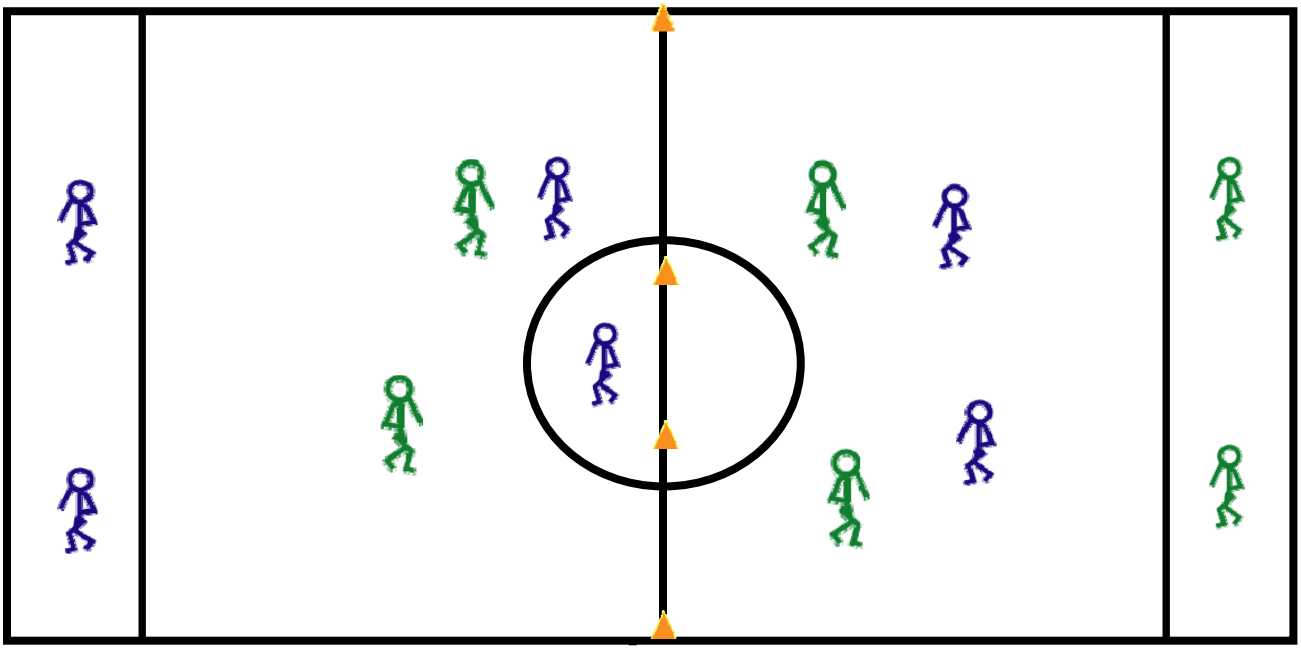
A – No support, so need some people near and some far away. Passing options need to be in front, to the side and behind.

Off-the-ball Movements	On-the-ball Skills
Recovery Movements When team loses possession of the ball the player attempts to get back behind the ball to defend.	**Passing** Get body in position by moving feet, when controlling ball keeping head up to look for open team mates. Move the ball quickly to force your team-mates to get open quickly and your opponents to have to recover, guard and mark quickly. Don't just look for long passes, try and look to the MOST OPEN player who is the BEST space (i.e. the player who is furthest away from a player on the opposition team)
Guarding or Cover Space Try and cover players or spaces in between players. Pressure the player with the ball. Adjust to the position of the ball. If you are a player up, try and double team the player with the ball. If players are a player down then they mark the spaces rather than the players and 'delay' the player with the ball and wait for help.	**Catching** Keep eye on-the-ball when catching, and give a lead arm to the player who is passing you the ball to communicate where you want the ball passed to, i.e. behind or out in front of you. However, using two hands is a safer option so move your feet and body so that you can always catch the ball with two hands, as this is safer and will means you will not drop the ball and lose possession to the other team.
Finding Space Try and cut to get open, move away and then come back into the space that you have left. Try and move urgently. You can also move into spaces that are occupied by your team-mates and then as you move into them ask them to leave this space so it is open for you. This allows you to stay in the diamond shape	

Support Attempt to get in open passing lanes, when a scoring passing lane opens, score the goal. Look to play give and go's, especially if on the 4 player team, and use overlaps and other combination plays such as cross-overs. Players attempt to help each other on their team advance the ball toward their opponent's goal by moving and supporting each other. If they cannot go forward they help their team maintain possession of the ball to draw the defenders out to the ball and leave the space in behind the defense. If you get stuck in a corner, protect the ball and drop the ball off backwards into the space and then the ball can be advanced from there.	

TASK PROGRESSION	REFINEMENTS - Cues	Extensions/ Simplifications
1. Can only hold onto the ball for 3 seconds	Try and look around before receiving the ball so know where you are in relation to the other players in your team	
2. Ball on floor, 4 v 4 soccer game.	Look to keep head up, especially after controlling the ball, tray and check where people are around you before you get the ball.	No 3 second rule. No tackling rule.

Session 2: Restricted Zones Game



Aim of the Game: 4 v 4 (+2 end line players). Green attempts to score a goal by getting the ball to one of the players of the same color situated over the end line. If purple win the ball back from green they also try and score by getting the ball to one of the players of the same color situated over the end line at the opposite end of the field.

Players need to keep one player in the attacking half of the field (a 'forward' player), one in the defensive half of the field (a 'defender'), and two 'midfielders' are allowed to go in both zones. This will help space the players out, and get them into a 'diamond' formation when playing (1-2-1).

Rules:

1. Must get ball to the players in the end zones that are on the same team.
2. Stay in assigned zones.
3. If ball goes off the field play a kick in – free pass in.
4. Swap with player when you score.
5. Can add a central goal (5 v 5 +GK's)

Tactical Awareness:

Space

Q - What happens to the game when you have to be in your restricted zones? Does this make for a better game?

A - More spread out, not bunching up, and therefore gives more passing options and space to run the ball into.

Q – What shape should you try and get into to help your team use all the space when they have the ball?

A – Diamond shape helps keep us spread out and we have passing options in all directions with this shape.

Q - How is my movement when I try and get open?

A – Slow, then explode and be ready to receive the ball.

Time

Q – What things can you do to get more time on-the-ball?

A – Move into the most open space so when I receive the ball I give myself some time to control the ball before I am closed down by a player from the other team. Also, we should keep the ball on the floor when passing as this makes it easier for each of out team to control the ball.

Risk/Safety

Q - When do you think you should pass to the player?

A - When they are in open space and no players are too close so they will easily tackle them, and when they call for ball

Q - What is an open passing lane?

A - A passing lane that is open so that you can get to the ball to the player easily without it being intercepted by a player on the other team.

Q – What problems may occur if both the midfield players go forward and attack at the same time?

A – This leaves out team exposed in defense and do not have enough cover when we lose the ball to your opponents.

Q – What does the defending player need to do if outnumbered?

A – Slow the attacker down, and wait for cover players.

Off-the-ball Movements	On-the-ball Skills
Recovery Movements When team loses possession of the ball the player attempts to get back behind the ball to defend.	**Passing** Prep: Get body in position by moving feet, when controlled get head up to look for open team mates. Wind-up: move back from the ball, and then take a jump step into the ball to gain momentum to help in the force phase when pulling the leg back. Hit the middle part of the ball and this will ensure it stays low. Force Phase: Push the leg forward, slight bend in the knee and standing foot planted next to and just behind the ball. Recovery: High finish and point to target, leg then comes back down to rest by non-kicking foot.
Guarding or Cover Space Try and cover players or spaces in between players. Pressure the player with the ball. Adjust to the position of the ball. If you are a player up, try and double team the player with the ball. If players are a player down then they mark the spaces rather than the players and 'delay' the player with the ball and wait for help.	**Control** Prep: Get body in position by moving feet, when controlled get head up to look for open team mates. Wind-up: move back from the ball, and then take a jump step back from the ball to cushion the momentum of the ball. Force Phase: if ball is in the air angles the leg down to help trap the ball under the foot. When in control step back from the ball and get the head up and look for passing options. Recovery: When in control step back from the ball and get the head up and look for passing options.
Finding Space Try and cut to get open, move away and then come back into the space that you have left. Try and move urgently. You can also	**Dribbling & Shielding the ball** Prep: Use the outside of the foot to dribble (walk like Charlie Chaplin). Turn toe in and have heel turned out. If someone

move into spaces that are occupied by your team-mates and then as you move into them ask them to leave this space so it is open for you. This allows you to stay in the diamond shape **Support** Attempt to get in open passing lanes, when a scoring passing lane opens, score the goal. Look to play give and go's, especially if on the 4 player team, and use overlaps and other combination plays such as cross-overs. Players attempt to help each other on their team advance the ball toward their opponent's goal by moving and supporting each other. If they cannot go forward they help their team maintain possession of the ball to draw the defenders out to the ball and leave the space in behind the defense. If you get stuck in a corner, protect the ball and drop the ball off backwards into the space and then the ball can be advanced from there.	approaches you to tackle, get the ball on the off-defender foot to protect the ball from being stolen. Wind-up: Bring the kicking leg back, bend at the knee bringing the heel to the butt, and then push forward. In the protecting the ball phase get low and have a wide base to as to shield the ball from the opponent. Force Phase: Push the leg forward so that the ball is pushed out in front out with high knee and ankle locked. In the protecting the ball, lean into your opponent and have the arms out for balance. From there you can 'bump' and 'roll' your opponents. Recovery: step to the ground and start process again. Explode out of the bump or roll into space

TASK PROGRESSION	REFINEMENTS - Cues	Extensions/ Simplifications
1. Play 5 v 5 with 2 v 2 in each zone and only one midfield player.	Look to see when you have 'numbers up' situations and take advantage by scoring to the end-line player. Freeze game so players can check cues, and look at spacing. They can be asked to take off coaching bib when bunching, place it on the floor and step back. This will allow them to see how they are bunching up.	Allow a defender to go up and join in when the ball is in the attacking zone.
2. Take out end players and put the goal in the middle, adding GK, and play 5 v 5 with GK's.	No zones, but keep them in mind so you have an awareness of where you are on the field and if you need to go and support the play or stay in your space.	

Appendix 10

Organization of Teaching Sessions

The TGFU intervention was conducted with the whole of each class. The two classes with fewer participants, A and C, received 11 teaching sessions, whilst the larger classes, B and D, received 13 teaching sessions (see appendices 8 and 19). All classes were in the afternoon after lunch, except class D (the final class to receive the intervention), which met after the schools morning break (see Table 1 for exact times).

Organization of Teaching Sessions from days 1 – 26 of the study

Teaching sessions on days 1 – 26 of the study were conducted in the large gym (40 x 30 yards in area). As each class had been divided into teams for the assessment games, for the most part (as absences did occur), the class played in these teams on a daily basis. This also served to ease the organization of the class for the instructor and enable him to start each class promptly (see Figure 4 for example of how class B was organized).

To keep teams as small as possible, participants played in three 4 v 4 or 5 v 5 games in each class, except when numbers were low in classes A and C and in this case, classes played two games. In the larger classes not all players could be accommodated on the field of play at one time, even in the large gym due to issues with space, thus, players rotated in and out of playing, but they were still 'active' as they were used as 'target players', i.e. a team had to pass to them to score (see Figure 4). Each of the games was divided by mats and step boxes so that the soccer ball did not run into and halt the adjoining games. Two of the games could also use the wall to play off; the middle court did not have this luxury, however and the peripheral area of this game had mats and step boxes on either side.

Organization of Teaching Sessions after day 26 of the study

Due to other staff members requiring use of the larger gym, all teaching sessions for classes B, C and D after day 26 of the study (see appendix 8) were conducted in the smaller 30 x 25 yard gym (class A had already completed all teaching sessions using the large gym). Due to the gym being smaller and the fact that it was difficult to keep all students involved playing, additional space was added by using the outside concrete basketball courts that adjoined the small gym. Thus, four games of 4 v 4 (or 5 v5) could be played with classes B and D (instead of just three games in the large gym), and all participants were active (see Figure 5 above for example of how class B was organized). With the smaller class, class C; two games were played on the outside courts. However, on day 28 and 31 with class C, and on day 38 with class D (see appendix 8) there was inclement weather and the whole of these two classes had to be accommodated in the small gym. Class C played two games and all participants could play the whole time. Class D played three games, but due to the larger class size, these were played with participants rotating in and out. Again gym mats and step boxes divided the games.

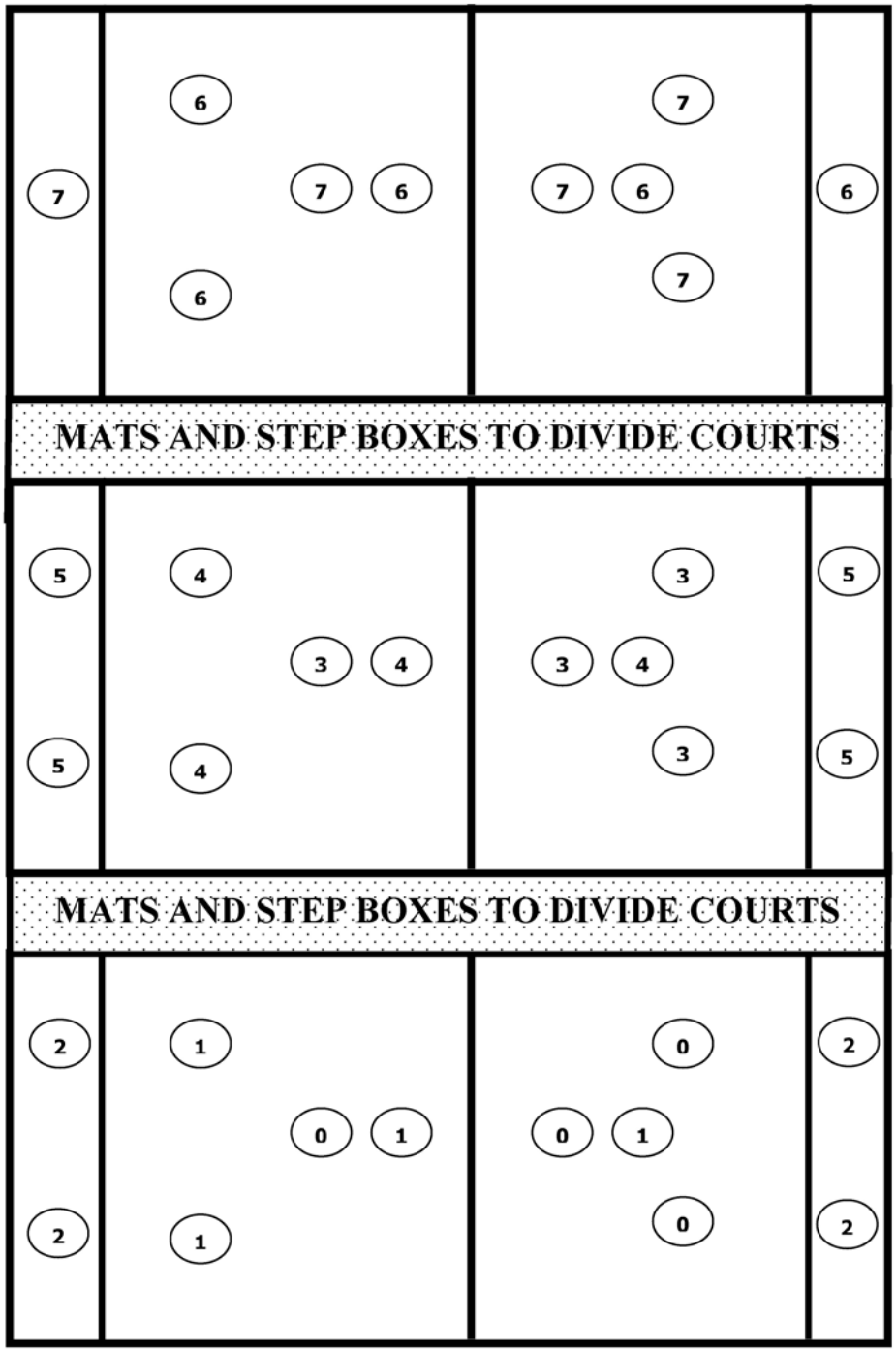
Each of the teams in each of the classes were awarded team points akin to a system used in sport education for scoring goals, playing as a team, being responsible, demonstrating sportspersonship, and for demonstrating the learning of content taught, for example, cutting into an open space to get open to receive a pass.

Once each group began the intervention they continued with the treatment until after they completed the final assessment, i.e. there was no removal of the treatment. However, there were a number of 'no school' days which gave the participants a break from the intervention. The whole data collection, took 50 days, including the teaching sessions,

assessment sessions, and no school days. Due to the fact that the participants had daily physical education and that each class received between 21 and 23 total sessions, the intervention took just over four weeks with each class (see appendix 8).

Appendix 11

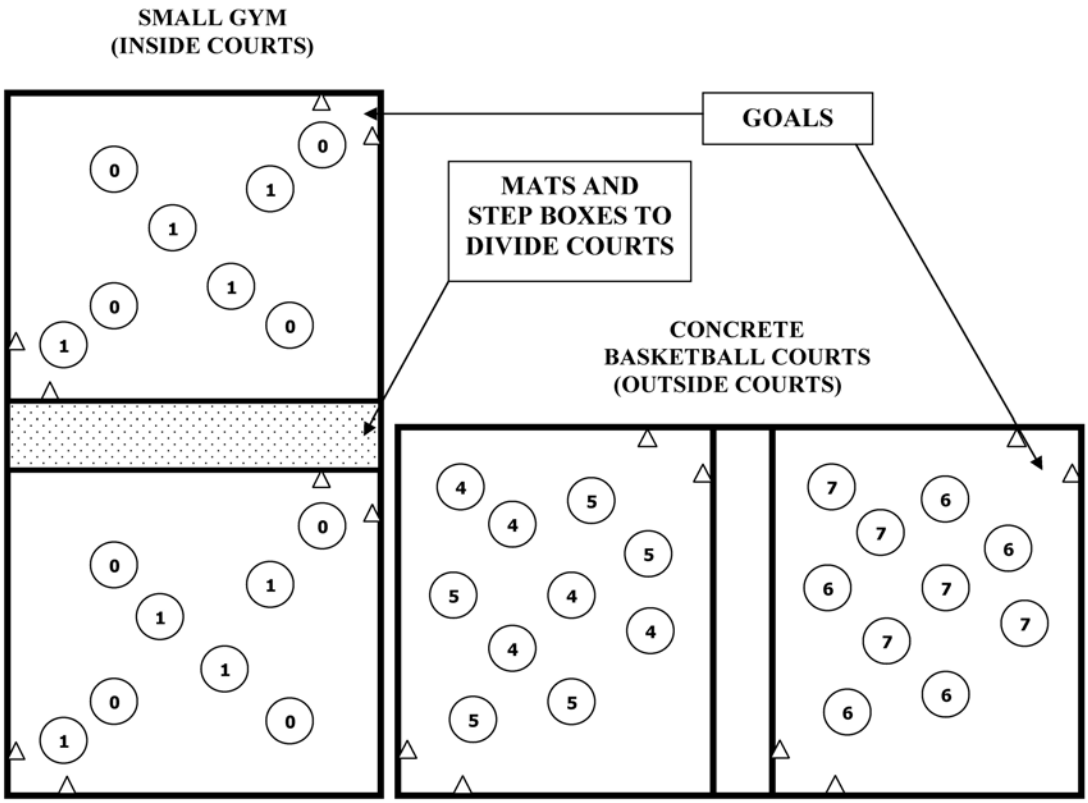
Figure Showing Class organization (all classes) for teaching sessions in large gym (40 x 30 yard area)



Note: In class B participants were organized into three games going across the gym (30 x 12 yard area) with three teams (except the top court) housing three teams. Participants scrimmaged in their assessment day teams and a list of these teams was placed on a whiteboard for easy reminder. The whiteboard also kept a note of 'team points'.

Appendix 12

Figure Showing Class organization (classes B, C and D) when using the small gym (40 x 30 yard area) and outside basketball courts (30 x 25 yard area) for teaching sessions



Note: In class B participants were organized into four games, two games going across the gym (20 x 11 yard area) therefore housing four teams (in the example we see the less experienced teams playing inside the small gym – team 0 v 1 and 2 v 3). The four more experienced teams then played on the outside basketball courts (35 x 20 yard area – team 4 v 5 and 6 v 7). Participants scrimmaged in their assessment day teams and a list of these teams was placed on a whiteboard for easy reminder. The whiteboard also kept a note of 'team points'.

Appendix 13

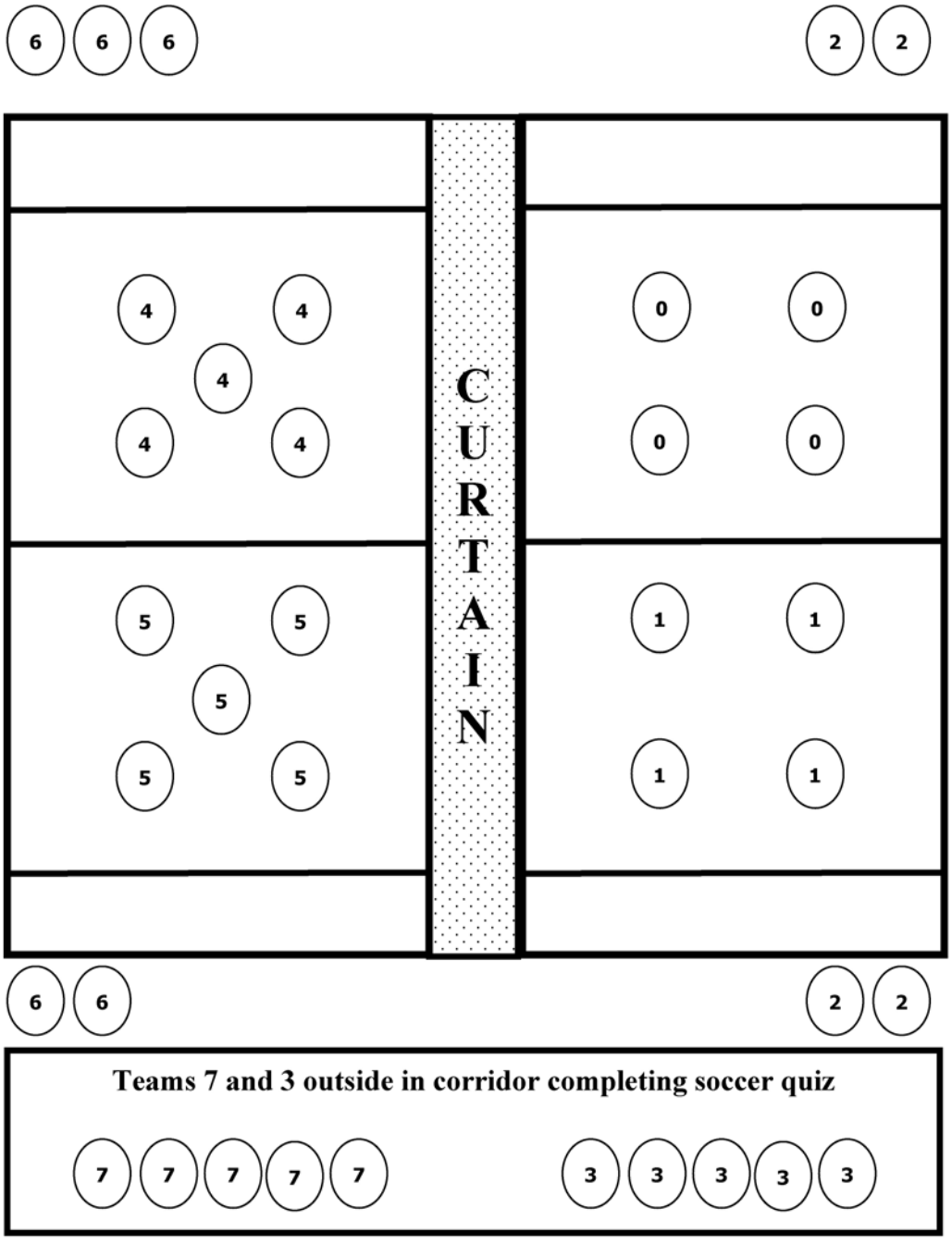
Teaching Validation Protocol (Turner & Martinek, 1999)

Coder makes judgments based on:	**1 = if occurring**	**0 = not occurring**
The student spent most of the lesson in games or game-based practices.		
The students spent the lesson learning specific skills taught by the teacher before playing the game.		
The teacher started the lesson with skill instruction.		
The teacher intervened in game play or in game-play situations to discuss strategies to students.		
The teacher based his teaching on observations of an initial game or game-related situation (e.g., 3 versus 1, 3 versus 3).		
The major emphasis of the lesson was skill teaching.		
The major emphasis of the lesson was tactical instruction in games or game like practices.		

Coding should therefore be 1 for items a, d, e and g and 0 for items b, c and f.

Appendix 14

Figure Showing Class organization (all classes) for assessment game in large gym (2 games 20 x 15 yard area)



Note: In class B four teams (0 – 3) of less experienced players played 4 v 4 assessment games and four teams (4 – 7) of more experienced soccer players played 5 v 5 games.

Appendix 15

Weekly Soccer Diary

Question	Answer
Name/assigned pinnie number:	
Class Period:	
Week of Study:	(ask instructor)
Please note how much soccer you have played this week outside of physical education (in hours and minutes).	Example: 1 hour and 30 minutes.
Was this an organized session?	Answer Y or N:
Did you receive coaching from your instructor?	Answer Y or N:
Which organization was this with?	Examples: AYSO, Competitive, and Pick-up soccer with friends?
Please make note of any other things that have happened this week that you would like to let us know about.	Examples: you watched games of soccer on TV, you were not putting in much effort in class this week etc.

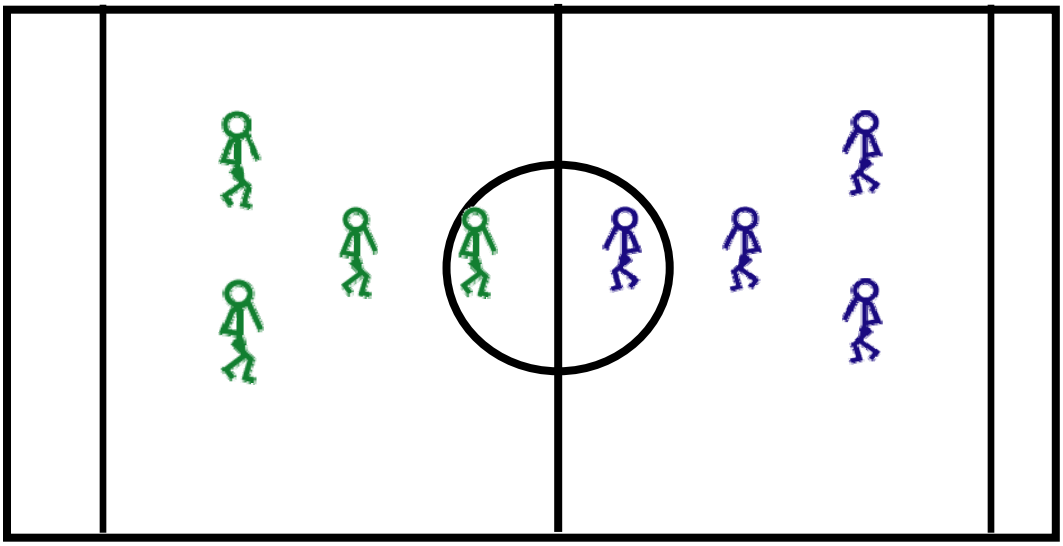
Appendix 16

Players Previous Experience Document

Question	Answer
Name:	
Age:	
Years Playing Soccer:	
Playing Experience (with years):	Please Name club/team played with or if in PE, put grade level: a) Youth/AYSO b) School (PE) c) Club d) Other
Other Relevant Experience:	

Appendix 17

Assessment Game Set Up and Rules



Procedures:

- The assessment game was played in a 30 x 15 yard area with walls surrounding the area so the ball stayed in play (end zone was 3 yards in length and the same width as the outfield).
- Teams played 4 v 4 (or 5 v 5) – all players were outfield players.
- A goal was scored when one of the players dribbled the ball into their opponent's end zone or passed to someone located in the end zone, as long as they had not been there for more than three seconds.
- The outfield players were individually assessed on their GP using the GPAI (elements of decision making, skill execution and support).
- Games lasted for 8 minutes.

Rules:

- Goal kick if ball hits the back wall – no matter who plays it out.
- Penalty goal if the defending team shoots at their own back wall.

- Only score from attacking half - to prevent long ball play.
- Only allowed in end zone for 3 seconds, then must leave, and can only go back after someone else has gone in.
- When one team scores, the opposition team receives a goal-kick to get the ball back into play which can be contested by the opposition team.

Appendix 18

Additional Information for Procedures of Assessment Game

An example of how the familiarization, assessment and teaching sessions were in dispersed for Classes A – D is outlined in Table 4. Data collection began with Class A whilst the other classes continued with their regular physical education curriculum, a unit of badminton (this net/wall game was considered to be an activity that would not clash with an invasion game such as soccer). After a short delay (approximately one week) Class B began the initial familiarization followed by the baseline assessment game data collection and then the teaching sessions, and this continued until all four groups have received all their TGFU teaching sessions (see Figure 1). **However, the length of the *delayed* baseline was varied between each class to allow the researcher to establish a *functional relationship* between the treatment and improvements in performance. In addition all classes received assessment days at different point within the study to, again, try and ascertain the *functional relationship*** (see appendix 19).

Appendix 19

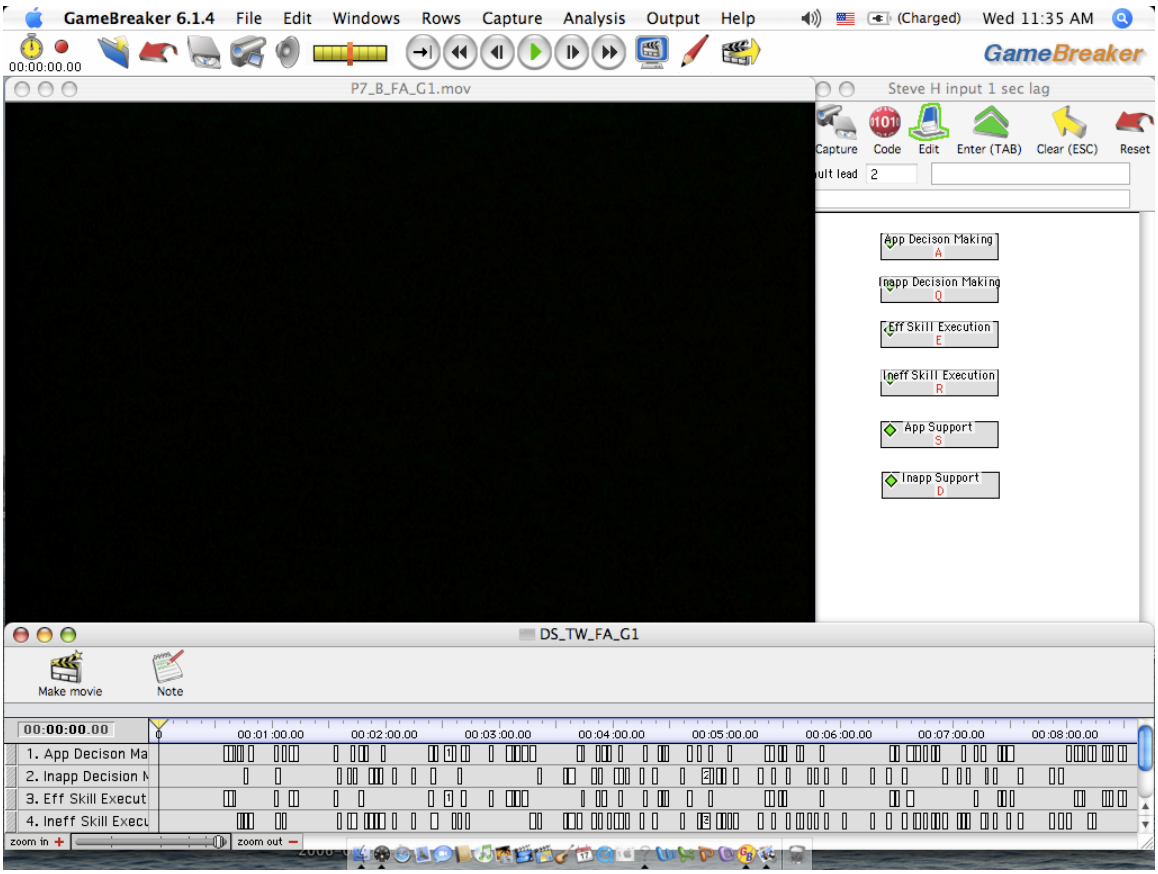
Table Showing Example of Research Design and timeline for the intervention and assessment sessions for the study for Classes A - D

DAY	Class A	Class B	Class C	Class D
1	BA1			
2	BA2			
3	BA3			
4	TS1			
5	TS2			
6	TS3			
7	NS			
8	TS4			
9	MA1			
10	TS5	BA1		
11	TS6			
12	MA2	BA2	BA1	
13	TS7			
14	TS8			
15	MA3	BA3	BA2	
16	TS9	TS1	BA3	
17	TS10	TS2	TS1	
18	TS11	TS3	TS2	BA1
19	FA	TS4	MA1	BA2
20		NS	NS	NS
21		NS	NS	NS
22		TS5	TS3	BA3
23		TS6	TS4	TS1
24		TS7	TS5	TS2
25		MA1	MA2	MA1
26		TS8	MA2	TS3
27		TS9	TS6	TS4
28		MA2	TS7	TS5
29		TS10	TS8	TS6
30	PCA	MA3	MA3	MA2
31		TS11	TS9	TS7
32		NS	NS	NS
33		TS12	TS10	TS8
34		TS13	TS11	TS9
35		FA	FA	MA3
36		FA		TS10
37				TS11
38				TS12
39				TS13
40				FA
50		PCA	PCA	PCA

Key: TS = Teaching Session, BA1 = Baseline Assessment 1, BA2 = Baseline Assessment 2, BA3 = Baseline Assessment 3, MA1 = Mid-Intervention Assessment 1, MA2 = Mid-Intervention Assessment 2, MA3 = Mid-Intervention Assessment 3, FA = Final Assessment, PCA = Post-Check Assessment, NS = No school.

Appendix 20

Figure Showing Game Breaker Computerized Match Analysis System Set Up



Appendix 21

Additional Information for Coding Protocols for Data Analysis

Procedures for GP (GP) Data Analysis

Observer Training and Coding for GP Data

Coder recruitment

Due to the fact that 96 videos (eight for each of the 12 participants) of eight minutes in length (768 minutes of game video in total) needed to be analyzed, five coders were recruited. One coder had just completed playing Division 1 college soccer, one coder had been trained and used GPAI components to analyze data in a previous study (Harvey et al., in review), one coder was a USSF 'D' License coach and a former coach in a local competitive youth soccer program, one was a former high school soccer coach, and the final coder was a licensed physical education teacher, who had previously coached middle school basketball (a similar invasion type games to soccer).

Expert 'Gold Standard' Coder

For the purposes of determining observer reliability and to prevent bias the author was considered the 'expert' or 'gold standard' coder due to his extensive experience. Thus, during observer training and the coding of the study's data, the coders had to obtain an 80% IOA level (based on total coding numbers only) with the author. In addition, the author trained each of the GP data coders extensively before they coded the study data, and maintained procedural reliability and controlled observer drift by systematically and randomly checking data evaluated by each of the coders throughout the training and coding of study data periods of the data analysis (results of systematic reliability analyses are reported in a later section of the paper). The behavioral descriptions for each coding category for the GP analysis can be found in appendix 7.

Coder Training

Coder training was conducted in five stages. Stage one of the training was a general introduction to the study and the game components to be analyzed (see Table 4). In stage two, the 'expert' coder introduced each coder to the Game Breaker® (www.sportstecinternational.com) match analysis software (on an Apple® laptop computer platform) and how to incorporate using this software with the behavioral definitions seen in Table 4, using game footage from a previous study (Harvey, et al., in review). Coders were trained how to:

- use the 'coding input window'
- use the computer keypad to code the data
- edit mistakes and move behaviors from one category to another along the Game Breaker® "timeline" (see appendix 20).
- review of judgments using the "make movie" feature
- slow the playback speed of the assessment game video

An image of the set up of the Game Breaker® software on the laptop computer screen can be seen in appendix 20.

Stage three of training comprised of coding five minutes of "decisions made" and "skill executions" from a moderately skilled player, and the fourth and final stage of training was coding eight minutes of "decisions made" and "skill executions" of a low skilled player.

When watching the videos, coders were to press the key on the laptop computer keyboard related to each target behavior (decision making and or skill execution, both on and off-the-ball) 'every time the ball and/or the player they were

coding moved' (see appendix 7). Coders were prompted to do this so as to encapsulate the dynamic nature of the game, and evaluate the real 'overall' performance of the participants game, both when their team HAD possession of the ball, and when their players team DID NOT have possession of the ball, as these concepts had been taught in the TGFU intervention. For example, if the ball moved and the player they were coding did not respond to the changing ball position/location, either in offense or defense, then this behavior was coded inappropriate. If they did respond, but did this inappropriately, (i.e. moving off-the-ball in offense but not into an open passing lane), then this was also coded inappropriate. Finally, if a player did respond, and did this appropriately in relation to the ball position and the positions of the rest of their team, then this was coded appropriate.

Coders watched each video twice, once to identify appropriate and inappropriate "decisions made" by the player, and then a second time to evaluate a) each appropriate/inappropriate decision based on whether each decision was effective or ineffective in terms of "skill execution", b) to look for decisions they might have missed, and c) to double-check their original coding decisions made.

Stage five consisted of the author checking the accuracy of the coding in terms of total actions coded, as well as any timing and pattern discrepancies of the data between him and individual coders on the Game Breaker® "timeline" window. The author went though short sections of the video (15 seconds) and evaluated it alongside the coder to establish consistency. This way, coders were then able to discuss any errors of judgment and reasons "why" they evaluated some actions as appropriate/inappropriate or effective/ineffective. This also allowed the author to gain consistency among coders in

evaluating game actions based on their definitions, and further enhanced the training of the coders. After this process was conducted, coders were asked to review their coding of the moderate and low skilled player before leaving from that training session. On completion of training reliability coefficients of 99% IOA were observed for each coder in terms of agreement with the 'expert gold standard' coder using an ICC (see appendix 22 for more information).

Game Breaker Movie Test and establishing IOA

At the completion of the observer training, coders completed a 22-item "movie test" which played four seconds of a clip of various decisions made by a moderately skilled player. Coders had to identify whether the clip showed an appropriate/ inappropriate decision and whether this led to either an appropriate/inappropriate skill execution. All coders met the required IOA training percentage of 80% IOA using the agreements/ (agreements + disagreements) x 100 method (van der Mars, 1989b) (see appendix 22).

Coding study data

Following the training each observer coded the eight sessions of two (or three) participants of two (or three) different skill levels. Coders were unaware which of the sessions related to which time point of the study (i.e. baseline, mid and final/post-check assessment sections of the study).

At each session, no coder watched more than two videos (in addition to the five minutes of reliability coding) to prevent mental tiredness. In addition, the coders were blind to the actual time frame when the video was taken, i.e. baseline, mid or final/post-check assessments. Thus, the order in which they watched the GP videos were not in the

sequence in which the data were collected and this further prevented coder drift/bias, i.e. the coder coding higher due to knowing it was a later part of the study. To further control for observer drift, coders were informed that each video may be used for IOA purposes.

Observer Reliability

Systematic IOA checks were conducted on approximately 30% of the data (Baumgartner & Jackson, 1991) across baseline, mid and final/post-check assessment sections of the study using the event-recording method. Each coder was asked to code half the regular length (four minutes) of one assessment game already coded by another observer. IOA checks were conducted between the 'expert' coder, the actual coder of the data, and a third coder, to enhance the IOA process. Coders were unaware which of the coded sessions they had coded was being used for IOA purposes. Reliability coefficients ranging from for 94% to 98% IOA were found between coders and between coders and the 'expert gold standard' coder, across the two behaviors using an ICC (see appendix 22 for more information).

The author ensured, to the best of his ability that data coding was consistent throughout use of randomized spot checks on data, coding multiple games (and not just those used for IOA purposes). Where the results of IOA differed between coders and the author, coders reviewed the assessment game, and, if necessary, the author would sit with the coder and code small sections of the video with the coder to "retrain" them.

Final Checking of Study Data and Separation of coded data into on and off-the-ball plays

Once all coders had completed their data analysis, further screenings of the data for accuracy were made by the lead researcher who watched all 96 videos to check for genuine mistakes in each Game Breaker® "timeline" by the coders. During this process

the lead researcher separated on and off-the-ball behaviors coded by the coders. IOA checks were completed on approximately 30% of the data (Baumgartner & Jackson, 1991) and reliability coefficients for all observed constructs met the required 80% IOA level using an ICC (see appendix 22). The final numbers were then placed into Microsoft Excel® (2003) for the calculation of percentage appropriate/ inappropriate on and off-the-ball involvement.

For the purposes of this part of the data analysis, on-the-ball involvement was defined as "involvement when participants had personal possession of the ball; when they made contact with the ball when attempting to gain control of the ball by trapping it; making contact with the ball when attempting to win the ball back for their team; or when making contact with the ball when it was in transition of possession from one team to the other".

Procedures for Verbal Protocol Analysis (VPA) Data Analysis

Procedures for Coding VPA Data

Participants VPA audio records were transcribed verbatim into Microsoft Word® (2003) by the lead researcher. Samples of these transcriptions were checked by a second coder for reliability of the transcription process. The lead researcher then coded each individual participant's transcriptions for concept content, concept structure variety and sophistication using McPherson and Thomas' (1989) coding protocol. Firstly, the author used Table 5 to determine the major concept coding category, i.e. goal, condition, action etc. of each of the statements made by the participants. Prompt words in the transcriptions (see appendix 28 for prompts words used for each concept category) aided in the process of coding the participants' statements. Once this process was completed,

the author assessed whether the coded statement was appropriate or inappropriate and evaluated the number of features associated with each coded statement. The total amount of codable statements and their variety and sophistication levels (in terms of hierarchical level, see appendix 28) were ascertained for each individual by summing the terms in each major concept category and sophistication level to assess for changes through the baseline to mid and final assessment time points.

A second coder was trained to determine the reliability of the primary coder. Inter-Coder Reliability (ICR) checks were therefore made on approximately 30% of the data (Baumgartner & Jackson, 1991). Transcripts were chosen at random from baseline, mid and final assessment time points. The second coder was blind to the time point of the transcription being coded to control for observer drift and maintain observer objectivity.

Whilst the second coder coded the aforementioned transcriptions for the purposes of reliability, the author re-coded each transcription from each participant at each study time point, based on the suggestions given by the second coder. On completion of these processes both coders totaled the amount of codes and added these into the coding tables at the end of each transcript in Microsoft Word® (2003) (see example in appendix 29). These coding tables for each coder were placed alongside each other in Microsoft Excel® (2003) and were then subject to a reliability analysis which evaluated both the variety of the codes, (i.e. goal, condition, action statements etc.) and their level of sophistication, (i.e. level 0, level 1, level 2 and level 3). Reliability coefficients were computed using the agreements/ (agreements + disagreements) x 100 method (van der Mars, 1989b). The

results of this analysis revealed an average IOA above the minimum level of 80% IOA (see appendix 29 for more information).

In stage two of the coding of VPA data, the second coder reviewed and marked areas for change in the remaining 24 transcriptions not used in the reliability analysis. These transcriptions were edited, where needed, by the author. The final transcriptions used in the data analysis were those of the author, with modifications suggested by the second coder.

Reliability of Data

In analyzing content it could be clearly seen that participants provided similar answers to the same questions at the different time points in the study, the only difference being the depth of content that they gave when answering the question, although this depth remained constant for some of the participants. An example vignette for comparison is provided below for a high skilled player who is responding to the question "Describe, general how well you think/feel the player you are watching is playing" at each time point during the study, baseline, mid and final assessment. In this analysis the reliability of the answer across the various time points of the study is clearly observed. However, the depth of answer clearly changes from baseline to the final/post check section of the study. Further examples can be seen in appendix 30.

Baseline

> I feel he is playing good (Affective, 1) because he is anticipating a lot with the team and helping his teammates (Condition, 2). Yeah, he is playing good (Affective, 1).

Mid Point

> I think he is playing good (Affective, 1) because he is using his moves to get away from the person (Condition, 2) and, he'll pass to his teammates (Predict, 1) by using his moves (Do, 1) so I think he is playing good (Affective, 1).
>
> Final/Post Check Assessment
>
> I think he's playing good (Affective 1), because he is really getting into the game and using his moves (Condition 2), he is passing to his teammates too (Do 2), and I think he playing good (Affective 1). He is also anticipating with his teammates (Predict 1) and helping them a little bit with the passes by making them not so hard (Do 2).

Validity of VPA data and participant's transcriptions

This was ensured by two observers, one the author and the other an independent observer with no vested interest in the outcome of the study, simultaneously watching listening to one of the participant's three VPA transcriptions whilst watching a video of the game the participant watched when completing that VPA. This was conducted after the VPA and assessment game data had been collected. To ensure a variety of time points were evaluated transcriptions were randomly chosen from baseline, mid and final assessment time points of the study.

The two observers determined the content validity of the transcriptions based on the participants effective description of the GP of the player that they were watching in the assessment game. In other words, the two coders ensured that the students VPA transcription aligned to the moments of the game that they were describing, and not a priori.

Appendix 22

Table Showing Levels of IOA on GP Data between 5 coders and the expert coder on completion of training

Coder	A	B	C	D	E	Overall
IOA	0.99	0.99	0.99	0.99	0.99	0.99

Note: Based on total numbers only, levels of agreement with expert 'gold standard' coder

Table Showing Levels of IOA on Game Breaker® Movie Test

Coder	A	B	C	D	E
IOA	83	83	*76	87	94

Note: 22 item test, levels of agreement with expert 'gold standard' coder
*This coder completed a second test and gained over the 80% IOA standard

Table Showing Levels of IOA between coders and expert coder for GP Data during Data Analysis

GP Construct	Appropriate Decisions	Inappropriate Decisions	Appropriate Skills	Inappropriate Skills
IOA 1	0.98	0.95	0.98	0.94
IOA 2	0.98	0.97	0.98	0.95

Note: Based on total numbers only, levels of agreement with expert 'gold standard' coder

Table Showing Levels of IOA between coder and expert coder for separating appropriate/inappropriate on and off-the-ball involvement in GP Data

GP Construct	Appropriate on-the-ball decisions	Inappropriate on-the-ball decisions	Appropriate on-the-ball skills	Inappropriate on-the-ball skills
IOA 1	0.98	0.87	0.97	0.87

Note: Based on total numbers only, levels of agreement with expert 'gold standard' coder

Appendix 23

Table Showing Percentages On and off-the-ball game involvement for 12 participants of three different skill levels (high, moderate and low) in a TGFU soccer intervention

Construct	Name	Skill	BA1	BA2	BA3	MA1	MA2	MA3	FA	PCA	BM	Int. M
Percentage	Neal	H	24.24	16.67	24.31	12.09	20.19	36.27	23.15	17.95	21.74	21.93
On-the-ball	Nancy	H	32.65	28.67	26.53	25.00	35.43	26.67	25.48	21.83	29.28	26.88
Involvement	Lane	H	32.26	34.92	27.03	34.51	32.11	45.00	29.73	33.65	31.40	35.00
	Harry	H	32.00	41.35	38.98	33.20	34.97	39.76	29.19	41.86	37.45	35.80
	Abby	M	7.27	7.64	3.65	7.77	14.71	15.97	5.00	6.54	6.19	10.00
	Lisa	M	20.79	27.78	28.13	21.54	16.41	25.00	17.97	26.97	25.56	21.58
	Mike	M	10.56	13.33	14.50	21.82	19.13	25.18	25.60	19.84	12.80	22.31
	Tiffany	M	13.60	10.61	15.38	7.14	10.99	12.00	13.77	7.14	13.20	10.21
	Evelyn	L	18.97	21.57	16.67	28.80	20.14	18.12	17.07	24.59	19.07	21.74
	Steve	L	24.48	22.00	24.78	23.76	18.18	22.90	19.44	23.38	23.75	21.53
	Naomi	L	6.67	10.00	10.67	25.29	23.93	24.80	20.47	26.12	9.11	24.12
	Wade	L	27.21	27.19	27.82	10.53	13.79	20.17	28.69	16.82	27.41	18.00
Percentage	Neal	H	75.76	83.33	75.69	87.91	79.81	63.73	76.85	82.05	78.26	78.07
Off-the-ball	Nancy	H	67.35	71.33	73.47	75.00	64.57	73.33	74.52	78.17	70.72	73.12
Involvement	Lane	H	67.74	65.08	72.97	65.49	67.89	55.00	70.27	66.35	68.60	65.00
	Harry	H	68.00	58.65	61.02	66.80	65.03	60.24	70.81	58.14	62.55	64.20
	Abby	M	92.73	92.36	96.35	92.23	85.29	84.03	95.00	93.46	93.81	90.00
	Lisa	M	79.21	72.22	71.88	78.46	83.59	75.00	82.03	73.03	74.44	78.42
	Mike	M	89.44	86.67	85.50	78.18	80.87	74.82	74.40	80.16	87.20	77.69
	Tiffany	M	86.40	89.39	84.62	92.86	89.01	88.00	86.23	92.86	86.80	89.79
	Evelyn	L	81.03	78.43	83.33	71.20	79.86	81.88	82.93	75.41	80.93	78.26
	Steve	L	75.52	78.00	75.22	76.24	81.82	77.10	80.56	76.62	76.25	78.47
	Naomi	L	93.33	90.00	89.33	74.71	76.07	75.20	79.53	73.88	90.89	75.88
	Wade	L	72.79	72.81	72.18	89.47	86.21	79.83	71.31	83.18	72.59	82.00

Notes: BA1 = Baseline Assessment 1, BA2 = Baseline Assessment 2, BA3 = Baseline Assessment 3, MA1 = Mid-Intervention Assessment 1, MA2 = Mid-Intervention Assessment 2, MA3 = Mid-Intervention Assessment 3, FA = Final Assessment, PCA = Post-Check Assessment.
BM = Baseline Mean (calculated by taking the average of the three baseline scores); Int. Mean = Intervention Mean (calculated by taking the average of the three baseline scores).
H = High Skill, L = Low Skill, M = Moderate Skill.

Appendix 24

Table Showing Percentage Appropriate and Inappropriate game involvement for 12 participants of three different skill levels (high, moderate and low) in a TGFU soccer intervention

Construct	Name	Skill	BA1	BA2	BA3	MA1	MA2	MA3	FA	PCA	BM	Int. M
Percentage	Neal	H	58.59	48.75	55.96	64.29	53.37	72.55	48.15	55.56	54.43	58.78
Appropriate	Nancy	H	65.31	64.00	72.79	69.76	70.87	64.67	69.75	71.13	67.37	69.23
Involvement	Lane	H	45.16	55.95	45.95	50.88	54.13	67.50	62.61	46.63	49.02	56.35
	Harry	H	73.33	70.68	77.97	80.86	62.27	78.92	75.47	81.86	73.99	75.87
	Abby	M	37.27	36.81	40.15	47.09	47.55	46.53	51.67	45.33	38.07	47.63
	Lisa	M	49.01	40.56	35.42	46.92	40.23	55.00	45.31	55.92	41.66	48.68
	Mike	M	46.13	43.70	49.24	44.55	47.83	52.52	56.00	53.17	46.36	50.81
	Tiffany	M	44.00	26.52	38.46	39.61	56.59	51.00	40.72	42.46	36.33	46.08
	Evelyn	L	58.19	55.39	42.71	58.80	50.00	54.71	60.57	61.89	52.10	57.19
	Steve	L	40.91	50.50	42.48	56.44	59.09	46.95	43.52	46.10	44.63	50.42
	Naomi	L	26.67	25.00	38.76	48.28	58.97	62.80	50.79	50.37	30.14	54.24
	Wade	L	46.60	47.81	54.51	50.53	48.71	51.68	57.38	50.47	49.64	51.75
Percentage	Neal	H	41.41	51.25	44.04	35.71	46.63	27.45	51.85	44.44	45.57	41.22
Inappropriate	Nancy	H	34.69	36.00	27.21	30.24	29.13	35.33	30.25	28.87	32.63	30.77
Involvement	Lane	H	54.84	44.05	54.05	49.12	45.87	32.50	37.39	53.37	50.98	43.65
	Harry	H	26.67	29.32	22.03	19.14	37.73	21.08	24.53	18.14	26.01	24.13
	Abby	M	62.73	63.19	59.85	52.91	52.45	53.47	48.33	54.67	61.93	52.37
	Lisa	M	50.99	59.44	64.58	53.08	59.77	45.00	54.69	44.08	58.34	51.32
	Mike	M	53.87	56.30	50.76	55.45	52.17	47.48	44.00	46.83	53.64	49.19
	Tiffany	M	56.00	73.48	61.54	60.39	43.41	49.00	59.28	57.54	63.67	53.92
	Evelyn	L	41.81	44.61	57.29	41.20	50.00	45.29	39.43	38.11	47.90	42.81
	Steve	L	59.09	49.50	57.52	43.56	40.91	53.05	56.48	53.90	55.37	49.58
	Naomi	L	73.33	75.00	61.24	51.72	41.03	37.20	49.21	49.63	69.86	45.76
	Wade	L	53.40	52.19	45.49	49.47	51.29	48.32	42.62	49.53	50.36	48.25

Notes: BA1 = Baseline Assessment 1, BA2 = Baseline Assessment 2, BA3 = Baseline Assessment 3, MA1 = Mid-Intervention Assessment 1, MA2 = Mid-Intervention Assessment 2, MA3 = Mid-Intervention Assessment 3, FA = Final Assessment, PCA = Post-Check Assessment.
BM = Baseline Mean (calculated by taking the average of the three baseline scores); Int. Mean = Intervention Mean (calculated by taking the average of the three baseline scores).
H = High Skill, L = Low Skill, M = Moderate Skill.

Appendix 25

Table Showing Percentage of appropriate and inappropriate on and off-the-ball game involvement for 12 participants of three different skill levels (high, moderate and low) in a TGFU soccer intervention

Construct	Name	Skill	BA1	BA2	BA3	MA1	MA2	MA3	FA	PCA	BM	Int. M
Percentage	Neal	H	19.19	13.75	14.68	9.89	15.38	31.37	16.20	15.81	15.87	17.73
Appropriate	Nancy	H	28.91	23.00	21.43	21.37	29.92	24.67	22.61	17.96	24.45	23.31
On-the-ball	Lane	H	21.77	23.81	20.61	25.22	23.85	35.00	23.42	20.67	22.06	25.63
Involvement	Harry	H	24.33	29.70	27.12	25.39	26.07	32.83	23.29	33.02	27.05	28.12
	Abby	M	5.00	5.56	2.55	3.88	11.27	10.42	2.50	6.07	4.37	6.83
	Lisa	M	13.86	17.78	15.63	13.46	13.28	16.25	11.33	20.39	15.75	14.94
	Mike	M	7.75	8.52	9.16	14.55	13.48	19.42	18.40	13.49	8.48	15.87
	Tiffany	M	8.00	3.79	7.69	2.60	6.04	7.00	8.38	3.17	6.49	5.44
	Evelyn	L	9.91	14.71	11.46	24.80	13.54	13.04	12.60	20.49	12.03	16.90
	Steve	L	15.73	15.50	19.91	19.80	12.12	18.70	13.89	19.48	17.05	16.80
	Naomi	L	4.29	7.00	7.87	18.97	15.81	20.40	16.93	19.40	6.38	18.30
	Wade	L	15.65	16.67	18.42	5.26	8.19	14.29	18.44	12.62	16.91	11.76
Percentage	Neal	H	39.39	35.00	41.28	54.40	37.98	41.18	31.94	39.74	38.56	41.05
Appropriate	Nancy	H	36.39	41.00	51.36	48.39	40.94	40.00	47.13	53.17	42.92	45.93
Off-the-ball	Lane	H	23.39	32.14	25.34	25.66	30.28	32.50	39.19	25.96	26.96	30.72
Involvement	Harry	H	49.00	40.98	50.85	55.47	36.20	46.08	52.17	48.84	46.94	47.75
	Abby	M	32.27	31.25	37.59	43.20	36.27	36.11	49.17	39.25	33.70	40.80
	Lisa	M	35.15	22.78	19.79	33.46	26.95	38.75	33.98	35.53	25.91	33.74
	Mike	M	38.38	35.19	40.08	30.00	34.35	33.09	37.60	39.68	37.88	34.94
	Tiffany	M	36.00	22.73	30.77	37.01	50.55	44.00	32.34	39.29	29.83	40.64
	Evelyn	L	48.28	40.69	31.25	34.00	36.46	41.67	47.97	41.39	40.07	40.30
	Steve	L	25.17	35.00	22.57	36.63	46.97	28.24	29.63	26.62	27.58	33.62
	Naomi	L	22.38	18.00	30.90	29.31	43.16	42.40	33.86	30.97	23.76	35.94
	Wade	L	30.95	31.14	36.09	45.26	40.52	37.39	38.93	37.85	32.73	39.99
Percentage	Neal	H	5.05	2.92	9.63	2.20	4.81	4.90	6.94	2.14	5.87	4.20
Inappropriate	Nancy	H	3.74	5.67	5.10	3.63	5.51	2.00	2.87	3.87	4.84	3.58
On-the-ball	Lane	H	10.48	11.11	6.42	9.29	8.26	10.00	6.31	12.98	9.34	9.37
Involvement	Harry	H	7.67	11.65	11.86	7.81	8.90	6.93	5.90	8.84	10.40	7.67
	Abby	M	2.27	2.08	1.09	3.88	3.43	5.56	2.50	0.47	1.82	3.17
	Lisa	M	6.93	10.00	12.50	8.08	3.13	8.75	6.64	6.58	9.81	6.63
	Mike	M	2.82	4.81	5.34	7.27	5.65	5.76	7.20	6.35	4.33	6.45

	Tiffany	M	5.60	6.82	7.69	4.55	4.95	5.00	5.39	3.97	6.70	4.77
	Evelyn	L	9.05	6.86	5.21	4.00	6.60	5.07	4.47	4.10	7.04	4.85
	Steve	L	8.74	6.50	4.87	3.96	6.06	4.20	5.56	3.90	6.70	4.73
	Naomi	L	2.38	3.00	2.81	6.32	8.12	4.40	3.54	6.72	2.73	5.82
	Wade	L	11.56	10.53	9.40	5.26	5.60	5.88	10.25	4.21	10.50	6.24
Percentage	Neal	H	36.36	48.33	34.40	33.52	41.83	22.55	44.91	42.31	39.70	37.02
Inappropriate	Nancy	H	30.95	30.33	22.11	26.61	23.62	33.33	27.39	25.00	27.80	27.19
Off-the-ball	Lane	H	44.35	32.94	47.64	39.82	37.61	22.50	31.08	40.38	41.64	34.28
Involvement	Harry	H	19.00	17.67	10.17	11.33	28.83	14.16	18.63	9.30	15.61	16.45
	Abby	M	60.45	61.11	58.76	49.03	49.02	47.92	45.83	54.21	60.11	49.20
	Lisa	M	44.06	49.44	52.08	45.00	56.64	36.25	48.05	37.50	48.53	44.69
	Mike	M	51.06	51.48	45.42	48.18	46.52	41.73	36.80	40.48	49.32	42.74
	Tiffany	M	50.40	66.67	53.85	55.84	38.46	44.00	53.89	53.57	56.97	49.15
	Evelyn	L	32.76	37.75	52.08	37.20	43.40	40.22	34.96	34.02	40.86	37.96
	Steve	L	50.35	43.00	52.65	39.60	34.85	48.85	50.93	50.00	48.67	44.85
	Naomi	L	70.95	72.00	58.43	45.40	32.91	32.80	45.67	42.91	67.13	39.94
	Wade	L	41.84	41.67	36.09	44.21	45.69	42.44	32.38	45.33	39.86	42.01

Notes: BA1 = Baseline Assessment 1, BA2 = Baseline Assessment 2, BA3 = Baseline Assessment 3, MA1 = Mid-Intervention Assessment 1, MA2 = Mid-Intervention Assessment 2, MA3 = Mid-Intervention Assessment 3, FA = Final Assessment, PCA = Post-Check Assessment.
BM = Baseline Mean (calculated by taking the average of the three baseline scores); Int. Mean = Intervention Mean (calculated by taking the average of the three baseline scores).
H = High Skill, L = Low Skill, M = Moderate Skill.

Appendix 26

Figure Showing Example of Verbal Protocol Analysis (VPA) Task Organization

Appendix 27

ESPN Announcer Task

Your task is to watch your assigned peer and, pretending that you are a broadcaster/announcer for ESPN, use your previous experience of playing the game of soccer to commentate on his/her performance in game that you are currently watching.

Whilst watching and commentating you will answer the following questions. These questions are placed in the order they come on the tape you will be listening to:

NOTE: Put on the headphones and make sure you are correctly attached to the LARGE cassette recorder and have in you hand the SMALL cassette recorder and laminated sheet of questions BEFORE you press play on the LARGE cassette recorder.

Preliminary Questions: ***Remember to press the RECORD button on your SMALL cassette recorder***

a) Please state your **Name** and **Assigned Jersey/Pinnie number**:
b) Please state the **Class Period** you are in:
c) Please state on the tape the **format number** of the laminated sheet you have in front of you (this is circled in red in the top right hand corner of the laminated sheet):

Main Questions: ***Please remember to leave the SMALL cassette recorder in the RECORD position***

1) What things does your player do to help **him/her keep *personal* possession** of the ball?

2) Describe how your player tries to stay **involved** in the game?

3) What things does your player do to **communicate** with team mates?

4) What things does your player try and do to **guard** players from the other team?

5) Describe, general how well you think/feel the player you are watching is playing.

6) What things does your player seem to **anticipate** happening?

7) What things does your player do to help **his/her *team* keep possession** of the ball?

8) How does your player help **his/her *team* regain possession** of the ball?

NOTE: Press the STOP button on your SMALL cassette recorder and place it down next to you. Now STOP and REWIND the cassette tape in the LARGE cassette recorder.

If you have any questions about what to talk about please do not hesitate to ask an instructor.

Appendix 28

Table Showing Example statements for helping code the Verbal Protocol Analysis (VPA) data of participants in a TGFU soccer intervention

Statement Type	**Example**	**Prompt words to characterize statement**
Goal statements	What the student intends to do to win or execute a technique/skill? Quality level: Level 0 – weak or inappropriate; Level 1 – appropriate, no features; Level 2 – appropriate, one feature; Level 3 – appropriate, 2 or more features.	***Tries to, try***
Condition Statements	Units of information that specify when or under what circumstances to apply an action or pattern of actions, i.e. this may be an opponent's weaknesses or current position. Levels – see goal statements section.	***As, if, because, so, when, then,***
Action Statements	Units of information that refer to the action selected or pattern of actions selected. An action may be a motor response (pass) or a perceptual response (hearing, looking) Levels – see goal statements section.	***Tackle, steals, Communicates, yells, Passes, dribbles, Attacks, defends, gets open,***

Do statements – a specialized elaboration of an action	Unit of information that describes how to execute the action or what a player is doing. Levels – see goal statements section.	***Do, does, by, to ('ing' statements)***
Regulatory statements – a specialized elaboration of an action	Units of information that describes whether an individual carried out a given action. Levels – see goal statements section.	***But, got, which, whether***
Affective statements – specialized meta-cognitive statements	Units of information that specify emotional responses or opinion statements during game play. Levels – see goal statements section.	***I think, pretty good, pretty well***
Prediction or probability comments - specialized meta-cognitive statements	Unit of information that predict future actions or patterns of actions within the game context. Levels – see goal statements section.	***Anticipates, Should, would, could, Knows when to, will, can, going to***

(Adapted from French, Werner, Rink et al., 1996; McPherson, 1999a, 1999b)

Appendix 29

Table Showing Layout of coding grid for each transcript coded for each participants VPA data in the TGFU soccer intervention

	Goal	Condition	Action	Do	Regulatory	Affective	Predict	Total
Level 0	0	0	0	0	0	0	0	**0**
Level 1	3	0	8	3	0	3	1	**18**
Level 2	1	5	2	5	0	0	0	**13**
Level 3	0	1	0	1	0	0	0	**2**
Total	**4**	**6**	**10**	**9**	**0**	**3**	**1**	**33**

Table Showing Levels of IOA of Verbal Protocol Analysis (VPA) Data between author and second coder

Statement	Goal	Condition	Action	Do	Regulatory	Affective	Predict	Average
IOA	80	86	87	79	75	71	80	80

Note: Calculated using No. Agreements / (No. Agreements + No. of Disagreements) x 100 method (van der Mars, 1989)

Appendix 30

Example Quotes for Verbal Protocol Analysis (VPA) to show developments in procedural knowledge over the duration of the study

Neal

Q: What things does your player do to help **him/her keep *personal* possession** of the ball?

Baseline
A: He yells, "I'm open", "I'm open" or "I'm not open", "I'm not open, don't pass it, someone else is open" (Action, 2).

Final Assessment
A: He dribbles down (Action 1), and makes sure nobody can get him (Predict 1), or he passes (Action 1), or gets into open spaces with the ball (Action 2). He can find open space (Predict 2), he has good vision (Affective 1).

Nancy

Q: Describe, general how well you think/feel the player you are watching is playing.

Baseline
A: I feel he is playing good (Affective, 1) because he is anticipating a lot with the team and helping his teammates (Condition, 2). Yeah, he is playing good (Affective, 1).

Final
A: I think he's playing good (Affective 1), because he is really getting into the game and using his moves (Condition 2), he is passing to his teammates too (Do 2), and I think he playing good (Affective 1). He is also anticipating with his teammates (Predict 1) and helping them a little bit with the passes by making them not so hard (Do 2).

Lane

Q: What things does your player do to **communicate** with team mates?

Baseline
A: Erm, he does not really do anything to communicate with team mates (Do 2) other than to tell them to pass him the ball (Do 2).

Final
A: He doesn't do a lot of communicating (Do, 1) but sometimes he yells for his team to pass him the ball or encouragement (Regulatory, 2).

Harry

Q: What things does your player do to help **his/her *team* keep possession** of the ball?

Baseline
A: She passes, she gets open and protects the ball, passes it (Action, 3), she helps defend it (Action, 1), she takes control of the team (Action, 1), she's a team player (Affective, 1). She's a good defender (Affective, 1).

Final
A: She's strong with the ball (Affective, 1), she doesn't (Do, 0), she doesn't (Do, 0), she moves to get open (Action, 1), she doesn't make a horrible pass (Affective, 1), one thing she could do (Predict, 0), one thing she could do to help or to (Predict, 0), things that she could do is she could go and get open more probably (Predict, 2).

Abby

Q: Describe, general how well you think/feel the player you are watching is playing.

Baseline
A: I think that he is playing really well (Affective, 2); he goes to the ball (Action, 1) when it is loose (Condition, 1), he passes to his teammates (Action, 1). He is very aggressive (Affective, 1).

Final
A: I think that he is playing fairly well (Affective, 2), he charges for the ball (Action, 1) when he has the chance to (Condition, 1), he protects the ball (Do, 1) when he has possession of it (Condition, 2), he takes every chance he can to steal the ball (Action, 2), he watches the person he is guarding (Action, 2) and if there is an open pass to him then he goes up on him (Condition, 2).

Lisa

Q: Describe how your player tries to stay **involved** in the game?

Baseline
A: When the ball is in no-ones possession she runs towards the ball (Condition 2) and tries to gain possession of the ball (Goal 1) and if she is not capable of doing that she tries to see if one of here teammates will kick the ball to her (Condition 3). Also, she backs away from where the ball is so if the ball goes in the opposite direction she can get the ball and stop it (Condition 3).

Final
A: She tries to communicate with her team to try to keep possession (Goal, 2), and she gets open (Action, 1) so that she knows that, her teammates, her other team members know that they can pass to her (Condition, 1). And she runs after the ball when no-one on her team is (Condition, 2) and she spreads out when people on her team are going after the ball (Condition, 2).

Mike

Q: What things does your player do to help **his/her *team* keep possession** of the ball?

Baseline
A: Try to stop passes (Goal, 0).

Final
A: He tries to get a like diamond shape (Goal 2), then he passes it when he starts to get attacked (Condition 2), then he starts to move around (Condition 1) and looks for someone who is open to pass to (Action 3) if he can (Condition 1) or he starts dribbling (Action 1) and goes down the court to make a goal (Do 2).

Tiffany

Q: What things does your player seem to **anticipate** happening?

Baseline
A: Well, whenever her team has the ball, she obviously thinks they are going to pass it her (Predict, 1) so she gets open (Condition, 1) and raises her hand and says "I'm open" so they will pass it to her (Condition, 2).

Final
A: Well, she's, like, if the other team has the ball (Condition, 1) she looks at where the other person is looking or the way she is facing and she goes that way to guard the player that she could be passing to or going to be passing to (Predict, 3), and she always knows if her team is going to get the ball or not (Predict, 2). When the ball goes inside the poly spots she is always the first one to kick it, yeah (Condition, 2).

Evelyn

Q: What things does your player do to help **his/her *team* keep possession** of the ball?

Baseline
A: She tries to win the ball back from the other team (Goal 2).

Final
A: When she is guarded she will move around (Predict, 1) so she is not guarded and can be passed to (Condition, 3), and if she, if she is guarded and has the ball she will pass to someone who is not guarded (Condition, 2).

Steve

Q: Describe how your player tries to stay **involved** in the game?

Baseline

A: Well he likes to talk to everybody (Affective, 1), and right now nothing else, just talking to people (Do, 1), getting coached or advised (Do, 1). It looks like someone is teaching him how to kick (Do, 1), so I don't know if he is really involved (Affective, 0), but I think he likes it (Affective, 1), but I am not sure (Affective, 0).

Final
A: Involved, I think he just sort of stands somewhere (Affective, 1) and then when he gets the ball he kicks it over to his goal (Condition, 1). He runs very slowly (Action, 1) so he's not really trying to get the ball (Condition, 1), the ball went right through his legs and he standing there doing nothing (Do, 2).

Naomi

Q: What things does your player do to help **his/her *team* keep possession** of the ball?

Baseline
A: She blocks (Action 1) and steals (Action 0) and does stuff (Do 0). Erm, he runs around (Action 1) and gets open for passes (Action 2), I don't know (Affective 0). He blocks mostly (Action 1).

Final
A: Oh this one's good (Affective, 1), when the other team is passing or guarding (Condition, 1), they are trying guard from him (Goal, 1), he does really well on taking it from the others (Affective, 1) by pushing his butt into the ball (Do, 1) and he, he, regains (Action, 0), he does a lot of fakes (Do, 1), actually he just did one here except it did not really turn out to be a fake, but, (Regulatory, 1), so…he helps guard a lot (Action, 1) and that helps so that the team doesn't get the ball so they do not have to regain it so (Condition, 2).

Wade

Q: What things does your player seem to **anticipate** happening?

Baseline
A: He stays on the defense of the other side of the game where he keeps the ball from (Action, 2), where he keeps the other team from scoring a goal and he sometimes switches from offense to defense and back (Action, 2).

Mid
A: He goes where the ball is going (Action 2) and where the people from the opposing team seem to be trying to pass the ball (Predict 2) so that (Condition 0) he can gain possession of the ball and help his team score (Predict 2).