Article

Exposing athletes to playing form activity: Outcomes of a randomized control trial among community netball teams using a game-centered approach.

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The authors declare that there is no conflict of interest.

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Abstract

Background: Activities relevant to competition (playing form) are recommended in athlete development.
Objective: To evaluate the efficacy of the Professional Learning for Understanding Games Education into Sport (PLUNGE into Sport) program on game-play outcomes and session involvement within junior netball players.
Methods: A group-randomized controlled trial in one junior netball club in the Hunter Region, NSW, Australia. Ninety female athletes (mean age = 9.04 years, SD 1.53) were randomized by team (n = 11) into the intervention (n = 41) or 9-week wait-list control (n = 49) condition. PLUNGE into Sport was undertaken in the first half of nine training sessions (9 x 30min). The intervention exposed athletes to playing form activity through a coach development program within training sessions. Athletes' decision making, support and skill outcomes during a small sided invasion game, and session involvement (pedometer step/min) was measured at baseline and 9-week follow-up.
Results: Linear mixed models revealed significant group-by-time intervention effects (p<0.05) for decision making (d=0.4) and support (d=0.5) during game play, and in-session activity (d=1.2).
Conclusion: An intervention exposing athletes to greater levels of playing form activity, delivered via a coach education program, was efficacious in improving athlete decision making and support skills in game play and increasing athlete involvement during sessions.

Keywords:
Coaching, community sport, netball, coach-development, junior sport

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Introduction

Competent sports performance, particularly during team sports, is not only dependent on the execution of technical (motor) skills, but also perceptual-cognitive skills concerned with obtaining and using information present within the game environment. These skill sets are thought to interact continuously in a dynamic manner during sports performance (Janelle & Hillman, 2003; Williams & Ward, 2007), with expert performers better able to extract relevant information from the game environment. Consequently, they are more likely to make appropriate decisions about effective actions to execute (Williams & Ford, 2008).

In order to promote the development of technical and perceptual-cognitive skills for the demands of competitive sport, research recommends that athletes spend greater amounts of time in training activities that replicate the technical, tactical and physical aspects of match-play (Ford, Yates, & Williams, 2010; Williams & Ford, 2008). This is referred to as playing form activity, and often includes implementing phase of play and small-sided games in training sessions. Traditionally however, athletes (particularly in a youth sport context) spend greater amounts of time in activities focused on motor-skill performance in isolation or in small group scenarios - devoid of competition-like context (Ford et al., 2010; Low, Williams, McRobert, & Ford, 2013; Partington, Cushion, & Harvey, 2014). This is

referred to as training form activity, and is considered less relevant to competition preparation than playing form activity (Ford et al., 2010; Starkes, 2000).

Additional to the development of technical and perceptual-cognitive skills, exposure to playing form activity also offers a way of simultaneously preparing athletes for the physiological demands of competition (Hoffmann Jr, Reed, Leiting, Chieh-Ying, & Stone, 2014). This can be achieved through the use of active small-sided activities that replicate repeated-intensity interval training (Laursen & Jenkins, 2012); with the aim and potential to enhance repeat sprint performance (Spencer, Bishop, Dawson, & Goodman, 2012) whilst developing physiological characteristics required for success in a range of team sports.

In physical education and sport pedagogy, a game-centered approach (GCA) has been suggested as an alternative to the sport-as-technique approach (Kirk, 2010). Sport-as-technique is characterized by the development of technical skills using progressively complex training form activities prior to competition style play (Deakin, Starkes, & Allard, 1998; Williams & Hodges, 2005). A GCA stems from approaches such as Teaching Games for Understanding (Bunker & Thorpe, 1982) and Game Sense (den Duyn, 1997) where a player's skills and tactical understanding is said to emerge 'in and through' learning processes (Biesta, 2010, p. 6) as each individual interacts with constraints present within game-centered activities (Chow et al., 2007). Importantly, a GCA offers a method of

delivering playing form activity for the development of technical and perceptual-cognitive skills within game play that mimics the technical, tactical and physical demands the athlete will be exposed to during competition (Ford et al., 2010; Williams & Ford, 2008).

In an early review of GCA literature, Oslin and Mitchell (2006) posed the question 'Can GCAs be used to transform community sport contexts?', noting a lack of research into the effectiveness of a GCA in this domain. Whilst there is a growing body of research surrounding coaches' perceptions of using a GCA (E.g. Evans, 2006; Evans & Light, 2008; Harvey, Cushion, & Massa-Gonzalez, 2010; Reid & Harvey, 2014), and the difficulties of implementing a GCA into a coaching environment (Cushion, 2013; Reid & Harvey, 2014), the lack of research investigating the improvement of athlete outcomes (e.g. decision making and support play) may have contributed to GCAs having received relatively little attention from coaches and coach educators (Cushion, 2013; Harvey & Jarrett, 2014). Indeed, the question regarding transformation of community sports through the use of a GCA remains largely unanswered (Harvey & Jarrett, 2014).

The Professional Learning for Understanding Games Education into Sport (PLUNGE into Sport) intervention was developed to facilitate game performance outcomes in junior netball players through a coach education process designed to help coaches develop athlete perceptual-cognitive skills through the use of GCA activities. The primary

aim of this research was to evaluate the efficacy of the PLUNGE into Sport 9-week pilot intervention for improving game-play decision making, support play and skill execution in junior netball players. An additional aim was to investigate the in-session activity (steps/minute) of participants.

Whilst the coach education process is of great interest in the development of coaching practice promoting perceptual-cognitive skills, this article focuses on presenting the intervention design, feasibility results and efficacy of the intervention for improving athlete outcomes. We hypothesized that participants in the intervention group would display more favourable changes in game play abilities and training session activity levels over the 9-week study period, in comparison to a control condition.

Methods

Study design

The study was a two-armed group RCT (Australia and New Zealand Clinical Trials registry: ACTRN12615000444583), with one arm receiving an intervention and the other a comparison group of the standard coaching received by participants (control group). Ethical approval for this study was obtained from the University of Newcastle ethics committee. All participants provided written assent accompanied with written parental consent and the study was conducted from April to August, 2015.

Recruitment and Participants

Twelve teams (Coach and athletes) from one junior netball club from the Hunter region in New South Wales, Australia were invited to participate in the study. Teams invited were: i) comprised of athletes 8 – 12 years of age, and ii) playing in the entry level recreational netball competition in this region. To maintain generalizability of results to recreational athletes trained by community level coaches, a team was excluded from the study if: i) the team comprised representative level athletes, and ii) the coach held an external sports coaching qualification, or a tertiary PE teaching qualification. Involvement in the study was as a team unit (coach and athlete consent). Only athletes assenting to involvement with consent from their parents were involved in assessment sessions.

Intervention

The goal of the PLUNGE into Sport intervention was to expose athletes to training sessions that: i) presented them with activities involving match-related decision making, and ii) promoted development of their technical and perceptual-cognitive skills within these activities.

Curriculum

To present athletes with match-related decision making, coaches were provided with GCA

curriculum. All activities within curriculum were based on the concept of playing form (Ford et al., 2010), all requiring some form of decision making directly related to expectations of actual game play (e.g. one or multiple defenders). Intervention curriculum was delivered in the first half of training sessions (approximately 30 minutes), with coaches responsible for the content addressed in the second half of the training session. This was undertaken under the assumption of replacing the training form activity typically undertaken in the first part of a traditional sport-as-technique approach (Williams & Hodges, 2005), and to allow coaches to still address any content arising from the weekend's game.

A series of three sessions were planned (one per week), with this series repeated three times across the 9-week intervention period. Curriculum was repeated in order to enable both coaches and athletes to become highly familiar with the activities, and to enhance coach knowledge of technical and perceptual-cognitive elements within activities through the coach education process (below). The curriculum goal for the series of sessions and the types of activities used are presented in Table 1. In line with design recommendations for a GCA (Tan, Chow, & Davids, 2011), the complexity of activities increased progressively across individual sessions and the three week series.

Table one around here please

Coach education program

To promote development of athlete technical and perceptual-cognitive skills, a coach education program designed to assist coaches in effective delivery of the GCA curriculum was undertaken. The coach education program was based on a mentoring model (Kennedy, 2005; Rhodes & Beneicke, 2003), which is underpinned by situated learning theory (Lave & Wenger, 1991), and involved a member of the research team mentoring a coach during the delivery of the GCA curriculum (first half of sessions).

The Game Sense model (den Duyn, 1997) in which physical and cognitive elements are addressed simultaneously during game-centered activities underpinned the focus of mentoring, with an established instructional routine used to scaffold mentoring (Miller, Eather, et al., 2016). The mentoring process (Table 2) was designed to involve the mentor heavily during sessions in the first phase (familiarization and team teaching: weeks 1 – 3), with mentor intervention in sessions reduced progressively across this phase. The mentor had no involvement with athletes in the second phase (instructional coaching: weeks 4 – 6), only assisting the coach to evaluate athlete performance and construct feedback focused on technical and perceptual-cognitive skill development. The coach was entirely responsible (mentor was not at sessions) for curriculum delivery in the final phase of the intervention (coach only: weeks 7 – 9). To maintain minimal coach burden, the mentor had a 3 – 5

minute discussion with the coach prior to the session to overview the session structure and content. All other involvement was within session times.

Table two around here please

Control condition

Athletes in the control condition received no intervention or information. Coaches in the control condition were asked to undertake their usual practice from baseline to follow-up assessment. There was no specification given as to the pedagogical approach used by the control coaches.

Measures

The primary outcomes for this study were athlete game play abilities (decision making, support and skill execution) measured prior to the start of the intervention (baseline) and post intervention (9-week follow-up). The secondary outcome of in-session activity, and additional measures of session activity type (playing or training form) and program fidelity were assessed at baseline and at time intervals corresponding to the end of each phase of the coach education program (3-week, 6-week, and 9-week follow-up).

Game play skills. A previously validated game performance assessment instrument was used to assess game play skills (Miller, Christensen, et al., 2016). All students were recorded on video playing a 6-minute 4 vs. 4 modified netball game against their team-mates, the aim of which was to move the ball across the space (1/3 netball court) to a 1-meter end-zone without running with the ball and using a minimum of five passes. Measurement scales for game play decision making and skill execution are outlined in Table 3. An individual player was observed from start to finish of the game (all athletes coded for analysis), with each on-ball (decision and skill execution) and off-ball (support) performance coded as positive (good) or negative (poor) for each game segment.

One research assistant performed assessment of game performance videos. Assessor training included rating of game performance using video previously rated by the first two authors (AM and NE) (>95% agreement rate required). Reliability was assessed by recoding a random selection of 20% of participant game play video (10% of control and intervention groups) from pre and post assessment periods one week after the initial coding took place. A percent agreement reliability test (Blomqvist, Vanttiinen, & Luhtanen, 2005) was used (number of agreements/number of agreements + number of disagreements). Intra-rater reliability displayed similar levels to those previously reported for game play assessment instruments (Blomqvist et al., 2005; Gray & Sproule, 2011), with all agreement

levels above 90%. Agreement of decision making coding was 95% and 93% for baseline and follow-up time points respectively, and agreement of skill performance coding was 95% at baseline and 92% for follow-up time points. A percentage of positive performance was used to determine the quality of each participant's involvement in each of the game assessment periods for decision, support and skill outcome categories (e.g. good decisions / (good decisions + poor decisions)).

In-session activity. Pedometers (Yamax Digi-walker CW700) were employed for comparison of in-session physical activity levels for each athlete as a proxy measure for session involvement. A pedometer functionality routine (30 steps taken with a result within 3 steps) was performed with athletes prior to the beginning of each recorded session (pedometer swapped if not acceptable), and session time was recorded from the completion of the pedometer check until the point at which the coach declared the session finished. Steps/minute were calculated for analysis.

Coaching activity type. Hand notation of the type (training or playing form) and the time (start and finish time) of activities during session observation of teams in both conditions was undertaken to determine the percentage of a coaching session spent in either 'playing' or 'training' form activity, using definitions from Ford et al. (2010). Playing form activity was game related and included some form of game-based decision making (e.g. phase of

play activity, and small-sided games), whilst training form activity involved no form of game-based decision making or game-based context (e.g. fitness activity, technique practice, and skill practice in drill form). Inter-rater reliability of this process was undertaken between the two observers at 10% of scheduled observations, with mean (SD) percentage agreement 96.3 (4.4) for session time in training form activity, and 97.3 (3.9) for time in playing form activity. Down time (e.g. water breaks and transitions) was not separated from activities in session time calculation (e.g. timing restarted at start of each new activity), and the percentage of the session and minutes spent in playing form activity were the units of analysis.

Intervention fidelity. To ensure athletes were exposed to the intervention as intended, two processes were undertaken during the follow-up session observations (3-week, 6-week, and 9-week) for the intervention group only: i) a count of the intended curriculum activities undertaken in the intervention time allocation (first 30 minutes of the session), and ii) the number and session proportion of any training form activities undertaken in the intervention segment of the session (as there were no training form activities in the intended curriculum). Inter-rater reliability of this process was undertaken between the two observers at 10% of scheduled observations, with 100% agreement achieved. Total and the range of results for the intervention group are reported for: i) the percentage of intervention

curriculum undertaken, and ii) training form activities as a proportion of total activities undertaken during the intervention time allocation.

Athlete exposure. Athlete attendance at sessions was recorded by the coach. Mean exposure and proportions of athlete attendance at sessions (1 – 9 sessions) are reported.

Table three around here please

Sample size

Our power calculation was based on a previous GCA intervention targeting changes in game play decision making (Miller, Christensen, et al., 2016), in which a moderate effect size (d = 0.7) was reported for intervention effect on decision making in primary school students. Using an alpha of 0.05 and power of 90%, a sample size of approximately 72 was needed to detect a between group difference of 0.10 units (SD = 0.15) for the decision making variable.

Randomization and blinding

Teams were stratified into younger (8 – 9 years), and older (10 – 12 years) groups, and teams matched within these strata (minimum three teams per strata) were randomly assigned after baseline assessment to one of two groups: i) PLUNGE into SPORT 9-week

pilot intervention (treatment), or ii) 9-week wait-list (control). Randomization was performed by an independent 3rd party using a coin toss. Assessment of the primary outcomes (game play performance) was blinded to treatment condition.

Analysis

Statistical analyses were completed using PASW Statistics 21 (SPSS Inc. Chicago, IL) software and alpha levels were set at $p < 0.05$. Independent samples t-tests were used to compare differences between intervention and control groups at baseline. Linear mixed models were fitted to compare intervention and control groups for continuous variables (decision making, support, skill execution, steps/minute and playing form exposure [percentage and time]). Group (intervention or control), time (baseline and 9-weeks) and group-by-time interaction (change relative to baseline values) were assessed as fixed effects within the model. All models included age to adjust for this interaction. Differences of means and 95% confidence intervals (CIs) were determined using the linear mixed models. Analyses included all randomized participants. Cohen (1988)'s *d* was used to determine effect sizes ($d = (M1 – M2) / \sigma$ pooled).

Results

Overview

The flow of participants through the study process is reported in Figure 1. The study sample included 90 athletes from 11 teams. Five teams were randomized to the intervention (n = 41) and six to the control (n = 49) condition. Mean age of athletes was 9.1 (SD 1.6) years, with no significant differences between control and intervention groups (Table 4). In terms of retention, measurements were obtained on 97% of the sample at 9-week follow-up in August 2015 (n = 87).

Figure one around here please

Baseline

At baseline, the primary outcomes of decision making, support or skill execution within game play displayed no significant differences between control and intervention groups. There were no between group differences for the percentage and time spent in playing form activities, with the majority of sessions spent in training form activities. With regard to activity within sessions (steps / minute) the control group were significantly ($p < 0.05$) more active during baseline assessment (Table 4).

Table four around here please

Intervention fidelity

Overall, the intervention teams completed 80% (48/60) of the total intended curriculum activities, with completion ranging from 75% to 92%. Training form activities comprised 9% (5/53 activities within intervention time) of the observed training sessions, with training form activities ranging from 8% to 10% of the allocated intervention time in these sessions.

Athlete exposure

The average number of sessions attended was 8.4 (SD = 1.0), with 64% attending all of the nine sessions, 24% attending eight sessions and 12% attending between seven and five sessions. No athlete attended less than five sessions.

Changes in primary outcomes

Significant beneficial treatment effects were found from baseline to follow-up for decision making ($p = 0.049$, $d = 0.41$) and support ($p = 0.024$, $d = 0.48$) outcomes, however there were no between group differences for skill execution ($p = 0.701$, $d = 0.00$) (Table 5). Figure 2 displays the group by time interaction of game play outcomes for both groups across the intervention period.

Table five around here please

Figure two around here please

Changes in secondary outcomes

There were significant beneficial treatment effects for activity type in training sessions at 9-week follow-up for playing form percentage ($p = 0.012$, $d = 1.37$) and corresponding minutes in playing form activities ($p = 0.028$, $d = 1.20$). The intervention group displayed a mean increase of 47.82% (95% CI = 25.05 – 70.59) for playing form in sessions, for a mean increase of 16.20 (95% CI = 3.90 – 29.21) minutes. The control group displayed no significant change in playing form activity, with coaches utilizing a traditional sport-as-technique approach throughout the study period. Figure 3 displays playing form activity usage across the intervention period. With regard to activity within sessions significant beneficial treatment effects were found across the intervention period ($p < 0.001$, $d = 1.18$). Figure 4 displays the shift in the intensity of session involvement across the intervention period.

Figures three and four around here please

Discussion

The aim of this research was to evaluate the efficacy of a 9-week GCA pilot intervention for the improvement of game-play skills and session involvement within junior netball

players. The PLUNGE into Sport intervention resulted in a significant increase in athlete exposure to playing form activity, higher intensity session involvement, and a significant beneficial intervention effect for game play outcomes of decision making and support. There was, however, no significant change in skill execution during game play over the study period in comparison to the control group.

This study explored the theoretical notion, from a motor learning perspective, that greater amounts of time should be spent in playing form activities in order to develop more competent athletes in team sports (Ford et al., 2010; Williams & Ford, 2008). This is the first study to connect the fields of motor learning and sports pedagogy for the development of more competent athletes within a community coaching setting. The results provide strong evidence for the development of athletes by involving them in playing form activity via a GCA when coaches are also provided with in-situ coach education regarding the use of a GCA.

The improvement of game play outcomes observed in this study is in line with previous findings of improvement in support play (Chatzopoulos, Drakou, Kotzamanidou, & Tsorbatzoudis, 2006; Gray & Sproule, 2011; Harvey, Cushion, Wegis, & Massa-Gonzalez, 2010; Miller, Christensen, Eather, Gray, et al., 2015), and decision making (Chatzopoulos et al., 2006; Gray & Sproule, 2011; Miller, Christensen, Eather, Gray, et al.,

2015; Nevett, Rovegno, Babiarz, & McCaughtry, 2001; Tallir, Lenoir, Valcke, & Musch, 2007) in GCA based interventions. These findings are not surprising given that athletes in the intervention group had significantly greater exposure to activities that required them to process information and enact movement responses, with the major (and mentor assisted) coaching focus on technical and perceptual-cognitive skills situated within these activities (Lave & Wenger, 1991).

Likewise, the lack of improvement in skill execution replicates previous findings (Gray & Sproule, 2011; Harvey, Cushion, Wegis, et al., 2010; Miller, Christensen, Eather, Gray, et al., 2015). Positive skill outcome indices of 73% and 70% at baseline for control and intervention groups, respectively, indicates relatively high performance initially in this cohort, producing a possible ceiling effect (Stone, McKenzie, Welk, & Booth, 1998). As intervention volumes lower than eight hours have displayed limited efficacy for this outcome (Gray & Sproule, 2011; Harvey, Cushion, Wegis, et al., 2010; Miller, Christensen, Eather, Gray, et al., 2015; Turner & Martinek, 1992), greater intervention volumes and/or longer term follow-up measures of game skill execution are recommended.

Previous GCA investigations in a PE setting have established the active nature of involving learners in game play (Harvey, Song, Baek, & van der Mars, 2015; Miller, Christensen, et al., 2016; Miller, Christensen, Eather, Sproule, et al., 2015). Involvement in

activities that more closely represent the demands of completion play can only be seen as a positive, and small-sided games are recommended for the physiological development of field sport athletes (Hoffmann Jr et al., 2014). In this study, exposure to curriculum based on playing form activity led to intervention athletes undertaking physical activity of significantly higher intensity during training sessions. Whilst positive, this result must be treated with caution as each activity recorded included the time between activities (until the next activity started), not separating out down-time. Despite the intervention not having any focus on changing coach behaviour (e.g. reduction of down time), this is accepted as a limitation.

The goal of this intervention was to expose athletes to playing form activity, and support coaches to present coaching focused on motor skill and perceptual-cognitive improvement through a coach development program. This approach moves on from presenting coaches with curriculum and pedagogy within a traditional training model (Kennedy, 2005), instead working in-situ through the a mentoring model (Kennedy, 2005; Rhodes & Beneicke, 2003). This approach has displayed efficacy in a primary physical education context (Miller, Christensen, et al., 2016; Miller, Christensen, Eather, Sproule, et al., 2015; Miller, Eather, et al., 2016), and the short term efficacy displayed in the current

study is promising for the provision of higher quality coaching in a community sports setting.

The contribution of curriculum and coach development (including mentor involvement) to the overall effect cannot be determined within this research design, however, both are considered integral in the results. Minimum monitored curriculum completion was 75%. Completion level is likely affected by coach (e.g. session intensity, personality, focus on correctness vs variety), athlete (e.g. motivation, ability level), and environmental (e.g. weather) factors, with further study required to elucidate the effect of completion level on outcomes. With regard to coach education, we would suggest that presentation of playing form activity without coach education is unlikely to achieve large effects, as evidence within teacher development demonstrates poor implementation of a new model of instruction without adequate support to increase teacher knowledge and skill in the teaching of the new model (Ko, Wallhead, & Ward, 2006; Ward, 2013).

Practical implications

These findings have implications for the design of future research within a community coaching setting. It is important to note that the control group did display improvements in game play outcomes across the study period, however the group exposed to the intervention improved game-play outcomes at a faster rate (Figure 3). The design of this research

(inclusion of a control group) provides evidence for coaches to consider a shift in practice, and it is suggested that future research utilize a control group in order to provide rationale for a change in coaching behaviors through improvement of outcomes beyond standard practice. Further research designed to elucidate the effects of intervention components is recommended (e.g. multiple treatment conditions), and as a GCA is student centered, further investigation of the potential positives of using this approach (e.g. improved motivational climate, player retention and talent development) within community sports setting are recommended.

Limitations

Despite the novelty of this study, there are some limitations that should be noted. First, this was a pilot investigation, and thus the intervention period was relatively short and the sample size relatively small. Second, due to funding constraints, intervention fidelity was not recorded at all sessions, and occurred during the same curriculum session (session 3) in each phase of delivery, providing only a snapshot of overall intervention adherence. Third, as down time was not separated from the recording of activity type, the percentage and time spent in playing form activity among the intervention group is likely to be over-reported. Finally, the research design was not pertinent in determining to what extend the coach development program or exposure to playing form contributed to athlete outcomes, and

further investigation utilizing multiple age and skill matched groups and mediation analysis is suggested.

Conclusion

During this study, in comparison to a control group, decision making and support play improved at a significantly greater rate, and athletes performed at higher intensity levels during training sessions as a result of participating in curriculum focus on playing form activity, presented through a coach education program. In reference to Oslin and Mitchell (2006)'s question 'Can GCAs be used to transform community sport contexts?'; the results from this study cannot answer yes to this question, but form a valuable evidence-based starting point for further promotion of a GCA to contribute positively to the preparation of young athletes.

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