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Pre-Service Physical Education Teachers' Implementation of "TGfU Tennis": Assessing Elementary Students' Game Play Using the GPAI

Mise en œuvre du « tennis APJ » par des stagiaires en éducation physique: Évaluation des élèves de l'élémentaire à l'aide du GPAI

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This article reports on a study[1] of upper elementary students' (years 4–6) learning of three games components (base, decision-making, skill execution) as a result of their participation in a tennis unit taught by pre-service physical education teachers. Utilizing the Teaching Games for Understanding (TGfU) model (Bunker & Thorpe, 1982), pre-service physical education teachers taught students (n = 54) from three separate schools. Video-recorded game play of 19 of these upper elementary students before and after tennis instruction was analyzed using the Game Performance Assessment Instrument (GPAI; see Oslin, Mitchell, & Griffin, 1998). Results indicate that mean indices for all three game components increased significantly between the baseline and post-intervention assessment dates. These results suggest that pre-service physical education teachers can utilize TGfU as an instructional model so that a group of novice learners can improve in selected game play components.

Cet article présente une étude sur l'apprentissage de trois composantes du tennis (bases, prises de décisions, application d'habiletés) réalisé dans une séquence d'enseignement basée sur l'approche « Apprendre et comprendre par le jeu » (APJ) (Bunker et Thorpe, 1982) et enseignée par des stagiaires en éducation physique. Les stagiaires ont enseigné ces leçons à des élèves (n=54) de 4^e^ à 6^e^ année de trois écoles. Des enregistrements vidéos illustrant les façons de jouer de 19 de ces élèves avant et après l'apprentissage du tennis ont été analysés à l'aide d'un outil d'évaluation de la performance en jeu, le GPAI (Game Performance Assessment Instrument) (Oslin, Mitchell et Griffin, 1998). Les résultats révèlent que les indices moyens de performance pour les trois composantes du jeu se sont améliorés significativement entre le pré test et post test.. Ces résultats portent à croire que les stagiaires qui donnent des cours d'éducation physique peuvent utiliser ACJ comme modèle d'enseignement pour aider un groupe d'apprenants novices à s'améliorer dans des composantes particulières du tennis.

Introduction

Teaching Games for Understanding (TGfU) is a games-centered teaching model that was initially intended to address traditional games teaching's limitations, especially with respect to such things as techniques-based instruction and sustaining learners' games interest (Bunker & Thorpe, 1982, 1986). Manifestations of these limitations, opine Bunker and Thorpe (1986), can be observed through various happenings, including learners' limited psychomotor success, inadequate games understanding, poor decision-making capabilities, and overdependence on teachers' guidance. Unlike traditional games teaching, in which learners are often taught a prescribed skill with limited-to-no mention or understanding of rationale or significance (Bunker & Thorpe, 1986), TGfU's focus is on teaching the *why* before teaching the *how* of a game. Such a paradigmatic shift, Bunker and Thorpe (1986) suggest, enables learners' increased games interest, enjoyment, and decision-making abilities.

Traditional teaching, in which a "series of highly structured lessons rely on the teaching of skills and techniques" (Werner, Thorpe, & Bunker, 1996, p. 28), has previously been labeled a "Technical Model." Within a Technical Model, once learners have mastered games skills, there is an expectation that these skills will be transferable to games and game-like scenarios (Werner et al., 1996). However, in practice, the application of learning does not necessarily follow such a linear path; it is with this observation that one might recognize the merits of a nonlinear pedagogy in which the manipulation of constraints within games instruction enables functional motor skills and patterns (Chow et al., 2007; Chow et al., 2009; Newell, Mayer-Kress, & Liu, 2006). Holt, Ward, and Wallhead (2006) have suggested that a techniques-based approach results in students learning inflexible techniques resulting in an inability to transfer, and apply, their learning to game scenarios. Though some might challenge such an assertion, evidence nonetheless suggests a generalization of tactics from instructional games to match games is more easily facilitated by a tactical model of instruction (Gray & Sproule, 2011; Lee & Ward, 2011).

TGfU, as a "The Tactical Model," presents an alternative that might also be recognizable as similar to some other recently popular terms for games-centered teaching approaches; in addition to TGfU these include: Game Sense, Tactical Games, Play Practice, Games Appreciation, and Games-Centered Learning (Butler, 2006; Griffin, Butler, Lombardo, & Nastasi, 2003; Hopper, 1998; Werner et al., 1996). During the almost 30 years which have passed since the publication of Bunker and Thorpe's (1982, 1986) original model (see Figure 1), TGfU has become a "focus for researchers and teachers in several countries" (Griffin, Brooker, & Patton, 2005, p. 214) including Canada, the United States, and the United Kingdom.

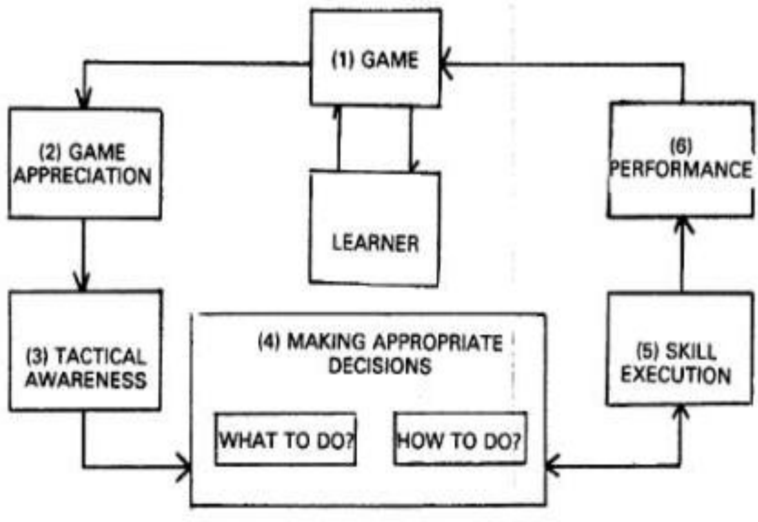

Figure 1. Bunker and Thorpe's (1986, p. 8) Curriculum Model.

Acceptance of the model within Western nations has also been similarly evidenced in other countries within South America, Africa, and Asia (Griffin et al., 2005; Light, 2006). TGfU has undoubtedly become an international movement for best practices in games teaching. Perhaps this has been best evidenced by the establishment of an Association Internationale des Écoles Superieures d'Education Physique (AIESEP) TGfU Special Interest Group (SIG), the introduction and continuation of international TGfU conferences, and the iteration of various TGfU pedagogical models within other countries.

TGfU Research Literature

Although some researchers and teachers might willfully adopt TGfU as a model for games instruction, such an adoption should be based on sound empirical research. That is, it would obviously be inadequate for those who intuitively recognize the immediate and long-term benefits and potential of TGfU (i.e., for whom it simply makes sense or feels right) to adopt such a model without reliable requisite evidence in support of it. Despite theoretical and pedagogical aspects of the TGfU model having been discussed in research and professional contexts (see Berkowitz, 1996; Griffin et al., 2005; Holt, Strean, & Bengoechea, 2002; Thorpe, 1992), there remains a continued need for empirical research related to the merits of TGfU. In order to improve upon the perceived legitimacy of TGfU, Griffin et al. (2003) recommend sound "data-based, not data-free development" (p. 215) is required. They suggest this will allow researchers to contribute to, and improve upon, the "limited empirical support to back up an intuitive sense that [TGfU] works for students" (Griffin et al., 2003, p. 215).

Initially, when the TGfU model became a possible alternative for games instruction, research often compared one approach (e.g., tactical) to another (e.g., technical) as researchers set out to determine, in a polarizing fashion, "Which method is best?" (Harvey, Cushion, Wegis, & Massa-Gonzalez, 2010, p.30). Such initial (see Allison & Thorpe, 1997; Capel, 1991; Lawton, 1989; Turner & Martinek, 1992) and subsequent (see Blomqvist, Luhtanen, & Laakso, 2001; Haneishi, Griffin, Seigel, & Shelton, 2009; Harrison, Blakemore, Richards, Fellingham, Oliver, & Wilkinson, 2004) research comparing tactical and technical approaches often focused on specific and/or particular games play components such as decision-making or recovery (Chow et al., 2007). The results from such research studies were, at best, equivocal (Chow et al., 2007; Holt et al., 2002). Indeed, the development of skill competency is yet to be consistently or conclusively found to be more likely or achievable within tactical models of instruction (see Chow et al., 2007; Blomqvist et al., 2001; Harrison et al., 2004). Further to this, Chow et al. (2007) explain,

> …there seems to be an absence of a clear affirmation of the superiority of a tactical over a technical approach for various performance outcome measures … and analysis of the extant literature generally reveals little in the way of empirical evidence to support its apparent effectiveness. (p. 255)

Though undoubtedly true that there may have at one time been "insufficient evidence to support the TGfU apologists [sic] claim that it is superior to other methods" (McMorris, 1998, p. 65), the results from contemporary research, nevertheless, suggest that TGfU deserves serious consideration.

Common to many of these previously mentioned studies, for example, is the notion that a TGfU model has some positive potential, especially with respect to learners' affect and games sense. For instance, Light (2003a) and Light and Georgakis (2005) have consistently found that a TGfU approach begets greater enjoyment and engagement among participants. Haneishi et al. (2009) also found that female collegiate soccer players indicated greater interest/enjoyment when taught with a games approach (compared to a traditional approach). Similarly, Jones, Marshall, and Peters (2010) found 11–14 year old physical education students to self-report higher scores for interest and enjoyment (as well as for effort) when taught with a TGfU approach. With respect to game sense, Rink, French, and Tjeerdsma (1996) revealed that students taught with a TGfU approach performed better on tests related to tactical knowledge than did those taught with a technical approach. Similarly, and more recently, Bohler's (2009) study in which sixth grade students were taught volleyball within a Tactical Games Model (TGM) demonstrated that their decision-making abilities improved significantly.

In response to previous comparative studies, Rink, French, and Graham (1996) have highlighted the inherent problems associated with discerning between tactical and technical instruction in the first place (e.g., the learning of tactics in a techniques-dominated class *free* of direct-tactical instruction). Hopper (2002) and Strean and Bengoechea (2003) have similarly stressed the inadequacy of a dichotomous approach in "focusing on either skill execution or tactical development" (Chow et al., 2007, p. 256). As the "pitting of technical against tactical approaches … was not the apparent purpose of the original TGfU model" (Holt et al., 2002), it may then be curious to some that earlier comparative studies were given such attention. It is entirely likely that these previous investigations were indicative and symptomatic of the scientific quantitative research paradigm of the time; more-recent qualitative approaches are certainly offering novel and rich insights into TGfU practice and understanding. Contrasting the frameworks of these previous investigations, Metzler (2005) contributes,

> I am suggesting that the question, which model is best? is inappropriate because … that research design is simply invalid …. Domain priorities, engagement patterns, and learning outcomes vary across models, so trying to test how well two models promote different types of outcomes with processes they do not hold in common is the empirical equivalent of comparing apples to oranges. (p. 190)

Rink (2001) articulates an equally important point when she suggests, "when you spend all of your effort proving that a particular kind of teaching is better than another kind of teaching, you limit what you can learn about the very complex teaching/learning process" (p. 123).

Within all of these previously mentioned studies, in-service teachers, trained coaches, or university researchers implemented tactical games instruction. Research into pre-service teachers' implementation of TGfU has been extremely limited (Robinson, 2011). In the small number of studies in which pre-service teachers have implemented TGfU, the research and research questions have focused on topics other than students' resultant games learning. For example, Melnychuk and Robinson (2008) researched pre-service teachers' experiences implementing TGfU, Robinson (2011) researched pre-service teachers' self-reported knowledge, comfort, and intentions after implementing TGfU, Light (2002, 2003b) investigated pre-service teachers' experiences while learning about TGfU in a university course, Li and Cruz (2006, 2008) investigated pre-service teachers' knowledge and intentions after implementing TGfU, and Dudley and Baxter (2009) reported on assessing pre-service teachers' understanding of TGfU using high-stakes testing.

Two especially familiar assessment instruments have facilitated the formal assessment of individual and team performance in various games. These include the Team Sport Assessment Procedure (TSAP; Gréhaigne, Godbout, & Bouthier, 1997, 2000) and the Game Performance Assessment Instrument (GPAI; Mitchell & Oslin, 1999; Oslin, Mitchell, & Griffin, 1998). The TSAP was developed to measure invasion game performance, though it has since been adapted for other game categories (Memmert & Harvey, 2008). The GPAI was developed to evaluate game performance across all four game categories (invasion, net/wall, striking and fielding, and target; Oslin et al., 1998). While both instruments have been validated in a number of contexts, and have been applied and adapted within various studies and physical education/activity scenarios, unlike the TSAP, the GPAI has proven to be especially suitable across all game categories. Memmert and Harvey (2008) have further suggested the "wide acceptance of the GPAI is demonstrated by a number of studies that have used the GPAI for recording data during game play" (p. 221).

The GPAI, as a valid and reliable method for assessing game performance, provides researchers "with a means of observing and coding performance behaviors" (Oslin et al., 1998, p. 233) such as appropriate movement and skill execution. Oslin et al.'s (1998) initial field testing of the GPAI for net/wall games was based on observations of volleyball and it included three of seven game components (adjust, decisions made, and skill execution) though some of the other components certainly applied to net/wall games; the remaining unobserved four components were base, support, cover, and guard/mark. Hopper's (2003) piloting of the GPAI for other net/wall games (e.g., badminton and tennis) led him to adapt six of the GPAI components (base, decision-making, cover, adjust, skill execution, and support). According to Hopper (2007), this adaptation was necessary due to the rapid nature of, and the related difficulty in assessing, game play in most net/wall games.

Mitchell, Oslin, and Griffin (2006) have suggested two methods of scoring game performance (a tally method and a 1–5 Likert-type method). The 1-5 method is attractive due to its user-friendliness (particularly for practitioners). Indeed, it can resemble rubrics that teachers are accustomed to creating and/or using (Griffin, Mitchell & Oslin, 1997; Memmert & Harvey, 2008). The tally method is especially suitable when game performance components can be analyzed using audiovisual equipment and/or computer software; with such technology it is possible to view, pause, and rewind play so that all movements and decisions can be properly tallied.

Research Context

Recognizing the need for further empirical evidence in support of TGfU (particularly without a continued focus on polarizing and comparative data), this study measured the impact of pre-service physical education teachers' TGFU-modeled instruction on the tactics and techniques of a group of upper elementary (years 4–6) students. While recent research has suggested that physical education teachers employing a TGfU model can have a positive effect on students' game play, researchers have yet to demonstrate that soon-to-be teachers can similarly enable such change.

Pre-service physical education teachers taught after-school tennis lessons (in a program titled "TGfU Tennis") using a TGfU framework as it was previously introduced to them within a compulsory elementary physical education curriculum and instruction course. After three weeks of instruction related to TGfU philosophy, research, and application, small groups of pre-service physical education teachers collaborated to design eight-lesson units in which they were required to apply Bunker and Thorpe's (1982, 1986) curriculum model. The primary research question guiding this study was:

> How does an eight-lesson tennis unit, taught by pre-service physical education teachers applying their knowledge of the TGfU model, impact elementary students' game performance in base, decision-making, and skill execution?

Given the decontextualized nature of traditional skill and drill practice, pre-service physical education teachers were encouraged to avoid decontextualized activities so that they might "promote an understanding of the purpose of skills as well as the product of those skills" (Chandler, 1996, p. 49). The pre-service physical education teachers' lesson plan format required that participating students would begin lessons with contextualized instant activities, followed by game play, skill development activities, with a return to game play. Similar to an earlier illustration by Mandigo and Anderson (2003), pre-service physical education teachers were required to include within their lesson plans potential reflective questions, appropriate generic and specific tactical problems, and authentic opportunities for decision-making. Meeting the design goals of the TGfU model, pre-service physical education teachers were also required to teach net/wall strategies and skills by allowing students to initially play modified games rather than teaching tennis skills before allowing games play (Doolittle & Girard, 1991). The pre-service physical education teachers were further encouraged to meet the major assumptions about TGfU previously summarized by Griffin et al. (2005); students were introduced to modified games that were representative of the advanced game form (i.e., modification through representation and exaggeration) and which included problems common to many net games through sampling (Griffin et al., 2005).

Doolittle and Girard (1991) posit tennis, perhaps as much as any other sport, "requires high skill levels for even moderate success" (p. 57). However, with the TGfU model, the pre-service physical education teachers modified tennis to fit the students' developmental levels and to emphasize fundamental concepts (Doolittle & Girard, 1991; Thorpe & Bunker, 1989). For example, pre-service teachers modified tennis games through representation and exaggeration; never did students have an opportunity to play the adult version of the game. Recognizing that pre-service physical education teachers often harbour misconceptions about students learning game strategy on their own (Rovegno, 1993; Rovegno & Bandhauer, 1994), and in the spirit of the TGfU model, lesson plans included explicit and specific attention to tactical problems and their solutions (e.g., consistency – positioning, setting up for attack – shot placement, etc.) as outlined by Mandigo and Anderson (2003). Lesson plans also included purposeful questions to be posed so that students might be enabled to engage more cognitively with their own tactical and technical learning.

Finally, so that the pre-service physical education teachers might also remain mindful of the responsibilities of physical education teachers, their lesson plans (and unit plan) were necessarily aligned with grade level curricular outcomes. Although this program occurred after school, the service-learning[2] program was truly intended to allow the pre-service physical education teachers authentic opportunities to teach physical education. So, while there are obviously some differences between a bona fide physical education class and the ones necessarily created for this service-learning project, the pre-service physical education teachers were directed to plan and teach just as they would for a *regular* physical education class.

Methods

Setting and Participants

Sixteen pre-service physical education teachers taught an after-school tennis program at three local elementary schools. The pre-service physical education teachers were all in their first year of a two-year after-degree Bachelor of Education (B.Ed.) degree program and all had previously completed a Bachelor of Human Kinetics (BHK) or Bachelor of Kinesiology (B.Kin.) degree. These after-school lessons were 90 minutes in length and were taught twice a week for four consecutive weeks (i.e., there were eight 90-minute lessons in all).

While a total of 54 elementary students from grades 4 through 6 participated in the tennis program, 19 students were also research participants (20 were actually involved but one student was absent on the final assessment day and so has been excluded from the data). The ten male students ranged in age from 9–12 years while the nine female students ranged in age from 10–12 years. Though no formal assessment was completed with respect to tennis experience, all 19 students could be fairly labeled as novice learners.

Instrument

The GPAI (Oslin, 2005; Oslin et al., 1998) was used to assess students' game performance behaviours before and after their participation in the after-school tennis program. Only three game components were included within this particular study; they were base, decision-making, and skill execution. While both the TSAP and GPAI have been shown to be valid and reliable measures of game performance (Oslin, 2005), the GPAI was utilized as it is a more appropriate assessment instrument for net/wall games (especially for *individual* net/wall games).

Data Collection

Prior to beginning the first tennis lesson, groups of four students engaged in a mini-tennis game in which their instructions were to cooperatively rally a ball for at least three hits before they were to attempt any winning shots. Modified equipment used for this initial assessment (and subsequent tennis lessons and the final assessment) included Wilson® Starter Foam Balls, a 45 cm Wilson® EZ tennis net, and children's 60 cm tennis racquets. The court dimensions were 16m by 7m (a modified smaller court size). Students were given no further information regarding such possibilities as where to stand, where to move after striking the ball, or how to strike the ball.

All five of these groups (two from School A, two from School B, and one from School C) included two female students and two male students. Other than maintaining an equal ratio of female to male students, the students were chosen randomly. Students were not screened for experience in tennis (or net/wall games) though it was (rightfully) assumed that few, if any, would have had any prior learning or playing experience with tennis. A research assistant (RA) video-recorded each mini-tennis game for a period of 12 minutes. After the completion of the final lesson, this same procedure was repeated. In the lone occasion when a student was absent for the final lesson, another student substituted for the game. This substitute was only required to maintain the doubles set-up; her performance was not assessed.

Data Analysis

The approximately 120 minutes of video-recordings were transferred to a MacBook Pro computer using the software program iMovie. Video-recordings of the students' performance were observed and analyzed for specific game components by the principal investigator (PI) using the GPAI. In order to provide a comprehensive view of students' performance (Oslin et al., 1998), base, decision-making, and skill execution were coded as appropriate/efficient or inappropriate/inefficient. More specific criteria for these three components are included in Table 1.

Table 1
GPAI Component Definitions (Griffin et al., 1997, p. 220) and Assessment Criteria

Component	**Definition**	**Criteria**
base	Appropriate return of performer to a home or recovery position between skill attempts	The student recovers to a base position at the baseline (or at the net) on her/his side of the "doubles" court after striking the ball
decision-making	Making appropriate decisions about what to do with the ball (or projectile) during a game	The student appropriately remains in her/his base position or moves forward to net when there is a perceived opportunity for an upcoming offensive shot or retreats backward from baseline when there is a perceived need for an upcoming defensive shot
skill execution	Efficient performance of selected skills	The student strikes the ball such that it lands in bounds

Because of the differing and relatively large numbers of movements/decisions made in both sessions, it was suitable to express these values as indices (see Table 2). That is, neither the numerator (appropriate/efficient) nor denominator (inappropriate/inefficient) was ever equal to zero or one.

Table 2
GPAI Component Indices and Formulae

Index	**Formula**
base index (BI)	Number of appropriate base recovery movements made ÷ number of inappropriate base recovery movements made
decision-making index (DMI)	Number of appropriate decisions made ÷ number of inappropriate decisions made
skill execution index (SEI)	Number of efficient skill executions made ÷ number of inefficient skill executions made

It is important to note that the decision to express these indices (i.e., BI, DMI, SEI) in this manner was simply a decision to utilize a previously employed arbitrary convention to present the relative frequency of appropriate/efficient movements/decisions to inappropriate/inefficient movements/decisions; others have used similar, but different, conventions (see Memmert & Harvey, 2008; Mitchell, Oslin, & Griffin, 2006). Using this convention, an index of 1.0 would indicate equal numbers of appropriate/efficient movements/decisions and inappropriate/inefficient movements/decisions (e.g., 25/25 = 1.0). Similarly, an index of 0.25 would indicate that appropriate/efficient movements/decisions occur four times less often than inappropriate/inefficient movements/decisions (e.g., 10/40 = 0.25) and an index of 4.0 would indicate that appropriate/efficient movements/decisions occur four times more often than inappropriate/inefficient movements/decisions (e.g., 40/10 = 4.0).

To ensure objectivity in applying the GPAI for coding students' game performance before and after their tennis instruction, a volunteer also viewed two of the video-recorded sessions and coded four of the students' game performance (i.e., 21% of the total research participants). This volunteer was especially familiar with TGfU and the GPAI. For example, she had completed a review of over 25 articles related to TGfU and had experience teaching tennis using a TGfU approach.

Results

Inter-observer Reliability

Inter-observer agreement (IOA) for the two separate coders was computed using a Pearson product moment correlation as well as through a common calculation of inter-observer reliability. Pearson's r-values were $r = .85$ (BI), $r = .89$ (DMI), and $r = .95$ (SEI). The especially high values for Pearson's r are likely due to its limitation with respect to considering the relative position of values in pair-wise correlations. It is for this reason that IOA was also calculated using another common calculation method (see van der Mars, 1989). This IOA calculation was also completed for base, decision-making, and skill execution. Calculations were made based on the observers' agreements and possible agreements, as previously identified and utilized by Harvey et al. (2010). In these calculations (agreements ÷ [agreements + disagreements] × 100; Caro, Roper, Young, & Dank, 1979; van der Mars, 1989), base had an IOA agreement of 88%, decision-making an IOA of 87%, and skill execution an IOA of 97%. Base and decision-making had acceptable IOA scores of greater than 80%. That skill execution had an IOA of 97% was expected; criteria for assessing skill execution was effectively product-based rather than process-based. That is, both observers reviewed video-recorded footage to see if the ball was successfully hit over the net and in bounds (rather than focusing on the form of the motor task).

Component Indices

The fewest number of game component observations for a student was 30 (decision-making and skill execution) and the most was 67 (base). The means and standard deviations for the indices for the three components were computed (see Table 3). In all three indices for the GPAI components, students demonstrated significant increases in their mean scores.

Table 3
Component Indices' Baseline and Post-intervention Means

Component Index	**Baseline Mean (*M*) and Standard Deviation (*SD*)**	**Post-Intervention Mean (*M*) and Standard Deviation (*SD*)**	**Δ**	**r^2**
BI	*M* = 0.568, *SD* = 0.107	*M* = 1.727, *SD* = 0.842	+1.159	.634
DMI	*M* = 0.783, *SD* = 0.137	*M* = 1.251, *SD* = 0.639	+0.468	.339
SEI	*M* = 0.625, *SD* = 0.182	*M* = 2.104, *SD* = 0.964	+1.479	.711

A repeated measures dependent samples two-tailed t test revealed statistical and practical significance[3] for this change for all three of the component indices. The BI ($t_{(18)} = -5.5928$, $p < .001$, $r^2 = .635$, $\alpha = .05$), DMI ($t_{(18)} = -3.120$, $p = .006$, $r^2 = .339$, $\alpha = .05$), and SEI ($t_{(18)} = -6.568$, $p < .001$, $r^2 = .711$, $\alpha = .05$) were 0.468 (DMI) to 1.479 (SEI) higher after students completed their eight 90-minute lessons.

Discussion

The increase from the students' baseline means in all three GPAI components, though positive, requires further discussion, especially with respect to a consideration of the meaning of index scores and limitations related to the design of this particular study. Initial indices ranged from *M* = 0.568 (BI) to *M* = 0.783 (DMI). An index of *M* = 0.568 suggests that for every 100 attempts, a student would be successful (i.e., appropriate or efficient) 36 times while an index of *M* = 0.783 suggests that for every 100 attempts, a student would be successful 44 times. When these indices are considered this way, one might more easily be able to consider the students' performance in the three game components after their involvement in the eight-lesson tennis program. Post-intervention game performance assessments have indices that obviously suggest a significant improvement for base, decision-making, and skill execution. Expressed as percentages (as previously described), students who participated in the tennis program would make appropriate base movements 63% of the time, appropriate decisions 56% of the time, and efficient skill executions 68% of the time. While the 68% success rate for the skill execution is lower than the 80% benchmark suggested by Rink (2010) and Doolittle (1995), the increase from a 30% to a 68% success rate is nonetheless also practically significant. Furthermore, individual students' SEI scores after instruction were as high as 3.884 (i.e., a success rate of 80%).

While these elementary students improved in the three game components (taught and) observed, the study's limitations command explicit consideration. These limitations are related to the nature of the activity, the nature of the participants, the amount of instructional time, the focus of instruction, and the implementation of TGfU. There was no tennis equipment (i.e., racquets, nets, foam tennis balls) at any of the three schools before the implementation of this research study. Informal interviews with school administration, physical education teachers, and participating students revealed that none of the students had participated in a school-based tennis program at any time (though one student had participated in a summer tennis program). Consequently, these students basically were being taught tennis for the first time. With such limited background in tennis, low baseline scores in all three game components might be expected (though, of course, positive transfer from other net and wall games could also occur). Consequently, their significant improvements in all three areas might also be expected because of this factor. Furthermore, unlike the captive audience characterizing in-school physical education programs, the after-school tennis program only included students who chose to enroll in the program. Because of this factor, participating students could be understood to be especially interested and motivated to participate in the tennis program. Again, because of this factor, greater success might be anticipated.

According to Janzen (2004), the eight 90-minute lessons exceed the amount of time traditionally dedicated to school physical education time within Canadian schools. Students at all three of the participating schools have physical education for 30-minute periods, twice every six-day rotation. Thus, in the four weeks the students participated in the after-school tennis program (equal to 720 minutes), they may have had as little as 180 minutes of physical education in-class instructional time. Quite obviously, the amount of time afforded to the tennis instruction exceeds the amount of time students would be afforded to within four weeks of physical education classes. Consequently, suggesting that such results might similarly occur within regular physical education instructional might be unmerited. While the study's results suggest that TGfU-framed lessons taught by pre-service teachers can have a significant impact on students' game play, continued studies in more-authentic physical education environments would be needed before one could make the conclusion that such an impact is possible in shorter periods of instruction (such as is afforded within physical education classes).

Another important aspect is that pre-service physical education teachers knew beforehand that the elementary students' game play would be observed for base, decision-making, and skill execution. With this awareness, the pre-service physical education teachers likely placed greater focus on these game components. In other words, it is entirely possible that the pre-service physical education teachers might have engaged in what has been perhaps best labeled as "teaching to the test." Nevertheless, while modern discourses related to standards and assessment may problematize such actions, it is perhaps an entirely fair question to ask, "What's wrong with teaching to the test?" (Posner, 2004, p. 749) That the pre-service physical education teachers might have spent a disproportionate amount of time teaching base, decision-making, and skill execution because these three components were to be tested is not altogether problematic; such a focus on such identified learning outcomes is indeed indicative of sound teaching practice. Nonetheless, because only these three components were assessed, it is impossible to suggest that students' similarly improved in other components that were taught but not assessed (e.g., adjust, cover).

Significant knowledge gained from this study was related to the task students performed during their baseline and post-intervention assessments. By requiring students to play in groups of four (i.e., doubles), there were additional, and unnecessary, people included in the video-recorded sessions. In fact, having students play a doubles mini-tennis game was most often a prohibitive structure as different ability levels prevented students from demonstrating their games understanding and abilities. In their observations of students' game play in volleyball, Buck and Harrison (1990) found similar results. There they found that low ability students would avoid play while expecting high ability players to take the ball; these same observations were witnessed when reviewing the video-recordings. Future researchers' use of the GPAI to assess students' game play in tennis should consequently consider engaging students in singles scenarios.

Finally, while pre-service physical education teachers were required to plan and teach using the TGfU model, it was not altogether possible to always label their instruction as a true implementation of a Tactical Model. This was to be expected as the service-learning project was also designed to be a learning occasion for the pre-service physical education teachers. Such "drift" from TGfU occurred despite the professors' three purposeful practices to help ensure TGfU implementation. First, the course professor spent twelve hours of instructional time (i.e., six two-hour classes) teaching and modeling the TGfU approach. Second, students' lesson plans were assessed (prior to implementation) to ensure an understanding of teaching according to a TGfU model. Finally, the professors' presence at all of the teaching sessions was intended to enable support for the pre-service physical education teachers' implementation of the TGfU model; this required that they engage in such activities as questioning, prompting, and modeling. Despite these efforts, some pre-service teachers would at times (particularly early on in the unit) seem to fall back upon their experiences as students. Such actions were characterized by a return to more direct instructional styles and some of the previously mentioned characteristics of a Technical Model. These actions were not altogether surprising as they have been similarly observed by Li and Cruz (2006) and Melnychuk and Robinson (2008).

Despite these limitations, this study nonetheless offers some empirical support for the potential of pre-service physical education teachers teaching games, including tennis (as a net/wall game) using a TGfU approach. The claim that tennis is a complex game (Hopper, 2007) is no exaggeration. That upper elementary students were able to demonstrate statistically significant improvement in their game play in all three components as a result of their pre-service physical education teachers' instruction suggests that the model has obvious potential in school-based physical education programs. While this service-learning project was intended to allow the pre-service physical education teachers to have opportunities to prepare themselves to be successful teachers (who are knowledgeable and skilled with respect to TGfU), the previously mentioned limitations undoubtedly prohibit sweeping generalizations about TGfU's application to the classroom context. However, it suggested that continued study in authentic environments might continue to support the sorts of claims established herein.

Future Directions

While this research study has aimed to contribute to the call put forth by Griffin et al. (2003) and Kirk (2005) for sound empirical research, continued research must also continue with focused attention to the results, limitations, and possibilities previously suggested. As Kirk (2005) explains, TGfU research like this needs to be practice referenced. Research needs to fit the "routine circumstances in schools in which teachers and students work [so as to] deal with the real-time issues teachers and learners face on a day-to-day basis (Kirk, 2005, p. 218). TGfU has been presented as a teaching model that might be incorporated into games instruction within physical education; similar research might aim to repeat aspects of this study while also aiming to more honestly reflect the physical education context experienced in todays' schools. For example, by teaching captive audiences for shorter periods of time, or by having student-to-teacher ratio greater than 20:1, conditions might be more similar to the authentic classroom environment. While such attention to the naturalistic setting certainly presents challenges (e.g., teachers feeling de-skilled, scheduling constraints; Brooker, Kirk, Braiuka, & Bransgrove, 2000), continued research is essential if we are to make inroads within pre-service *and* in-service education programs. Contributing to this challenge is the reality that one cannot simply add TGfU to existing practice as it requires that some teachers would need to undergo a radical philosophical adjustment (Butler, 1996). While TGfU continues to encounter resistance from in-service physical education teachers, Light (2002) has more recently suggested that pre-service physical education teachers might become "amenable to the TGfU approach" (p. 299) if given opportunities to engage with it within their teacher education programs.

While the GPAI utilized for this survey only considered three of the game components, future research might also consider the two others suggested by Hopper (2007) for net/wall games. As ongoing and future research continues to contribute to the growing body of literature providing sound empirical support for TGfU as a games instruction model, increasing numbers of physical education pedagogues, their university students, and in turn, public school students will continue to benefit.

References

Allison, S., & Thorpe, R. (1997). A comparison of the effectiveness of two approaches to teaching games within physical education. *British Journal of Physical Education, 28*(3), 9–13.

Berkowitz, R.J. (1996). A practitioner's journey: From skill to tactics. *Journal of Physical Education, Recreation and Dance, 67*(4), 44–45.

Blomqvist, M., Luhtanen, P., & Laakso, L. (2001). Comparison of two types of instruction in badminton. *European Journal of Physical Education, 6*(2), 139–155.

Bohler, H. (2009). Sixth-grade students' tactical understanding and decision-making in a TGM volleyball unit. In T. Hopper, J. Butler, & B. Storey (Eds.), *TGfU... Simply good pedagogy: Understanding a complex challenge*. Ottawa, ON: PHE Canada.

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

Buck, H., & Harrison, J.M. (1990). An analysis of game play in volleyball. *Journal of Teaching in Physical Education, 10*(1), 38–48.

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

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

Butler, J. (1996). Teacher responses to teaching games for understanding. *Journal of Physical Education, Recreation and Dance, 67*(9), 17–20.

Butler, J. (2006). Curriculum constructions of ability: Enhancing learning through Teaching Games for Understanding as a curriculum model. *Sport, Education and Society, 11*(3), 243–258.

Capel, S. (1991). Teaching games as interactive activities. *International Journal of Physical Education, 27*(2), 6–9.

Caro, T.M., Roper, R., Young, M., & Dank, G.R. (1979). Inter-observer reliability. *Behaviour, 69*(3/4), 303–315.

Chandler, T. (1996). Teaching games for understanding: Reflections and further questions. *Journal of Physical Education, Recreation and Dance, 67*(4), 49–51.

Chow, J.Y., Davids, K., Button, C., Renshaw, I., Shuttleworth, R., & Uehara, L. (2009). Non-linear pedagogy: Implications for Teaching Games for Understanding. In T. Hopper, J. Butler, & B. Storey (Eds.), *TGfU... Simply good pedagogy: Understanding a complex challenge*. Ottawa, ON: PHE Canada.

Chow, J.Y., Davids, K., Button, C., Shuttleworth, R., Renshaw, I., & Araújo, D. (2007). The role of nonlinear pedagogy in physical education. *Review of Educational Research, 77*(3), 251–278.

Doolittle, S. (1995). Teaching net games to skilled students: A teaching for understanding approach. *Journal of Physical Education, Recreation and Dance, 66*(3), 18–23.

Doolittle, S.S., & Girard, K.T. (1991). A dynamic approach to teaching games in elementary PE. *Journal of Physical Education, Recreation and Dance, 62*(4), 57–62.

Dudley, D., & Baxter, D. (2009). Assessing levels of student understanding in pre-service teachers using a two-cycle SOLO model. *Asia-Pacific Journal of Teacher Education, 37*(3), 283–293.

Dunlop, W.P., Cortina, J.M., Vaslow, J.B., & Burke, M.J. (1996). Meta-analysis of experiments with matched groups or repeated measures designs. *Psychological Methods, 1,* 170–177.

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

Gréhaigne, J.-F., Godbout, P., & Bouthier, D. (1997). Performance assessment in team sports. *Journal of Teaching in Physical Education, 16,* 500–516.

Gréhaigne, J.-F., Godbout, P., & Bouthier, D. (2000). Students' precision and interobserver reliability of performance assessment in team sports. *Research Quarterly for Exercise & Sport, 71*, 85–91.

Griffin, L.L., Brooker, R., & Patton, K. (2005). Working towards legitimacy: Two decades of Teaching Games for Understanding. *Physical Education and Sport Pedagogy, 10*(3), 213–223.

Griffin, L., Butler, J., Lombardo, B., & Nastasi, R. (2003). An introduction to Teaching Games for Understanding. In L. Griffin, J. Butler, B. Lombardo, & R. Nastasi (Eds.), *Teaching Games for Understanding in physical education and sport: An international perspective*. Oxon Hill: NASPE.

Griffin, L.L., Mitchell, S.A., & Oslin, J.L. (1997). *Teaching sport concepts and skills: A tactical games approach*. Champaign, IL: Human Kinetics.

Haneishi, K., Griffin, L., Seigel, D., & Shelton, C. (2009). Effects of games approach on female soccer players. In T. Hopper, J. Butler, & B. Storey (Eds.), *TGfU… Simply good pedagogy: Understanding a complex challenge*. Ottawa, ON: PHE Canada.

Harrison, J.M., Blakemore, C.L., Richards, R.P., Fellingham, G., Oliver, J., & Wilkinson, C. (2004). The effects of two-instructional models-tactical and skill teaching-on skill development and game play, knowledge, self-efficacy, and student perception in volleyball. *The Physical Educator, 61*(4), 186–199.

Harvey, S., Cushion, C.J., Wegis, H.M., & Massa-Gonzales, A.N. (2010). Teaching games for understanding in American high-school soccer; a quantitative data analysis using the game performance assessment instrument. *Physical Education & Sport Pedagogy, 15*(1), 29–54.

Holt, J.E., Ward, P., & Wallhead, T.L. (2006). The transfer of learning from play practices to game play in young adult soccer players. *Physical Education and Sport Pedagogy, 11*(2), 101–118.

Holt, N.L., Strean, W.B., & Bengoechea, E.G. (2002). Expanding the teaching games for understanding model: New avenues for future research and practice. *Journal of Teaching in Physical Education, 21*(2), 162–176.

Hopper, T. (1998). Teaching Games for Understanding using progressive principles of play. *Canadian Association for Health, Physical Education, Recreation and Dance, 27*(1), 1–15.

Hopper, T. (2002). Teaching games for understanding: The importance of student emphasis over content emphasis. *Journal of Physical Education, Recreation and Dance, 73*(7), 44–48.

Hopper, T.F. (2003). Four R's for tactical awareness: Applying game performance assessment in net/wall games. *Teaching Elementary Physical Education, 4*(2), 16–21.

Hopper, T. (2007). Teaching tennis with assessment 'for' and 'as' learning: A TGfU net/wall example. *Physical and Health Education Journal, 73*(3), 22–28.

Janzen, H. (2004). Daily physical education for K-12: Is government legislation in sight? [electronic version]. *Physical and Health Education Journal, 69*(4), 4–12.

Jones, R.J.A., Marshall, S., & Peters, D.M. (2010). Can we play a game now? The intrinsic benefits of TGfU. *European Journal of Physical & Health Education, 4*(2), 57–63.

Kirk, D. (2005). Future prospects for Teaching Games for Understanding. In L.L. Griffin & J.I. Butler (Eds.), *Teaching games for understanding: Theory, research, and practice*. Windsor, ON: Human Kinetics.

Launder, A.G. (2001). *Play practice: The games approach to teaching and coaching sports*. Windsor, ON: Human Kinetics.

Lawton, J. (1989). Comparison of two teaching methods in games. *Bulletin of Physical Education, 25*(1), 35–38.

Lee, M., & Ward, P. Generalization of tactics in tag rugby from practice to games in middle school physical education. *Physical Education & Sport Pedagogy, 14*(2), 189–207.

Li, C., & Cruz, A. (2006). Learning to teach games for understanding: Experiences from four pre-service PE teachers in the Hong Kong Institute. In R. Liu, C. Li, & A. Cruz (Eds.), *Teaching Games for Understanding in the Asia-Pacific Region* (pp. 25–36). Hong Kong: The Hong Kong Institute of Education.

Li, C., & Cruz, A. (2008). Pre-service PE teachers' occupational socialization experiences on teaching games for understanding. *New Horizons in Education, 56*(3), 20–30.

Light, R. (2002). The social nature of games: Australian pre-service primary teachers' first experiences of Teaching Games for Understanding. *European Physical Education Review, 8*(3), 286–304.

Light, R. (2003a). The joy of learning: Emotion and learning in games through TGfU. *Journal of Physical Education New Zealand, 36*(1), 93–109.

Light, R. (2003b). "No room for heroes": Australian, pre-service teachers' responses to TGfU. In L. Griffin, J. Butler, R. Nastasi & B. Lombardo (Eds.), *Teaching Games for Understanding in Physical Education and Sport: An International Perspective.* Oxon Hill, MD, USA: National Association for Sport and Physical Education.

Light, R. (2006). Implementing understanding approaches to teaching games and sport in Asia. *Asian Journal of Exercise and Sport Science, 2*(1), 39–48.

Light, R., & Georgakis, S. (2005). Integrating theory and practice in teacher education: The impact of a games sense unit on female pre-service primary teachers' attitudes towards teaching physical education. *Journal of Physical Education New Zealand, 38*(1), 67–83.

Mandigo, J.L., & Anderson, A.T. (2003). Using pedagogical principles in net/wall games to enhance teaching effectiveness. *Teaching Elementary Physical Education, 14*(1), 8–11.

McMorris, T. (1998). Teaching games for understanding: Its contribution to the knowledge of skill acquisition from a motor learning perspective. *European Journal of Physical Education, 3*(1), 65–74.

Melnychuk, N., & Robinson, D.B. (2008, May). *Experiences of preservice teachers with Teaching Games for Understanding*. Paper presented at the International Teaching Games for Understanding (TGfU) Conference, Vancouver, BC.

Memmert, D., & Harvey, S. (2008). The Game Performance Assessment Instrument (GPAI): Some concerns and solutions for further development. *Journal of Teaching in Physical Education, 27*(2), 220–240.

Metzler, M.W. (2005). Implications of models-based instruction for research on teaching: A focus on teaching games for understanding. In L.L. Griffin, & J.I. Butler (Eds.), *Teaching games for understanding: Theory, research, and practice*. Windsor, ON: Human Kinetics.

Mitchell, S.A., & Oslin, J. (1999). *Authentic assessment in games teaching: The Game Performance Assessment Instrument (NASPE Assessment Series)*. Reston, VA: NASPE.

Mitchell, S.A., Oslin, J.L., & Griffin, L.L. (2006). *Teaching sport concepts and skills: A tactical games approach* (2nd ed.). Champaign, IL: Human Kinetics.

Newell, K.M., Mayer-Kress, G., & Liu, Y.T. (2006). Human learning: Power laws or multiple characteristic time scales? *Tutorials in Quantitative Methods for Psychology, 2*(2), 66–76.

Oslin, J. (2005). The role of assessment in teaching games for understanding. In L.L. Griffin & J.I. Butler (Eds.), *Teaching games for understanding: Theory, research, and practice*. Windsor, ON: Human Kinetics.

Oslin, J., Mitchell, S.A., & Griffin, L.L. (1998). *The game performance assessment instrument (GPAI): Development and preliminary validation, 17*(2), 231–243.

Posner, D. (2004). What's wrong with teaching to the test? *Phi Delta Kappan, 85*(10), 749–751.

Rink, J.E. (2001). Investigating the assumptions of pedagogy. *Journal of Teaching in Physical Education, 20*(2), 112–128.

Rink, J.E. (2010). *Teaching physical education for learning* (6th ed.). Boston, MA: McGraw Hill.

Rink, J.E., French, K.E., & Graham, K.C. (1996) Implications for practice and research. *Journal of Teaching in Physical Education, 15*(4), 490–502.

Robinson, D.B. (2011). Possibilities for physical education teacher education: Service learning and TGfU. *PHENex Journal/Revue phénEPS,* 3(1), 1–16.

Rovegno, I. (1993). The development of curricular knowledge: A case of problematic pedagogical content knowledge during advanced knowledge acquisition. *Research Quarterly for Exercise and Sport, 64*(10), 56–68.

Rovegno, I., & Bandhauer, D. (1994). Child-designed games: Experience changes teachers' conceptions. *Journal of Physical Education, Recreation & Dance, 65*(6), 60–63.

Stevens, C. (2008). *Service learning for health, physical education, and recreation*. Champaign, IL: Human Kinetics.

Strean, W., & Bengoechea, E.G. (2003). Beyond technical vs. tactical: Extending the games-teaching debate. In J. Butler, L. Griffin, B. Lombardo, & R. Nastasi (Eds.), *Teaching games for understanding in physical education and sport*. Reston, VA: National Association for Sport and Physical Education.

Thompson, B. (1997). Editorial policies regarding statistical significance tests: Further comments. *Educational Researcher, 26*(5), 29–32.

Thorpe, R.D. (1992). The psychological factors underpinning the "Teaching Games for Understanding" movement. In T. Williams, L. Almond, & A. Sparkes (Eds.), *Sport and physical activity: Moving toward excellence* (Proceedings of the AIESEP World Convention, Loughborough, UK). London: E & FN Spon.

Thorpe, R., and Bunker, D. (1989). A changing focus in games teaching. In L. Almond (Ed.), *The plan of physical education in schools* (pp. 163–169). London: Kogan.

Turner, A.P., & Martinek, T.J. (1992). A comparative analysis of two models for teaching games (technique approach and game centered [tactical focus] approach). *International Journal of Physical Education*, *29*(4), 15–31.

van der Mars, H. (1989). Observer reliability: Issues and procedures. In P. Darst, D. Zakrajsek, & V. Mancini (Eds.), *Analyzing physical education and sport instruction* (pp. 53–80). Champaign, IL: Human Kinetics.

Werner, P. Thorpe, R., & Bunker, D. (1996). Teaching Games for Understanding: Evolution of a model. *Journal of Physical Education, Recreation & Dance, 67*(1), 28–33.

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[2] Service learning is a "class-based, credit-bearing experience in which student participate in an organized service activity that meets a particular need of a community" (Stevens, 2008, p. xii).

[3] The decision to use r2 (rather than the more commonly used Cohen's d) to report on effect size was due to the relatively high correlations between baseline and post-intervention index scores; this results in a gross overestimate of effect size when calculating for d (Dunlop, Cortina, Vaslow, & Burke, 1996; Thompson, 1997).