

Teachers' Pedagogical Content Knowledge and Students' Learning Outcomes in Ball Game Instruction

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Abstract

Pedagogical content knowledge (PCK) has particular relevance for understanding the factors that contribute to high-quality teaching behaviors. This study sought to explore the relationship between teachers' PCK and students' opportunities related to learning outcomes in primary school physical education (PE), during ball game instruction. Data were collected from five female, primary PE specialist teachers and 125 students from the participating teachers' classes. Teacher PCK aligned with higher-level curriculum/developmental outcomes, greater student enjoyment and engagement, and more effective feedback for students. This research highlights the importance of PCK in accessing students' opportunities related to learning outcomes and student learning.

Keywords: PCK, PE, teacher behaviors

Physical educators aim to provide children with the necessary skills to equip them for successful participation in lifelong physical activity (Trost, 2005). Furthermore, to motivate and engage students, physical education (PE) programs should be enjoyable and be tailored to meet student needs. For example, Tinning and colleagues (Tinning, Macdonald, Wright, & Hickey, 2001) outlined that high-quality teachers strive to make lessons meaningful, purposeful and enjoyable, as well as reflect on their own practice and the performance of their students. These elements of effective teaching are broadly captured by the notion of pedagogical content knowledge (PCK). PCK is defined as one's knowledge of how to teach specific content in specific contexts (Mellado, Blanco, & Ruiz, 1998), and Grossman (1990) identified four unique subcomponents. The first dimension of PCK relates to the teacher's knowledge about the purpose of teaching, which is reflected in a teacher's goals (Grossman, 1990). Second, PCK incorporates the teacher's knowledge of the students' understanding of the subject matter. In particular, teachers should be aware of what a student already knows, as well as having knowledge of the subject matter that is likely to be challenging and need development. The third element of PCK refers to the teacher's knowledge of instructional strategies for teaching specific topics, and the final part of Grossman's framework consists of the teacher's knowledge relating to curriculum content/materials, as well as knowledge of the specific content required for a given cohort.

Unfortunately, there is limited research into the relationship between PCK and the student experience and opportunities related to learning outcomes in PE. Whilst the term 'learning outcomes' can change according to the research focus; in this work learning outcomes denotes the behaviors, both general and lesson content related, and attitudes displayed by the students. In a recent unpublished PhD thesis, Insook (2011) reported that by enhancing PE teachers' PCK, through content knowledge focused workshops, students' learning outcomes, as measured by correct and incorrect

trials of skills and tactics during badminton performance, were improved. Previous to this work, Gusthardt and Sprigings (1989) analyzed the effect of teachers' PCK behaviors, concluding that expert teachers (i.e., those with high PCK) provide more opportunities for appropriate skill practice, resulting in student learning. However, much of the published research has evaluated PE teachers' confidence and motivation to teach PE in response to professional development aimed at enhancing PCK (Armour & Duncombe, 2004; Petrie, 2010). Moreover, whilst functional analysis has been used to evaluate PE teacher's PCK (Ayvazo & Ward, 2011), it is the teachers behaviors and the antecedents typically associated with those behaviors that are reported and not the impact of these teacher behaviors on the opportunities for students to engage with, and display, the desired learning outcomes. With this in mind, the overall purpose of this study was to examine PE teachers' PCK through the lens of Grossman's (1990) theoretical model and report opportunities for students to learn and display defined learning outcomes using a multifaceted research approach. That is, we sought to implement a group of data collection techniques that would allow insight into teachers' beliefs about the purpose of teaching, knowledge of students' understanding, knowledge of instructional strategies, knowledge of curriculum requirements and necessary content, and how these teachers effectively provided learning outcome opportunities for students during ball games.

Existing research into aspects of PCK in PE has provided support for the utility of this construct in terms of understanding teacher behavior and student experiences/learning (for a review, see Amade-Escot, 2000). For example, Hastie and Vlaisavljevic (1999) explored the relationship between Australian PE teachers' subject matter expertise and instructional strategies. These authors used interviews with teachers to ascertain teachers' level of experience and qualifications in relation to the varied sports being taught. In addition, they conducted observations of the teachers' behaviors and instructional practices during PE classes. Hastie and Vlaisavljevic concurred with Grossman (1990), noting that high PCK teachers displayed strong subject matter expertise. In addition to providing support for the role of PCK, Hastie and Vlaisavljevic's study underscored the importance of varied methodological approaches (e.g., observation, interview) for the accurate assessment of this concept. Further PE-based research has emphasized the significance of PCK for effective instruction (e.g., Rovegno, 1993; Tsangaridou, 2002), and the training of PCK has been discussed as a critical factor in the development of effective PE teachers (see Weigand, Bulger, & Mohr, 2004). Indeed, Weigand and colleagues noted that, "the acquisition of PCK represents the instructional backbone of a physical educator's professional preparation" (p. 52).

Gusthardt and Sprigings (1989) analyzed the effect of teachers' PCK behaviors on student learning. Data collection in their study comprised of videotaped lessons and the use of a systematic observation instrument over a three-week period. Analysis targeted

teacher dialogue, selection of tasks, opportunities to practice new skills, use of demonstration, and student attainment of learning outcomes. The authors concluded that expert teachers (i.e., those with high PCK) communicate clearly both the intent and nature of the task, and also provide sufficient opportunity for appropriate skill practice. In doing so, Gusthardt and Sprigings recommended that effective recording of teaching behaviors (e.g., PCK) requires consideration of the specific teaching environment that surrounds the teacher, and not just the teacher's behaviors in isolation. In line with this suggestion, it is important that researchers examining PCK adopt a multi-method approach that accounts for teacher behaviors alongside those of students. When designing the data collection procedures in this investigation, these existing findings and recommendations were used to underpin a variety of approaches, such as videotaping lessons, a systematic observation schedule, and analysis of teacher behaviors and dialogue. However, to date no investigations have attempted to use this diverse methodological approach in order to capture a global account of teacher PCK in its entirety and the impact that teachers' PCK has on the student experience and opportunities related to learning outcomes in PE. As a result, this study promises to provide insight into the way in which a group of PE teachers evidence PCK (relative to one another) and reflect on how this PCK impacts on student learning outcomes.

Methods

Participants

PE lessons were conducted by five female primary school teachers who declared themselves to be specialist PE teachers (i.e., were responsible for the planning, teaching, and assessment of PE); however, they possessed a variety of formal qualifications. Four of the five teachers held a specialist higher-education (i.e., university) qualification in PE. One remaining teacher held a general primary school Bachelor of Education qualification. The teachers had between three and 10 years of PE teaching experience (8.4 years average). One hundred and twenty five primary school students (representing five classes, one per teacher) also participated in the project, ranging in age from nine to 13 years old. The schools represented were drawn from the western part of Australia. Each participating class consisted of an average of 25 students (range 20-31), and PE lessons were conducted on an outdoor, grassed sports field. Lessons lasted an average of 39 minutes (range 27 to 47 minutes).

Data Collection and Procedure

Ethical approval for the investigation was obtained from the authors' institution prior to collecting data. The school principal, teachers, parents and students provided informed consent before the study began. The research design employed a multi-faceted approach to develop an in-depth understanding of teacher and student behaviors. Data were collected via field observations, interviews, questionnaires, activity analyses, and voice analyses. All observed lessons were videotaped using a digital video camera. As previously indicated, each data collection procedure was selected in order to provide evidence of (at least one aspect of) PCK.

Teacher data collection and analysis.

Teacher values. The Value Orientation Index-2 (VOI-2; Ennis & Chen, 1995) was employed to identify teachers' beliefs about and priorities for PE curriculum decisions. In this investigation, the VOI-2 was used to provide evidence relating to teachers' knowledge and beliefs about the purpose of teaching. The VOI-2 is a 90-item instrument, and each item reflects goals and objectives for PE within one of five broad orientations. The five orientations are discipline mastery (i.e., knowledge and mastery of skills), learning process (i.e., learning movements and processes), ecological integration (i.e., student needs and growth), self-actualization (i.e., integrating student needs with their environment), and social responsibility (i.e., focusing on social interaction and cooperation). Teachers were asked to rank statements reflecting each of the five orientations using a five point Likert-type scale, anchored at 1 (*strongly disagree*) and 5 (*strongly agree*). In line with previous research (Lockhart & Whipp, 2010), minor modifications were made to the terminology of the original VOI-2 in order to suit the respondents in this study (i.e., the term 'kinesiology' was replaced with 'human movement'). After completing the VOI-2, a profile for each teacher was created.

To assist with inferences regarding evidence of PCK (or a lack thereof) displayed by teachers in this investigation, the raw VOI-2 (Ennis & Chen, 1995) data from the five participating teachers were inserted into the data set constructed by Lockhart and Whipp (2010), and were converted into z-scores for each VO domain. This enabled the results from this small sample to be standardized against those from an existing comparable population. Standardized z-scores >1.0 were considered to represent a high value priority, and z-scores <-1.0 were considered to represent a low priority. A teacher needed to rank an item consistently high or low to achieve a high or low priority for the domain.

Teacher behavior. A combination of qualitative and quantitative approaches were used to gather observational data using the modified observation schedule designed by Whipp et al. (2006). The observation schedule data were gathered to detail lesson time allocation, teaching style (Mosston & Ashworth, 2002), activity focus, student behavior, and state-defined curriculum framework student outcomes (Curriculum Council, 1998). One key component of this investigation was to document the extent to which teachers evidenced PCK relative to one another, via the opportunities for learning they provided, in line with stated recommendations in the local curriculum framework (Curriculum Council). Curriculum frameworks vary across educational boundaries, and so it is important to outline the five overarching curriculum guidelines under observation in this study. First, within *knowledge* and *understanding*, PE classes are expected to provide health-promotion information, relating to physical activity, sports, diet, disease prevention, and the various factors that may shape physical development. *Skills for physical activity* reflects the provision of fundamental movement skills of locomotion, body management, and object control in free and structured settings, achieved through incremental skill practice using independent, paired, and team-based activities. The third PE curriculum requirement is termed *self-management skills*, and reflects the use of sports and physical activity (PA) in order to refine decision-making skills, raise awareness of the consequences of one's actions, set effective

goals, manage stress, and understand appropriate physical activity levels. Fourth, *interpersonal skills* focuses on the way in which PE classes should help develop communication, cooperation, conflict resolution, and empathy through the adoption of roles during class (e.g., participant, leader, player, coach). Finally, *attitudes* and *values* centers on recognizing the value of hard work, physical activity, fair play, teamwork, as well as social and moral responsibility, and respecting and including others.

The various methods used for data collection were chosen to enable evidence of PCK in PE teaching. Figure 1 outlines how the various aspects of Grossman's conceptual model were evaluated in this investigation. An insight into teachers' knowledge of (a) the purpose of teaching was obtained via interviews and value orientation questionnaires, (b) student understanding was provided by interview and various forms of behavioral data, (c) curriculum content was derived from interview, questionnaire, demographic, and instructional data, and (d) instructional strategies was obtained via examination of teaching style, dialogue, and lesson time allocation.

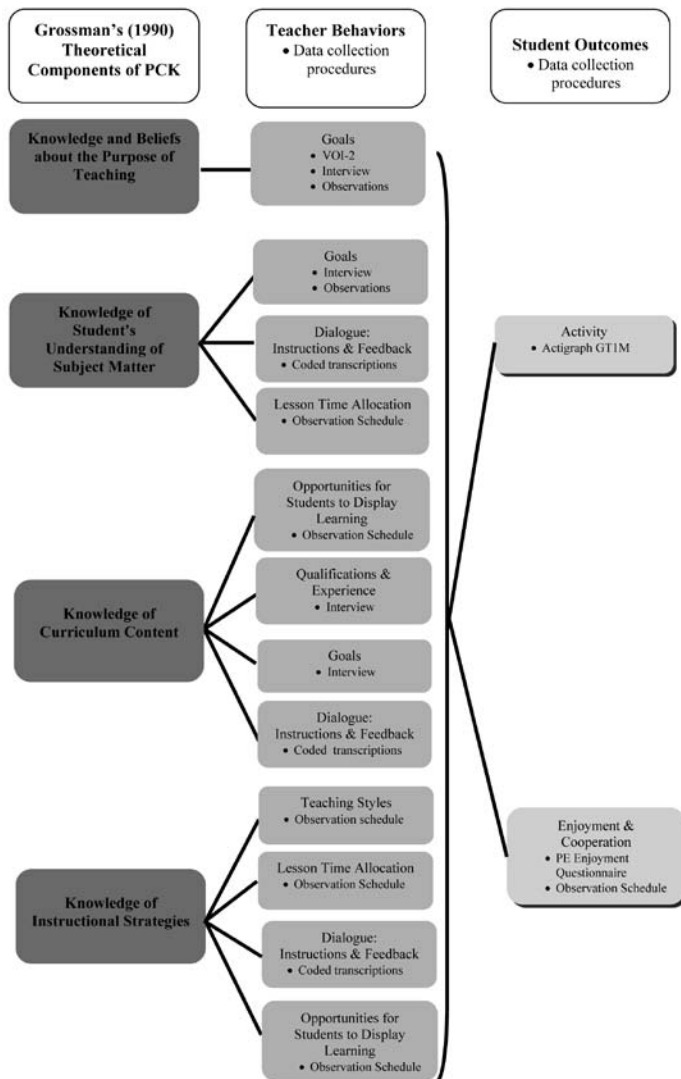


Figure 1. Grossman's (1990) theoretical framework and data collection procedures

In terms of students' understanding, observations were made in line with the extent to which teachers provided students with the opportunity for high-level (versus basic) attainment on the curriculum objectives (e.g., skills for physical activity, knowledge and understanding, etc). To ensure objectivity and a consistent approach to the observations, the schedule was designed using both duration and interval recording techniques. Duration recording techniques were used to measure the time spent on different activities and the different teaching styles demonstrated. In line with Mosston and Ashworth's (2002) framework, teaching styles were coded as either (a) command (i.e., teacher makes decisions and instructs), (b) practice (i.e., tasks prescribed by teacher, but student sets pace, rhythm, etc.), (c) reciprocal (i.e., students act as observers and participants, providing feedback), (d) self-check (i.e., learners self-assess using consistent criteria), (e) inclusion (i.e., student chooses level of performance based on ability), (f) guided discovery (i.e., students progressively solve a series of stages/problems), (g) divergent (i.e., various strategies to overcoming a problem are encouraged), or (h) individual program (i.e., individualized program developed by each student).

Interval recording techniques, on the other hand, were used to record representative behaviors during the class for target students and whole class. An audiotape was used which prompted the researcher (with a beep) to make systematic observations at regularly timed intervals. Interpretation of the observations was made on the basis of the expertise of the observer. Each teacher was observed on four occasions within one school term (approximately 10 weeks). The researcher, also first author, adopted a role of non-participatory observer. In an attempt to maximize consistency across subject matter, teachers were asked to select a ball sport to be the focus of their teaching for the observed lessons, and at the close of the lesson each teacher was asked to confirm that their behavior during the lesson had matched their 'standard' behavior when not under observation.

Teacher dialogue. A digital voice recorder was attached to the arm of the PE teacher prior to the commencement of each observed lesson. The digital voice recorder tracked all teacher verbalizations for the entire lesson, and data were used to provide evidence relating to three of Grossman's (1990) PCK components; knowledge of students' understanding of subject matter, knowledge of curriculum content, and knowledge of instructional strategies. At the completion of the lesson, the voice recorder was removed and data were downloaded and transcribed verbatim. The transcription was analyzed by coding each comment made by the teacher into categories based on (a) value feedback (i.e., either positive or negative judgements), (b) corrective feedback (i.e., correction in task related behavior), (c) neutral feedback (i.e., an acknowledgement without judgement), (d) ambiguous feedback (i.e., statements from teachers that may have been misinterpreted by students), (e) learning-focused instructions, and (f) classroom management-focused instructions. The transcriptions were content analyzed and coded into similar categories by the first author. To ensure reliability and rigour in coding, a piloting process was followed, which involved an independent experienced researcher (external to the author team) coding a lesson transcript. This external report was then compared with the researcher's coded transcript and 100% agreement in coding was achieved.

Furthermore, the independent experienced researcher provided ongoing confirmation of the coding process by repeating the audit process on two additional occasions.

In order for comparison to be made across lessons and between teachers, the total number as well as the percentage of words spoken in each instruction and feedback category was calculated.

Teacher interviews. Each teacher was interviewed at the conclusion of the observed lessons. All interviews were audiotaped using an unobtrusive digital voice recorder with additional written supplementary notes documented concurrently to assist with further questioning. The original semi-structured interview guide was developed in consultation with two academic staff members who were experienced in conducting interviews and were familiar with the PCK literature. Prior to collecting data, the interview guide was piloted with a non-participant primary PE teacher and questions were added to enable teachers to also comment on the impact of the support they received from their school. In the final interview schedule, opinions were sought regarding various aspects of teaching (with consideration to the ball sport observed in the lessons), including teachers' perceived level of comfort teaching the sport, their personal and professional background in the sport, their rating of their PE teaching expertise, any changes they would like to make to their teaching, the barriers that prevented them from instructing in an 'ideal' way, the support gained from school community, and the basis for their programming (e.g., decisions based on carnivals, student interest, school priorities, etc). On average, interviews lasted for approximately 15 minutes. The first author became familiar with the data by repeatedly reading the transcripts and listening to the audiotapes. The audiotapes were subsequently transcribed verbatim and processed through open, axial, and selective coding (Burns, 1997). Open coding was used to select, identify, and label categories as part of the data analysis. Axial coding techniques were employed to understand and explain the relationship between the categories and their relationship to the teacher's PCK. Subsequently, selective coding validated the initial conclusions and further refined the themes. Transcripts were analyzed deductively for themes pertaining to support received for teaching PE, and for three of Grossman's (1990) PCK domains; knowledge and beliefs about the purpose of teaching, knowledge of students' understanding of subject matter, and knowledge of curriculum content. Two researchers with experience in PCK cross-validated the lead author's analysis by reading and independently coding a sample of meaning units. Specifically, the first author presented themes and meaning units to researchers for comparisons to be made with the original researcher's coding, and any areas of disagreement were resolved through re-analysis and group discussion. This process ensured that all meaning units were grouped under appropriate themes, and allowed for consensus between researchers regarding the meaning of participants' responses.

Student data collection and analysis.

Student behaviors. The following data collection procedure was used to evidence student engagement in the learning activities. Using the modified observation schedule designed by Whipp et al. (2006), each target student (n=20 students, all of average ability and participation as determined by the participating PE teacher)

was observed for a period of 10 seconds, once every four minutes. Observations were made for on-task or off-task behavior consistent with Rink's (2002) definition of ALT-PE, with recordings made of the type of behavior (e.g., on-task, off-task, waiting, motor appropriate or inappropriate, transition, and instruction). The whole class was also observed every fourth minute, scanning students once only from left to right, to determine what proportion of the class were engaged in on- or off-task behaviors listed above. Validation of the live-class observations to code behaviors was made with post-lesson video review. All student behavior data were summed for each category and are presented as percentages of the total time of the lesson.

Student activity levels. Accelerometers (i.e., ActiGraph GT1M) were used to indicate student activity levels and intensity. High correlations between activity counts, activity energy expenditure, and heart rate have demonstrated that ActiGraph accelerometer data align closely with energy expended in activity (Puyau, Adolph, Vohra, & Butte, 2002). Teachers were asked to select 4 students (2 boys and 2 girls) who were representative of class average ability and participation to wear accelerometers, and units were placed on these students for each observed lesson. Physical activity levels were presented as mean counts, and were also split according to the amount of time spent working at a given intensity. Age-specific intensity thresholds were determined via the use of calibration studies that relate accelerometer counts to measured activity expenditure (Troiano et al., 2008). Prior to each observed lesson, accelerometers were preset to record activity counts in 15-second epochs. The data from each monitor was downloaded into Microsoft Excel, using the Actigraph GT1M software. Age specific cut points were used to classify the activity intensity as low, moderate or vigorous as specified in the Freedson child equation (2005). The amount of time spent in each of these activity intensities was calculated. In addition, total activity counts, mean activity counts, peak counts and total epochs were calculated after each observed lesson for each student.

PE enjoyment. A modified version of the PE enjoyment questionnaire constructed by Hashim, Grove, and Whipp (2008a) was used to assess six domains of PE enjoyment; these being, self-referent competency, other-referent competency, teacher-generated excitement, activity-generated excitement, peer interaction, and parental encouragement. Two items from the instrument directly related to student enjoyment. These were item numbers 11 (PE is fun) and 18 (I enjoy PE very much).

Given that students in this study (9 – 13 years) were younger than those used in developing the original instrument (i.e., 12 – 16 years), piloting was undertaken to confirm comprehension with a sample of 15 students from one of the participant schools (aged 9 – 11 years). Specifically, changes were made throughout the piloting process to ensure that all items were relevant and easily comprehensible for all students and included the original statement of 'My PE teacher is **helpful** and **friendly** during PE classes' being separated into two statements 'My PE teacher is helpful during PE classes'. The original statement; 'Compared to **last term**, I am getting better at PE activities' was changed to 'Compared to **last year**, I am getting better at PE activities'. A five-point scale anchored at 1 (strongly disagree) and 5 (strongly agree) was used, and has been shown to demonstrate adequate validity and reliability

in previous studies (e.g., Hashim et al., 2008b). The questionnaire served to evaluate multiple processes of enjoyment related to PE through the use of a relatively brief assessment instrument (20 minutes). The lead author was present during questionnaire completion in order to assist students with their responses where necessary. The six teaching processes related to PE enjoyment were calculated by determining the mean score for the domain-specific clustered questions.

Results

The multi-faceted methodological approach in this study allowed insight into an array of PCK-related teacher behaviors and student outcomes. Prior to presenting our findings, it is important to reiterate that our conclusions regarding ‘evidence’ of PCK are not absolute judgments, rather they are inferences based on PCK displayed relative to the other teachers recruited in this study. In the following sections, we outline the different ways in which this data collection method (with teachers and students) enabled judgements to be made regarding the extent to which teachers evidenced PCK.

Teacher Data

Goals. Goal setting was classified as either long-term or short-term (i.e., the specific lesson). Evidence relating to goals was gathered from interviews as well as voice data. Evidence of high levels of communication with students regarding short-term goals appeared for those teachers who displayed evidence of PCK. PCK was further evidenced by the teacher demonstrating an awareness of her knowledge of curriculum content and the skill level of the students. This display of expertise resulted in the students immediately gaining an understanding of specific plans and goals for each lesson. On the other hand, a relative lack of PCK was associated with a failure to communicate lesson-specific, short-term goals.

With respect to long-term goals, all teachers displayed an awareness of the importance of these targets in their interviews. Preparation for school sports carnivals and exposure to a variety of sports was consistently identified as a fundamental PE program goal. In contrast, the teachers’ Value Orientation Index-2 (VOI-2; Ennis & Chen, 1995) profiles confirmed evidence of divergence in the teachers’ broad goals. Four of the teachers professed a high priority for discipline mastery; however, two of these teachers also gave equal priority to social responsibility. One teacher indicated a high priority for learning process. Three of the four teachers who professed a high priority for discipline mastery delivered lessons that were consistent with this values profile. Extensive corrective feedback, demonstrations and effective skills practice were evidence of teaching within the discipline mastery framework. The practice teaching style exclusively employed by these teachers was symptomatic of teachers who seek discipline mastery outcomes. When there was a high level of consistency between teachers’ stated values, (interview and VOI-2) and their actual teaching behavior, this was deemed to evidence PCK; that is, these teachers were sufficiently knowledgeable and skilled to put their values ‘into practice’. On the reverse, the two teachers who professed an equal priority for discipline mastery and social responsibility, and for the teacher who had a high priority for learning process

were unable to access these learning outcomes in their lessons. A lack of PCK was inferred for the teachers whose values were not reflected in their instruction and behavioral actions, and who did not provide a pre- or post-lesson account as to why the lesson may have not been commensurate with their pre-determined values.

Dialogue.

Instructions. Verbal instructions accounted for approximately three-quarters of total words spoken (i.e., 73.46%, on average). Learning instructions directly associated with skills, strategies, and rules accounted for an average of 38.59% (range = 21.06% – 46.87%) of total words spoken of all study participants. Management instructions (i.e., class business not related to instruction) accounted for an average of 34.87% (range = 27.99% – 52.83%) of total words spoken by the study participants. All but one teacher delivered more learning than management instructions (Figure 2).

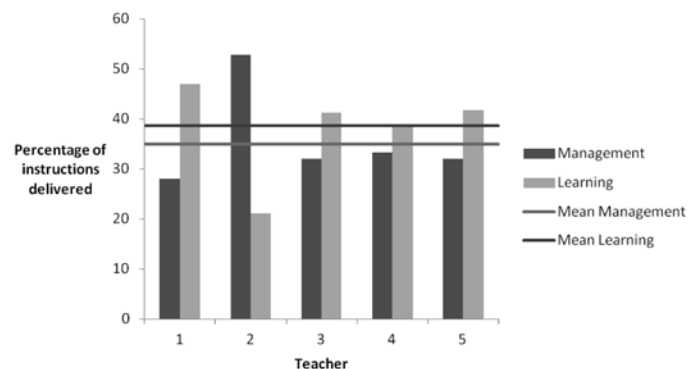


Figure 2. Mean percentage of learning and management instructions delivered (of total words spoken). Mean learning instructions = 38.59%, mean management instructions = 34.87%

PCK was evidenced by the delivery of instructions that focused on a particular skill, rule or strategy (i.e., learning instruction). In these cases, instructions were delivered in a manner that displayed an awareness of the readiness of the students, and teachers also ensured that they had the attention of the students before delivering their instructions. In addition, teachers who evidenced PCK supported learning instructions with either student or teacher demonstration, and checked for understanding via the use of questioning as part of the instruction. Whilst teachers delivered a relatively large quantity of learning instructions, PCK was evidenced when the instructions were deemed to enhance the learning opportunities for the students and realised a student response of making an effort to modify their performance to reflect the learning instructions given by the teacher (video footage).

Feedback. Feedback strategies accounted for approximately one quarter of the total words spoken (26.38%, on average). In particular, the use of corrective and value-based feedback was most indicative of PCK. PCK was evidenced by teachers identifying errors and providing corrective feedback that was presented in a manner that displayed an awareness of the cognitive, physical, and developmental needs of the students. In addition, when providing corrective feedback, these teachers also displayed an understanding of how children learn, for example one teacher commented to the class, “I shouldn’t see all five team members here because once

the balls gone they can just lob it into the keyway. Ok, think about positioning. Pass it in. That's the way. Push it up. Ok, down and set up." Teachers who evidenced PCK in this sample also provided value-based feedback where necessary; however, there was considerably more verbal dialogue allocated to corrective than value-based feedback. On average, the teachers delivered 15.37% (range = 9.12% – 20.93%) of corrective feedback and 6.18% (range = 1.99% – 13.47%) of value-based feedback.

To provide feedback, a teacher needs to be able to identify the error, as well as how to fix it and then communicate this to the student in an assuring and motivating manner (Silverman & Ennis, 1996). A lack of corrective feedback delivered was inferred to evidence an absence of PCK. For example, two teachers who did not evidence PCK gave corrective feedback that consisted of comments such as "go and defend" without actually giving the student feedback to detail how she should defend. The limited corrective feedback provided to the students further reduced opportunities for students to acquire and develop the necessary skills, rules and strategies.

Teaching styles. All teaching was observed within the context of Mosston and Ashworth's spectrum of teaching styles (2002) using the modified observation schedule (Whipp et al., 2006). Of the lessons observed, the teacher-centered practice style of teaching predominated with virtually no student-centered pedagogy employed. Four of the teachers identified discipline mastery as a high priority in their value orientation. The practice teaching style employed by these teachers was symptomatic of teachers who seek discipline mastery outcomes. However, for the two teachers who professed a high priority for social responsibility, and for the teacher who had a high priority for learning process, a teacher-centered practice style appears incongruent with accessing these affective learning outcomes.

Lesson time allocation. As Figure 3 illustrates, only two teachers allocated more than 50% of their lesson time to activity, with the remaining time comprising transition as well as instruction and management. PCK was evidenced by teachers allocating the highest percentage of lesson time for activity and the least to transition. When the management and instruction data were examined further (Figure 2), it appeared that teachers delivered considerably more instructions focused on learning than management. Conversely, PCK was not evidenced when a low percentage of lesson time was allocated to activity, alongside a high percentage of lesson time allocated to transition. Moreover, these teachers delivered considerably more management focused instructions and fewer learning focused instructions when compared to all other participating teachers. Therefore, the students in these classes were provided with less time to practice and develop skills. In addition, they spent more time moving between activities and organising students and equipment than the other teachers who displayed PCK. As a result, students under the control of teachers who did not evidence PCK were provided with fewer opportunities for skill development, activity engagement, and enjoyment. The impact of lesson time allocation on PCK lies in the minimization of transition and management instructions, coupled with maximizing opportunities for activity and learning instructions.

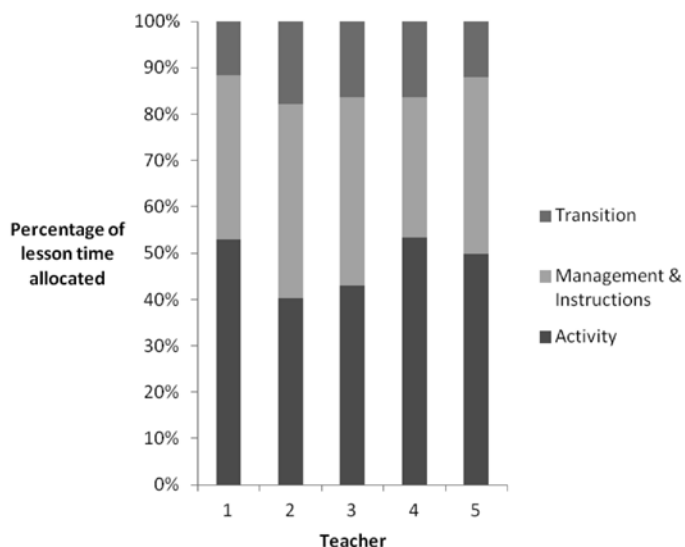


Figure 3. Mean percentage of lesson time allocated

Opportunities to display learning. Evidence of opportunities provided for students to display learning was gained from observations of the implementation of the local curriculum guidelines (Curriculum Council, 1998). Within these guidelines, the vast majority of teaching focused on Skills for Physical Activity (SPA). All teachers provided opportunities for students to learn and display SPA at a fundamental level; however, evidence of PCK was illustrated by providing opportunities for higher level SPA attainment. This could be explained by the corrective feedback provided to the students and effective delivery of instructions that displayed an awareness of the developmental needs of the students. Almost all students who were under the direction of teachers who failed to evidence PCK displayed only basic SPA. Teachers who evidenced PCK provided more opportunities for higher SPA student outcome attainment than teachers who do not evidence PCK.

Student Data

Activity levels. On average, teachers allocated 47.68% (range = 39.86% – 52.99%) of lesson time to opportunities for students to be active. Accelerometer data indicated that students were engaged in moderate to vigorous levels of physical activity (MVPA) for 32.16% (range = 21.07% – 39.74%) of the lesson time. However, lower intensity exercise (or no activity at all) accounted for the remaining 67.83% of lesson time. When overall activity counts were examined, it appeared that the teachers who did not evidence PCK achieved the highest activity counts. These teachers stopped the lesson or individual students less frequently when compared with the teachers who did evidence PCK. Comparing these findings with those reported for lesson time allocation, it appeared that although teachers who evidenced PCK allocated greater time to activity; this did not translate into higher activity counts for students (i.e., accelerometer data). For those teachers who did not evidence PCK, despite allocating less time to activity, students accumulated higher activity levels.

Enjoyment. The mean PE enjoyment of all study participants was 4.61 (range= 4.3 – 4.79), and the facets of 'teacher generated

excitement' ($M = 4.44$, range = 4.23 – 4.78) and 'activity generated excitement' ($M = 4.30$, range = 4.11 – 4.58) were relatively high when compared to a study of older students (Hashim et al., 2008b). The relatively highest student enjoyment results were gained by the teachers who evidenced PCK in their teaching. Conversely, the students of the teachers who did not evidence PCK in their teaching were observed to be non-compliant during observations. One of these teachers delivered considerably more discipline focused feedback to the students than any other teachers (8% of total words spoken, mean of all study participants = 2.38%). In addition, these students demonstrated the lowest scores for PE enjoyment (PE enjoyment = 4.3, mean of all study participants = 4.61). It is impossible to state the exact cause of the non-compliant student behavior and lower levels of student enjoyment. However, it is interesting to note that this teacher largely failed to evidence PCK.

Discussion

The purpose of this study was to employ a multi-faceted approach to explore, using Grossman's (1990) theoretical framework, the relationship between teachers' PCK and students' opportunities related to learning outcomes in primary school physical education (PE), during ball game instruction. This project permitted a detailed analysis of PE and in turn, inferences were made regarding the extent to which each teacher evidenced PCK and how PCK aligned with student outcomes.

Teacher Behaviors Not Incorporated in Grossman's (1990) PCK Framework

Through the data collection and analysis, it was apparent that whilst many elements of PCK clearly related to Grossman's (1990) theoretical framework of PCK, there were other elements that did not appear to be associated with the existing PCK framework. Of the eight broad student and teacher behaviors observed, it was established that five clearly related to PCK, whilst three did not, namely qualifications, teaching styles, and students' activity levels. The qualifications and experience of the teachers in this investigation did not correlate with PCK. That is, the single teacher who did not possess a formal PE-specific qualification did evidence PCK relative to the other (formally qualified) teachers. Although experience has been shown to relate positively to PCK in the past (see Amade-Escot, 2002), the findings in this study are potentially due to the teachers all having at least three years teaching experience (i.e., no newly qualified teachers were recruited), as well as the lack of diversity in terms of qualifications held by the teachers (i.e., no non-specialists were recruited), and the relatively small sample size in this study.

The teaching styles that were observed also did not appear to discriminate between those who possessed PCK, in as much as the teachers exclusively implemented practice styles of teaching. There was a distinct absence of student-centred pedagogy that are seen to promote cognitive processes as well as being more inclusive and enjoyable such as that of guided discovery (Light & Georgakis, 2007; Siedentop, Herkowitz & Rink, 1984).

When overall activity counts were examined, students in the classes with teachers who did not display PCK achieved the highest levels of activity. This could be explained by the relatively low

amounts of effective learning instructions and feedback delivered. Moreover, student activity data also indicated that overall activity intensity in the PE lessons was relatively low, with students, on average, engaged in MVPA for less than one-third of lesson time. From the data gathered, there appeared to be a negative association between the quantity of corrective feedback given and the activity intensity. That is, teachers who evidenced PCK displayed a greater amount of corrective feedback, limiting the amount of MVPA displayed by their students. Intuitively, this finding – that 'lower quality' instruction aligned with greater student physical activity – may appear somewhat paradoxical. However, if PE teachers seek to enhance students movement skills, favourable attitudes towards sport and physical activity, and high-level knowledge of sport and activity that can be retained over time (rather than simply making students as active as possible), then greater feedback and corrective instruction is clearly warranted (Grossman, 1990; Rink, 2002).

Teacher Behaviors that Aligned with Grossman's (1990) PCK Framework

Five broad categories of outcomes did appear to be successful in discriminating evidence of teacher PCK. First, the devising and communication of goals was indicative of teacher PCK. PCK was evidenced in the development and communication of clear, long-term and short-term goals for students. In addition, teachers who evidenced PCK appeared to teach consistently with their Value Orientation (VO) profile. A lack of evidence for PCK was apparent when teachers displayed limited goal setting and did not represent their VO profile in their teaching (or account for any discrepancies). Second, with respect to dialogue, teachers evidenced PCK by delivering clear and relevant instructions that focused on the needs of the students. This concurs with the work of Gusthardt and Sprigings (1989) who established that when teachers explain to students what they are expected to learn, and demonstrate the steps needed to achieve this outcome; students are able to learn more effectively. With teachers who evidenced PCK, it appeared that their teaching behavior was consistent with the work of Rink and Hall (2008), who postulated that successful instruction explicitly targets the positive behaviors that the teacher wishes to develop. Furthermore, consistent with the work of Grossman (1990), through their delivery of these instructions, teachers who evidenced PCK utilized a variety of activities, although they were limited within the practice style, to clearly demonstrate their understanding of the student's abilities and the curriculum content. The teachers who evidenced PCK also provided greater amounts of corrective feedback, which was associated with increased opportunities for the students to display SPA outcomes. A lack of evidence of PCK, on the other hand, was associated with the delivery of fewer skill- and corrective-based instructions, in favour of increased management-related instructions. In short, teachers who evidenced PCK were able to provide additional verbal support to students, representative of stronger contextual knowledge and understanding. The data collected from these teachers concurs with the work of Silverman and Ennis (1996), who explained that feedback is capable of improving learning if the feedback is assuring, motivating and results in the student making changes to what they are doing.

Lesson time allocation was a third component that did relate to Grossman's theoretical framework for PCK. Teachers who evidenced PCK maximized time allocated to activity, whilst minimizing time allocated to transition between activities as well as management and instructions. Conversely, teachers with relatively limited evidence of PCK allocated their lesson time in an inverse manner (i.e., more management and transition at the expense of activity). Fourth, it was noteworthy that the lowest enjoyment scores were obtained for students of the teacher who demonstrated a relative absence of PCK. These students also received the highest amount of discipline feedback. Conversely, the students of the teachers with evidence of PCK reported the highest enjoyment scores, least discipline feedback, and the most learning instructions when compared to the other learning contexts observed. When the student enjoyment data gathered is compared with the results obtained by Hashim et al, (2008b) it can be concluded that the students in this project appeared to enjoy PE more than the students aged 12 – 16 years of age.

All teachers, regardless of their PCK, provided opportunities for the students to achieve basic-level curriculum framework outcomes. However, teachers who evidenced PCK through the delivery of effective instructions, frequent corrective feedback and structured opportunities to practice facilitated student attainment of more intricate and higher-level outcomes. These teachers were also able to provide students with opportunities to maximize learning outcomes. Researchers have outlined the importance of the primary school PE environment in equipping children with important social interaction skills (Bouffard, et al., 1996) as well as essential fundamental movement skills necessary for participation in future PA (Blanksby & Whipp, 2004; Maeda & Murata, 2004; Morgan, 2005). Given that PCK was associated with higher-level curriculum/developmental outcomes, greater student enjoyment and engagement, and more effective feedback for students, this research highlights the importance of PCK in accessing students' opportunities related to student learning outcomes.

Future Research and Conclusions

PCK is a broad, multi-dimensional concept that is difficult to adequately examine in field settings. Whilst using Grossman's (1990) conceptual model the findings indicated some observed lesson elements were more consistently related to PCK than others. It is important to acknowledge that although we made inferences regarding teachers' relative PCK, we did not control for the ability or behavior of students when making these judgements. It is possible that our decisions regarding PCK may have rested, in part, upon the extent to which the respective classes (i.e., students) under the control of each teacher displayed differences in readiness and interest levels. Future research that accounts for student characteristics when judging teacher PCK and its impact of student outcomes is encouraged. For instance, observations of teacher behavior may be more insightful when they are observed teaching a range of different classes at various developmental/skill levels. In future, research would also be worthwhile that seeks to refine the complex nature of Grossman's (1990) framework. In particular, this could be achieved by placing the elements of the framework in a hierarchical arrangement in order to determine the relative influence of each component. By determining the

significance of each element of PCK, researchers may be able to construct a single global tool for measuring PCK. This tool may ultimately assist in the identification of key quantifiable components of PCK that account for significant variation in student outcomes. The sample size in this investigation was modest and a limitation of the study. Therefore, in order to further investigate the importance of PCK a similar study should be undertaken with a larger sample size. Nonetheless, the primary contribution of this study lies in the diverse methodological techniques that were employed in order to concurrently examine numerous aspects of PCK and opportunities for students to engage with, and display, the desired learning outcomes. With that in mind, this investigation presents a comprehensive and novel approach for the assessment of a construct that may be highly important in primary school settings and beyond.

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