EXPLORING THE PEDAGOGICAL CONTENT KNOWLEDGE OF EFFECTIVE TEACHERS IN PHYSICAL EDUCATION

DISSERTATION

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By

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Pedagogical Content Knowledge (PCK) is the blending of content knowledge and pedagogical knowledge for the purpose of teaching in ways that are comprehensible for learners. Although PCK was initially termed by Shulman in 1986, it has never been operationally defined. This study was based on two primary assumptions: (a) Pedagogical Content Knowledge can be predicted by a set of operational variables, and (b) the conceptualization that PCK develops on a continuum from one end to another, from immature to mature forms of PCK. The purpose of the current investigation was to: (a) test a proposed operational definition of PCK, and (b) to examine how the PCK of experienced teachers differ in the teaching of their stronger and weaker units of instruction. The study was a descriptive investigation based on the behavior analytic theoretical framework. The investigation was organized into three phases. Phases 1 and 2 included a focus group and individual interviews to (a) gain initial understanding on the teachers’ learning history relative to PCK; (b) identify possible contingencies the teachers’ behavior is operating under, that cannot be found by observing the immediate teaching context; and (c) discover variables related to PCK that could be observed during teaching. Phase 3 employed direct observation of two elementary physical education teachers delivering two instructional units that they identified as their stronger and
weaker instructional units. The following variables were measured: types and sequence of
tasks, instructional forms used, recipient of tasks, type and number of cues used,
antecedents for task modification, type of adaptations, appropriateness of individual
adaptations and appropriateness of tasks delivered to the entire class. The results
demonstrated differences between the stronger and weaker unit of instruction for one of
the teachers. The differences consistently illustrated more depth of CK and more mature
PCK displayed in the strong unit of instruction. For the other teacher, the difference
between the stronger and weaker units of instruction was variable. Some variables (e.g.,
types of tasks, instructional forms, and appropriateness of modified tasks) supported
richer CK and more mature PCK in the strong unit of instruction; other variables (e.g.,
cues used, and antecedents for modifying tasks) indicated richer CK and more mature
PCK in the weaker unit. The overall CK and PCK levels of the second teacher were
similar in both units. This study contributed to the literature in three ways. Conceptually,
this study examined and validated an operational and functional definition for PCK. It
also validated the development of PCK on a continuum from an immature to more mature
forms. Methodologically, this study investigated PCK utilizing a behavioral
methodology, which was substantially different than previous research that has relied
primarily on qualitative descriptions to determine PCK. In contrast, this study used
operational variables that were directly observable and measurable. Finally, acquisition of
proficient CK was found to be vital for the acquisition of PCK, and can and should be a
primary focus of Physical Education Teacher Education Programs (PETE). Other
practical recommendations were made for PETE for improving the teaching and
acquisition of PCK.
Dedicated to my beloved family
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Hebrew translation of my acknowledgment to my family:

לבסוף. אני רוצה להודות מקרוב ללב שלי להוריה, לאהותי מאיה, ולאחים
אבר. כלכם יהיו כן בשוב, 벌크, אלפים מל, אך זה צמ זד קרבם אף, הברינש של שמחה או
במות נפש, פאש הר_$קוה למס זור משל. אריא אמא, אתה נטעפת את הבסיס הזקוק של תあと.
למאמר אוורט זרכים ואוהב לאל נים, אווי פורר$ת הרות עמו, הרות של שיעורכם ללהים או
והם. אני אוהבת את כלכם לאין שעור.
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PUBLICATIONS


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CHAPTER 1

INTRODUCTION

Pedagogical Content Knowledge (PCK) was originally proposed by Shulman (1986) as the amalgam of content knowledge (CK) and general pedagogical knowledge that is represented in a comprehensible fashion that facilitates students' understanding. Since then, PCK has been widely referenced by the educational community (Bullough, 2001; Loughran, Milroy, Berry, Gunstone, & Mulhall, 2001; Marks, 1990; Segall, 2004). From 1986 through 1990, the concept of PCK was modified and refined in the following ways (Grossman, 1990; Gudmundsdottir & Shulman, 1987; Mark, 1990; Shulman, 1986, 1987). In 1987, Shulman situated PCK as one of seven knowledge domains required for teaching: CK, PCK, curricular knowledge, general pedagogical knowledge, knowledge of learners, context of schooling, and knowledge of educational ends. Gudmundsdottir and Shulman (1987), and Marks (1990), argued that PCK is derived from three knowledge domains: CK, pedagogical knowledge, and knowledge of the learner or from previous PCK. Grossman (1990) differed in her view of PCK and argued that PCK is derived from the following four knowledge domains: conceptions and purposes of teaching, knowledge
of students’ understanding, curricular knowledge, and knowledge of instructional strategies.

Today, 20 years after the postulation of PCK, there is still great uncertainty as to what PCK really is. The interpretation of PCK is diverse: some researchers have viewed PCK as a cognitive construct that involves the blending of several domains of knowledge into a new general knowledge domain (Loughran et al., 2001). Other researchers have viewed PCK as the blending of pedagogy and content that is used in particular ways in specific contexts (Loughran et al., 2001). The educational field is still at the descriptive phase of the inquiry of PCK. In general education, inquiry into PCK has used methods such as interviews, concept mapping and other questioning methods termed inferential techniques to better understand PCK. These studies have often concluded in recommendations about PCK based on high inference interpretations, rather than recommendations about what one should do about PCK, as directly derived from low inference data (Loughran et al., 2001; Loughran, Mulhall, & Berry, 2004).

For example, Penso (2002) measured preservice biology teachers’ ability to capture students’ difficulties through the use of written diaries. Penso (2002) found that the teachers’ identification of students’ difficulties was low. Additionally, the preservice teacher’s assumption relative to the reasons for the difficulties exhibited by their students was examined for validity or reliability. Penso (2002) asserted that knowledge of the learners is an important characteristic of PCK and therefore recommended the use of didactic processes such as written diaries of observations on students’ learning and difficulties in teacher education programs. The recommendation of such didactic
processes was disconnected from the actual data collected in Penso’s study as Penso (2002) did not measure how exactly those processes influenced the preservice teachers’ PCK, and therefore could not convey clearly how the aspect of knowing the learner is in fact related and significant for PCK. Penso’s conclusions deviated from the findings.

The physical education literature on PCK has mirrored its general education counterpart. Some authors conceptualized PCK based on Shulman’s definition (e.g., Barrett & Collie, 1996; Chen, 1994; Doutis, 1997; Kutame, 2002). Other authors have used Grossman’s definition (e.g., McEachery, 2004; Schempp, Manross, Tan, & Fincher, 1998; Tsangaridou, 2002). A total of 25 studies have investigated PCK in physical education and for the most part have utilized similar methods to the ones that have been used in general education. Those methods have included field observations as well as interviews of preservice teachers, novice teachers, and experienced teachers. The studies have been interpretive and involved a high level of inference, despite a call for experimental investigation of PCK (Rovegno, 1992). Like their general education counterparts, the studies have resulted in good recommendations but not recommendations that were directly tied to the empirical data found in those studies.

For example, following a series of interviews with preservice and inservice teachers, Graber (1995) concluded that the teachers’ PCK was specific to a particular setting, students, and grade level. Solely based on interviews, Graber (1995) recommended teacher education programs begin designing effective ways to increase PCK. Nonetheless, this investigation and its findings did not provide an explanation as to how PCK is acquired, nor did it address the particular areas that are lacking in teacher...
education programs and therefore require improvement. Two other studies (Jenkins, Garn, & Jenkins, 2005; Jenkins, & Veal, 2002) examined what and how preservice teachers observe during peer coaching. The two studies concluded that observations enhanced the preservice teachers’ PCK due to increased familiarity with the learners (Jenkins et al., 2005; Jenkins, & Veal, 2002). Although Jenkins et al. (2005) supported the incorporation of peer coaching in methods classes, they did not clarify exactly how the increased familiarity of the students did enhance their PCK.

Many of the studies did not functionally identify what PCK is, and the conditions under which PCK develops. Most of the studies used PCK as the cognitive concept provided by Shulman (1986) and/or Grossman (1990) and described what teachers knew, how they came to acquire their CK and PCK, and characteristics of their instruction (e.g., Doutis, 1997; Jenkins et al., 2005; Jenkins & Veal, 2002; Kutame, 2002; Rovegno, Chen, and Todorovich, 2003; Sebren, 1995). These studies did not explain the relations among those components. For example, although the studies in physical education (e.g., Chen, 2004; Jenkins et al., 2005; Jenkins & Veal, 2002; McCaughtry & Rovegno, 2003; Rovegno, 1992, 1995; Sebren, 1995; Tsangaridou, 2002; Whipple, 2003) as well as in general education (e.g., Grossman, Schoenfeld, & Lee, 2005) argued that CK is related to the development of PCK, no study has explained in what way CK is related to PCK.

Statement of the Problem

PCK today “is almost taken for granted as though representing common sense” (Bullough, 2001, p. 657). However, if PCK is considered a foundation of teacher education (Shulman, 1987; Loughran et al., 2001), is widely accepted by the educational
community (Bullough, 2001; Loughran et al., 2001; Marks, 1990; Murray, 1996; Segall, 2004), and can contribute to professional practices (Loughran et al., 2001), it should be operationally defined and measured.

The absence of a functional definition poses a significant problem in discussing and using PCK in research and in practice. Several questions still remain unanswered: Is PCK observable? Can one measure PCK? How can one determine the appropriateness of PCK? Recently my colleagues (Ward, Ayvazo, & Stuhr, 2006, p. 13) and I proposed a functional definition of PCK: *Pedagogical Content Knowledge is the act of selecting content from one’s knowledge base for the purpose of teaching in a specific context.* The knowledge base is the content of physical education that is represented by four main domains: (a) rules/etiquette of the sport or activity, (b) techniques and tactics, (c) skill discrimination, (d) and drills and progressions (Ward, 2005). The act of selecting from one’s knowledge base can take three commonplace forms. One form is the selection of content to be included in the lesson plan. In short, the lesson plans are the documentary evidence. The second form is the enactment of the content in the actual act of teaching. This refers to the choices the teacher makes relative to how to represent the content to the learners. The final form of selection involves practice and refinement of the content through repeated interactions with the same specific content, for example, when a teacher delivers the same team handball unit to three classes.

Ward et al. (2006) also suggested referring to PCK as a class of behaviors that develop on a continuum, from immature to mature forms of PCK. Based on our proposed definition of PCK, all teachers, in the act of planning and in the act of teaching, are
necessarily selecting content to teach, and make choices as to how to teach. Thus, the PCK for every teacher can be situated on the continuum from immature to mature, regardless of the teachers’ years of teaching or level of expertise (Ward et al., 2006).

Based on her epistemological beliefs as a behavior analyst, the author of this dissertation conceptualized PCK as a class of behaviors that may include, but are not limited to, teaching practices such as types of content tasks provided by teachers (e.g., informing, extending, refining, applying); instructional forms they utilize (e.g., verbal instructions, metaphors, physical guidance, demonstrations); types of cues they use (e.g., technical, visual, metaphorical); and the way they adapt tasks to individual students (e.g., modifying tasks complexity, providing a different tasks, extending or breaking skills down, changing competition conditions). The researcher conceptualized that PCK develops from immature to mature forms, and therefore was interested in examining the possible difference between effective teachers’ forms of PCK relative to stronger and weaker CK.

Therefore, the purpose of the current investigation was to: (a) test the modified definition of PCK, and (b) to examine how the PCK of experienced teachers differ in the teaching of their stronger and weaker units of instruction.

Research Questions

The main research question of this study was: How does the PCK of experienced teachers differ in the teaching of their stronger and weaker units of instruction? The answer to this question was pursued via examination of the following research sub-questions:
1. How do teachers describe how they acquired their CK and PCK relative to their stronger and weaker units?

2. What teaching practices do teachers identify as their PCK?

3. How do teachers ensure the content delivered is appropriate to the students’ developmental level?

4. What was the percentage of each type of content task used in the teacher’s stronger and weaker unit of instruction?
   a. In what order were the types of tasks presented in the stronger and weaker instructional units?

5. Which instructional forms were used by the teachers to represent the content to the students?

6. How many tasks were provided to the class, to a small group, and to the individual student?

7. What types of cues were used by the teachers to represent the content?
   a. How many times were the types of cues used during the lesson and unit?

8. Which antecedents preceded the teacher’s presentation of the task to an individual student?

9. What types of adaptations (from the initial tasks provided) were made by the teachers to enhance the students’ performance?
   a. How many adaptations were made?

10. What percentage of the students performed the teacher’s task correctly?
11. To what extent were the adaptations made for individual students appropriate?

Significance of the Study

This study extends the literature in at least four ways. First, it proposes an operational definition of PCK that allows PCK to be observed and measured. The operational definition enables the inclusion or exclusion of behaviors under the umbrella of PCK behaviors. Once PCK is made observable and measurable, teacher education programs can utilize it for evaluating pedagogical practices, and can systematically teach it to preservice teachers. Second, a model of PCK is proposed that, regardless of a teacher’s years of experience or expertise, allows their PCK to be situated along a continuum. The continuum concept is extremely important because it allows assessing the appropriate use of content specific pedagogical acts, for the purpose of improving these teaching skills. Third, this study extends the methodological practices utilized in both the general and the physical education literature so far. This study employs a behavior analytic approach for collecting and analyzing data in contrast to the predominant qualitative approach that has been utilized since 1986 for the investigation of PCK. Considering diverse perspectives of PCK and the lenses through which one observes and analyzes, this project contributes to the body of knowledge on PCK. Finally, the study of PCK in light of its operational definition, may contribute to further research on PCK that perhaps will result in a more coherent and cohesive knowledge about PCK.
Limitations

This study is limited:

1. To instructional units personally identified by the teachers as their stronger and weaker content knowledge.

2. By initial superficial acquaintance of the investigator with three of the teachers who participated in phase 1 of the study. The investigator had at least two years of acquaintance with three of the teachers who participated in phase 1, and no prior acquaintance with the other three participating teachers.

3. By the investigator’s modest experience with interviewing.

4. To the investigation of PCK within the confines of two instructional units reported by the participants as stronger and weaker.

5. To the examination of PCK within the confines of a single 90-minute interview with experienced physical education teachers.

6. To the ways of accessing teachers’ PCK via group interview, individual interviews, and direct observation on selected teaching practices.

7. To the sensitivity of the data which were collected on site as well as videotaped. Due to students' movement, some of the students’ behaviors were difficult to observe and record.

8. To the determination of the appropriateness of the teacher’s task based on one trial performed by each student in the class.
9. To the determination of the appropriateness of the teacher’s modification based on a 10 seconds interval that, at times, was too short for the initiation of more than one trial by the student.

10. To the way in which tasks were delivered to the students. Tasks often included wide boundaries and lacked accountability.

11. By the varying invasion games content taught by one elementary teacher. As such, the instructional unit included three distinct invasion games contents that were taught for no more than three lessons each.

12. To the investigator’s familiarity with the subject matter taught by the teachers.

**Delimitations**

This study is delimited to:

1. The specific observation methods and variables as introduced in chapter three.

2. The teaching of a specific subject matter (e.g., invasion games unit and golf) taught by the teachers to elementary school students.

3. Suburban elementary schools.

4. Teachers with more than 14 years of experience in teaching physical education, who were considered by PETE program faculty to be effective teachers, and who serve as cooperative teachers for teacher candidates.

**Definition of Terms**

*Activity time.* Time that is devoted to motor engagement in physical education activities (e.g., skill practice, scrimmages, games, fitness, warm up; Parker, 1989).
Adaptation. Change of task or instruction to an individual student while considering the student’s “conception, preconceptions, misconceptions, and difficulties, language, culture, and motivations, social class, gender, age, ability, aptitude, interests, self concepts, and attention” (Shulman, 1987, p. 15).

ALT-PE. Academic learning time in physical education. The duration of time the students are engaged with appropriate materials to their ability, with high rates of success and low rates of error (Siedentop, Tousignant, & Parker, 1982).

Antecedents. Environmental stimuli that exist or occur immediately before the initiation of a response (Cooper, Heron, & Heward, 2007).

Applying task. A task that centers on assessment of form or on how to use the movement, rather than just how to do the movement (Rink, 2006).

Appropriate adaptation. An adaptation that was followed by a correct performance.

Behavior. “That portion of an organism’s interaction with its environment that is characterized by detectable displacement in space through time of some part of the organism and that results in a measurable change in at least one aspect of the environment” (Johnston & Pennypacker, 1993, p. 363).

Consequence. Environmental stimuli that come immediately after a behavior of interest (Johnston & Pennypacker, 1993).

Contingencies of reinforcement. A relationship between the behavior and stimuli that precede or follow it and result in reinforcement of the behavior of interest (Johnston & Pennypacker, 1993).

Correct performance. Performance that met the teacher’s stated criteria for quality of performance.

Cue. A key word or a phrase that communicates the critical elements of a movement to the learner (Rink, 2006).

Demonstrations. A visual communication, when the teacher nonverbally models how to perform or how not to perform the task (Cooper et al., 2007; Rink, 2006).

Depth of content. Descriptive word used by effective teachers to depict their extensive knowledge in their stronger unit of instruction.

Described contingencies of reinforcement. These are contingencies that operate when the behavior is exposed to a description of reinforcement. For example, reading a map of instructions on how to get from point A to point B, but not actually driving through the route (Skinner, 1974).

Direct contingencies of reinforcement. These are contingencies that operate when the behavior is directly exposed to reinforcement. For example, driving from point A to point B, instead of just reading to map of instructions on the driving route (Skinner, 1974).

Environment. The world surrounding the individual (Cooper et al., 2007).

Experienced teachers. Teachers who are involved in teaching over a long period of time in a specific context (Siedentop & Eldar, 1989).
**Extending task.** A task that increases the level of difficulty of a previous task (Rink, 2006).

**Extinction.** Occurs when the reinforcement for a previously reinforced behavior is no longer provided (Cooper et al., 2007).

**Immature PCK.** Level of PCK that is closer to the immature end of the knowledge development scale.

**Inappropriate adaptation.** Adaptation is inappropriate if it is followed by an incorrect performance.

**Incorrect performance.** Performance that did not meet the teacher’s stated criteria for quality of performance.

**Informing task.** “The initial task in the progression of a skill” (Rink, 2006, p. 115).

**Knowing.** Evidence for knowing is in the possession of behavior. Knowing is doing (Skinner, 1974).

**Knowledge time.** Time the students spend in receiving knowledge about physical education content (e.g., rules, how to execute technique or tactic, guideline for appropriate and inappropriate behaviors, and the subject’s history; Parker, 1989).

**Management time.** Time spent in business activities that are not related to instruction (Parker, 1989).

**Mature PCK.** Level of PCK that is closer to the mature end of the knowledge development scale.
Metaphorical cue. Key word or a phrase that communicates the critical elements to the students using characteristics of another subject (Kutame, 1997).

Metaphors. Occur when the teacher transfers names or attributes of one subject to the other (Newman, 2001; White, 1996).

Motivating operations. Stimuli that momentarily increase or decrease the frequency of behavior and the effect of reinforcement (Laraway, Snycerski, Michael, & Poling, 2003).

Off task. Time the student is engaged in another activity he or should not be engaged in. The student is not engaged in the activity assigned by the teacher (Siedentop et al., 1982).

Pedagogical content knowledge (proposed). The act of selecting content from one’s knowledge base for the purpose of teaching in a specific context (Ward et al., 2006).

Pedagogical content knowledge (Shulman). PCK is “the ways of representing and formulating the subject matter that makes it comprehensible to others” in content areas that teachers teach regularly and repeatedly (Shulman, 1986, p. 9).

Pedagogical knowledge. General knowledge, conceptions, and skills related to teaching (Grossman, 1990).

Punishment. A consequence of a behavior that decreases the occurrence of the behavior it follows (Cooper et al., 2007).

Refining task. A task that expresses additional focus on the quality of performance (Rink, 2006).
**Reinforcement.** When a stimulus occurs immediately after the behavior, and as a result the behavior occurs more often in the future (Cooper et al., 2007).

**Response class.** A collection of similar responses that produce the same consequences (Cooper et al., 2007).


**Rich knowledge.** A description of subject matters in which teachers possess extensive knowledge.

**Stimulus.** A condition, event, or change in the physical world that can be differentiated from some other aspect of the environment (Cooper et al., 2007).

**Task.** A set of implicit or explicit instructions about what a person is expected to do to successfully cope with a situation (Doyle, 1981).

**Technical cue.** Key word or a phrase that emphasizes a technical characteristic of the skill to be performed. For example, “elbow up” in basketball shot, or “hand-hand-foot-foot” for a cartwheel performance (Kutame, 1997).

**Thinking.** A covert behavior that often cannot be detected by the naked eye (Skinner, 1974).

**Transition.** Time the student spends in managerial and organizational activities that are related to instruction (Parker, 1989).

**Verbal instructions.** Occurs when the teacher uses a word or several words to tell, explain, or prompt to occasion students’ response (Cooper et al., 2007).
**Visual cue.** Objects or other aids the teacher uses to occasion a correct response. For example, hand foot cues or taped line on the ground to occasion correct hand foot placement during a cartwheel performance (Kutame, 1997).

**Waiting time.** Time when the student has already completed a task, and has a period of no activity and no movement between activities (Parker, 1989).
CHAPTER 2

REVIEW OF LITERATURE

This chapter is organized into five sections. First, pedagogical content knowledge (PCK) is reviewed from an historical standpoint, which includes how PCK had been conceptualized in the past, and how has it been investigated in the general education literature. The second section reviews inquiry into PCK in the physical education literature both from a conceptual and a methodological standpoint. In the third section, the author proposes a new definition of PCK. This section is followed by an explanation of the author’s epistemological belief and the theoretical framework that underlie this study. Finally, the chapter concludes with a re-conceptualization of PCK and a model that explains PCK development.

The Historical Evolution of PCK

The discussion about PCK emerged as Shulman (1986) reflected on what he called the “missing paradigm” problem. Shulman argued that teachers are expected to demonstrate subject matter content as a prerequisite to teaching. As an example, a physical education teacher is required to demonstrate knowledge of field hockey prior to
teaching this content to her sixth graders. In 1986, Shulman recognized the extensive research on pedagogy, but lamented the absence of a research focus on subject matter. Shulman (1986) called the absence of research on subject matter the "missing paradigm."

Shulman (1986) not only argued that research on teaching lacked a focus on subject matter content, he argued further for an emphasis on how that content is transformed from the knowledge of the teacher into the content of instruction. The questions that were not yet asked during that era evolved around "How do teachers select and teach the content to their students?" Therefore, the study of PCK poses questions such as "How physical education teachers select the content to teach to the class?" What questions they ask students when teaching field hockey (or any other content)?" and "How do they deal with students misunderstanding?"

*Pedagogical Content Knowledge and Teacher Knowledge Base in 1986*

According to Shulman (1986, p. 9), PCK “goes beyond knowledge of subject matter” to the aspects that make the subject matter teachable to others. By definition, PCK is “the ways of representing and formulating the subject matter that makes it comprehensible to others” in content areas that teachers teach regularly and repeatedly (Shulman, 1986, p. 9). Those representations can be, but are not limited to, useful ideas, analogies, illustrations, examples, and demonstrations that result in students’ understanding. Additionally, PCK included the students’ current knowledge about the subject matter they bring with them into the educational setting. Their backgrounds, conceptions, and misconceptions about the content makes the teaching (and students’
learning) easier or more difficult to teach, and is also a component of PCK (Shulman, 1986).

In the 1986 article, Shulman situated PCK as one of three categories of knowledge base that were required for teaching, as diagramed in Figure 2.1. The other two categories were content knowledge (CK) and curricular knowledge. Content knowledge, the first category postulated by Shulman, referred to the teachers' organization and breadth of knowledge about the subject matter.

<table>
<thead>
<tr>
<th>Teacher Knowledge Base (Shulman, 1986)</th>
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<tbody>
<tr>
<td>Content Knowledge</td>
</tr>
<tr>
<td><strong>Pedagogical Content Knowledge (PCK)</strong></td>
</tr>
<tr>
<td>Curricular Knowledge</td>
</tr>
</tbody>
</table>

Figure 2.1 Teachers’ knowledge base categories according to Shulman (1986)

Curricular knowledge, the third category, was represented by a range of topics planned and sequenced for teaching a specific subject matter at a given level. This planning and sequencing of content included instructional materials in relation to the topics of the curricular plan, under particular conditions (Shulman, 1986).

*Pedagogical Content Knowledge and Teacher Knowledge Base in 1987*

A year after proposing PCK, Shulman (1987) broadened the categories of knowledge base that were required for teaching, adding four more categories to CK, PCK, and curricular knowledge that were already postulated. Figure 2.2 diagrams the seven categories of teacher knowledge base.
Figure 2.2 Teachers’ knowledge base categories according to Shulman (1987)

<table>
<thead>
<tr>
<th>CK</th>
<th>PCK</th>
<th>Curricular Knowledge</th>
<th>General Pedagogical Knowledge</th>
<th>Knowledge of Learners</th>
<th>Context of Schooling</th>
<th>Knowledge of Educational Ends</th>
</tr>
</thead>
</table>

Note: CK= Content knowledge, PCK=Pedagogical content knowledge

The first category, general pedagogical knowledge, mainly included strategies and practices for classroom management and organization. The second category, knowledge of the learners and their characteristics, emerged from Shulman’s assertion in 1986 regarding knowledge of students’ conceptions and misconceptions about the subject matter. In 1986, this assertion was included under the definition of PCK, while in 1987 Shulman classified it as an independent knowledge base category. The third category was knowledge of contexts of schooling, ranging from familiarity with the classroom and districts, to practices of the community and cultures. The last category was knowledge of educational goals, as well as philosophical beliefs and values. Shulman’s view of teaching included CK and PCK as the first phases of teaching. In short, the teacher should know what is to be taught and how it should be taught (Shulman, 1987).

Theoretically, the postulation of seven knowledge base categories could have contributed to further distinction between PCK and other types of teaching knowledge, and therefore was significant to the further development of PCK. In reality, it helped distinguish between PCK and other types of knowledge, but was less useful in explaining what PCK really is. Pedagogical content knowledge was still represented by “ways of
talking, showing, enacting, or otherwise representing ideas so that the unknowing can come to know, those without understanding can comprehend and discern, and the unskilled become adept” (Shulman, 1987, p. 7).

The delineation of these different categories of the knowledge base for teaching led Shulman (1987) to argue that PCK is derived from other types of knowledge. Thus, PCK represents the blending of CK and pedagogical knowledge that results in a teacher’s understanding of how the content should be organized, represented, and accommodated to learners of diverse abilities and interests. In conclusion, Shulman’s 1987 article further refined of the PCK definition to include the integration of CK and pedagogy that are transformed via some selected actions to a diverse group of learners. Yet, the “blending” of content with pedagogy that resulted in PCK was still not always crystal clear. Therefore, Gudmundsdottir and Shulman (1987) attempted to further refine PCK.

**Areas of Pedagogical Content Knowledge**

Following this early work by Shulman, Gudmundsdottir and Shulman (1987) argued for three distinct areas in PCK, based on the root knowledge that influences those PCK areas. Marks (1990) also made a similar attempt to clarify PCK in the same way. Figure 2.3 diagrams the areas of knowledge that influence PCK.

<table>
<thead>
<tr>
<th>Pedagogical Content Knowledge (Gudmundsdottir &amp; Shulman, 1987; Marks, 1990)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCK derived from Content Knowledge</td>
</tr>
</tbody>
</table>

Figure 2.3 Teachers’ knowledge base categories according to Gudmundsdottir and Shulman (1987) and Marks (1990)
The first area of PCK was identified by Gudmundsdottir and Shulman (1987) and by Marks (1990) as PCK that is derived from the subject matter knowledge. This included knowledge of the main topics and areas of the subject matter (Gudmundsdottir & Shulman, 1987), and the \textit{interpretation} of those concepts, transforming them from CK into PCK (Marks, 1990). For example, when teaching object control skills, the teacher knows that students should learn throwing and catching before they learn how to apply those basic skills in games situations (Rink, 2006). Also, the teacher may find it more effective to instruct elementary school students to "twist their trunk like sponge" when they prepare to throw a bean bag instead of providing a more technical explanation.

The second area of PCK is the one derived from the general pedagogical knowledge. This area referred to the use of demonstrations, simulation, and questioning strategies to explain a concept to the learners (Gudmundsdottir & Shulman, 1987; Marks, 1990). For example, the physical education teacher may choose to demonstrate how to execute leaping, over verbal instructions or questioning. This process of using generic knowledge to create specific PCK in a particular context is entitled specification (Marks, 1990).

The third area of PCK was identified slightly differently by Gudmundsdottir and Shulman (1987) and later by Marks (1990). According to Shulman (1986) and Gudmundsdottir and Shulman (1987), the third area of PCK is influenced by knowledge of the students. Specifically, they referred to students’ conceptions or misconceptions they bring with them into the learning setting. Marks (1990), on the other hand, argued that the third type of PCK springs from previous PCK. This includes previous use of
learning activities, teaching strategies, and also from awareness of students’ lack of knowledge of the subject matter. For instance, the teacher might place color stickers on the learner’s foot to remind the student which foot to step with when throwing the bean bag. The teacher may also provide the rationale for this particular pedagogical act: he uses the sticker method because when he taught his other first grade class to throw, the majority of students were confused about which foot they should step with when throwing. When he uses stickers, the children learn.

Marks (1990) suggested that PCK was equally derived from the subject matter and the general pedagogical knowledge. Knowledge, however, does not develop in isolation. Marks (1990) proposed that PCK was composed from students’ understanding, subject matter, instructional process, and media for instruction. The latter category was an addition to Shulman’s concepts (Jenkins & Veal, 2002). Following Shulman, Gudmundsdottir, and Marks, Grossman was another researcher who examined how PCK can be conceptualized.

Pedagogical Content Knowledge and the Teacher Knowledge Base in 1990

Grossman (1990) argued that PCK has four central components as presented in Figure 2.4. First, PCK includes knowledge and conceptions about the purpose of teaching at different grade levels. For example, a physical education teacher may believe that students in preschool and early elementary grades should learn basic movement skills first, and only during later grades of elementary school should learn skills and apply them in various sport games. Another teacher may believe the purpose of physical education is to teach fitness education and therefore design the curriculum accordingly (Metzler,
The teacher’s conception is reflected in her goals for teaching the subject matter and likely in her structuring of the physical education curriculum.

<table>
<thead>
<tr>
<th>Pedagogical Content Knowledge (Grossman, 1990)</th>
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<tbody>
<tr>
<td>Conceptions of Purposes for Teaching Subject Matter</td>
</tr>
</tbody>
</table>

Figure 2.4 PCK components as postulated by Grossman (1990)

The second component, the knowledge of students’ understanding, is identical to the category discussed by Shulman (1986), Gudmundsdottir and Shulman (1987), and Marks (1990). This category refers to the teacher’s knowledge of what the students already know about the subject matter, their skills and ability, and what they still find puzzling about the content (Grossman, 1990).

The third component of PCK according to Grossman (1990) is curricular knowledge. Shulman (1986, 1987) argued that curricular knowledge was one of the knowledge base categories required for teaching. However, he did not include curricular knowledge as a component of PCK. Grossman (1990) differed from Shulman, postulating that curricular knowledge is one of the four components of PCK. Curricular knowledge pertains to knowledge about curricular materials that may be used to teach particular content, and about vertical and horizontal curricula progressions for a topic. This knowledge may be represented by the teacher’s curriculum plan of teaching basketball passing, dribbling and 2 versus 2 games in fourth grade, followed by basketball dribbling,
lay up, and 3 versus 3 games in fifth grade. As part of the curricular knowledge, the teacher draws upon knowledge of what the students already learned in fourth grade, and on what they are likely to learn in the future (Grossman, 1990).

The last component of PCK includes teaching strategies and representations in specific topics. Grossman (1990) referred in this category to teachers’ repertoire of metaphors, examples, and activities that are particularly effective for teaching a particular topic. In physical education, “twist your trunk like a sponge” is an example that is particularly effective for teaching preschool children to rotate their upper bodies.

Grossman (1990) included PCK as one of four general categories of teachers’ knowledge base. The other three categories were: general pedagogical knowledge, CK, and knowledge of context. Differing from Shulman, Grossman (1990) noted that these four categories were interactive rather than isolated. The general pedagogical knowledge and CK were similar to the ones described by Shulman (1987) and therefore will not be elucidated again.

Knowledge of context, the fourth category described by Grossman (1990), pertained to the teachers’ understanding of the context in which they teach and to adaptation of their knowledge to the setting and the individuals they teach. This knowledge includes information about the school district, the school setting, the expectations, culture, departmental guidelines and other contextual factors that might impact teaching. For example, this category may include the teacher’s consideration of the equipment available and the space available for use inside the gym. This category
also includes knowledge of the students, their strengths and weaknesses, family and background, and their community.

In summary, Grossman’s (1990) chief contribution was in her different delineation of PCK than the original definition made by Shulman (Jenkins & Veal, 2002). In contrast to Shulman, Grossman (1990) did not discuss CK as part of the PCK components. Instead, she introduced the importance of the conceptions of teachers regarding the purposes of teaching in the different grade levels. She included curricular knowledge and knowledge of the students as components of PCK, unlike Shulman (1987) who indicated those two categories as independent knowledge base categories for teaching. The final component of PCK according to Grossman (1990) was instructional strategies, which resemble the general pedagogical knowledge as discussed by Shulman (1986).

Pedagogical Content Knowledge in 2005

More than a decade after Grossman’s (1990) postulation of PCK, Grossman, Schoenfeld, and Lee (2005) explained that PCK refers, among other things, to the teachers’ ability to anticipate students’ understanding or misunderstanding within the subject matter, to respond to diverse learners, and to address their understanding or misunderstanding by providing ample examples and various representations of the content that make the concept being taught more accessible to the students (Grossman et al., 2005).

Grossman et al. (2005) called for the uncovering of PCK by the utilization of questions “that lie at the heart of PCK-what it means to understand one’s subject matter
for the purpose of teaching it to others” (p. 207). These questions focus mostly on PCK although they also pertain to CK, and are targeted to preservice teachers in a content-specific pedagogy course. For example, some questions address the issue of the subject matter and its importance. How is the particular content taught? Are specific curricula designated for this subject matter? In summary, Grossman et al. (2005) advocate that PCK is mostly influenced by two components: (a) teachers’ understanding of the subject matter and (b) teachers’ knowledge of the students and their ability to deal with students misunderstanding. This postulation of PCK differed from Grossman's initial delineation in 1990. Her writing in 2005 did not include great emphasis on curricular knowledge and knowledge of instructional strategies as components of PCK that were included in her original conceptualization of PCK.

In conclusion, despite some shifts (Grossman, 1990; Grossman et al., 2005; Gudmundsdottir & Shulman, 1987; Marks, 1990) in the conceptualization of PCK from the original definition (Shulman, 1986), PCK is still considered the amalgam of pedagogical knowledge and the teacher’s approach to and delivery of the subject matter (Loughran, Milroy, Berry, Gunstone, & Mulhall, 2001). In 2007, two decades since the original introduction of PCK by Shulman (1986), the term PCK is commonplace in the teacher education literature (Bullough, 2001; Segall, 2004). Pedagogical content knowledge is frequently cited, referenced, and used but it has seldom been critically questioned (Segall, 2004). The next section examines the main strategies of investigating PCK in the general education domain.
Investigating Pedagogical Content Knowledge in General Education: An Overview of Methods and Findings

This overview of methods and findings of research into PCK in general education provides a summary of findings relative to five methods that have been used to study PCK. I have borrowed the categories used by Baxter and Lederman (1999) in their review of PCK: (a) inferential techniques, (b) concept mapping, card sorts, and pictorial representations, and (c) multi-method evaluation. In addition to these three categories, case studies (Grossman, 1990) and diary writing (Penso, 2002) have been added. In each of the categories, an example of a typical study is provided, the author explains how the study was conducted, and summarizes the findings as related to the category.

The investigator conducted a computer search for literature reviews on PCK in general education using the words pedagogical content knowledge combined with literature review, across three search engines (i.e., Eric, Academic Search Premier, and PsycInfo). The initial search did not provide results. The investigator then conducted a search across the same engines, using the combinations PCK and math, PCK and reading, PCK and science. Again, no literature reviews were found. After consultation with her academic advisor, the investigator selected exemplary articles for the investigation of PCK and also based the literature review on a PCK book chapter and PCK books by Grossman et al. (2005), Gess-Newsome and Lederman (1999), and Grossman (1990).

Inferential Techniques

This category includes strategies such as short answers, multiple choice questions, and Likert-type self-report scales to evaluate teachers’ PCK. For example, Kromery and
Renfrow (1991, as cited by Baxter & Lederman, 1999) measured content specific (C-P) PCK using multiple choice test. The questions were a description of a desired teacher’s knowledge and compared the answers of preservice and inservice teachers. It is difficult to report on the findings of inferential techniques because those techniques, designed for the assessment of PCK, had not been widely used. Moreover it is yet unknown what the items of C-P actually measure and what they reveal about teachers.

The items under C-P referred to a determination of a correct response, depending on the CK as it is to be taught in an educational situation. The C-P category included four sub-groups: error identification, communication with the learner, organization of instruction, and learner characteristics. Error identification referred to the teacher’s ability to identify the error in the student’s performance. Communication pertained to the selection of an appropriate approach to communicate with the student. Organization of instruction referred the selection and sequence of activities, contingent on the student’s performance. Finally, learner characteristics focused on the teachers’ familiarity with the developmental norms within the discipline.

The C-P items captured an instructional episode in great details, and therefore were difficult to write, edit, and analyze. In addition, their construct validity was still to be determined. Therefore, it is not yet known what these items really measure, and how well they reflect effective classroom instruction (Kromery & Renfrow, 1991, in Baxter & Lederman, 1999).

Loughran et al. (2001) were concerned that documentation of PCK episodes fails to portray the diverse ways teachers grasp concepts, respond to particular educational
situation, and shape their teaching. On a similar note, Baxter and Lederman (1999) argue that the main assumption of C-P items is that a right answer does exist and that it is a single answer. In essence, a single correct answer to each instructional episode contrasts the concept that PCK represents, among other things, the teacher’s ability to deal with unusual aspects of teaching.

Concept Mapping and Card Sorts

Concept mapping is widely used for measuring teacher’s PCK. This method is typically used by cognitive researchers, and is considered to reflect the organization of knowledge in the teachers’ long term memory. The researcher presents a label or concept to the participants, ask them to generate words or phrases related to the concept, and then asks them to group all of the words in a meaningful way, and to explain their grouping method. Often participants are also required to draw the connections between the key terms (Baxter & Lederman, 1999).

Morine-Dershimer (1989, as cited by Baxter & Lederman, 1999) used concept maps to examine the change of preservice teachers’ knowledge before and after a methods course. The preservice teachers drew two concept maps regarding peer teaching in the course and teacher planning. The post mapping resulted in substantial increase number of key term categories the preservice teachers described. The results of this study were: (a) Preservice teachers increased their conceptual understanding and developed their knowledge base for teaching. (b) The maps served as feedback for novice teachers on how their understanding varied and changed. Despite the positive increase in knowledge for teaching, Kagan (1990) criticized such short term studies, claiming that
the apparent changes may be transient, and therefore of little value for the understanding of PCK.

Gess-Newsome and Lederman (1993, cited in Baxter & Lederman, 1999) on the other hand, assessed teachers’ knowledge changes over a longer period of time. They assessed preservice biology teachers’ knowledge four times, using open ended questions. The assessment began with the initiation of the methods course to four months after the conclusion of the student teaching experience. Slightly different than concept maps, the participants could respond to the questions describing any concept they wish. They also could represent the relationships in the way that best represented their views. The results indicated that the preservice teachers (a) developed a coherent knowledge about their subject matter, and (b) that they included more topics related to how to teach biology after their field experience.

In card sorting, the participants are required to organize pre-made cards that contain concepts and labels in a way that best represents the relationships between those concepts. This method is very similar to concept mapping, yet somewhat more restricting, as participants are required to arrange concepts that were determined by the researcher (Baxter & Lederman, 1999).

In conclusion, concept maps may provide teachers valuable information about their knowledge. Nonetheless, the assumption that those maps reflect the internal memory structure is questionable because two teachers may exhibit the same performance, yet illustrate a fundamentally different conceptual organization of the
knowledge (Phillips, 1983, cited in Baxter & Lederman, 1999). This concern was not addressed by any of the studies.

**Multi-Method Evaluation**

Other studies employed several methods of data collection to examine teachers’ PCK. Most of the studies on PCK in science employed the multi-method evaluation through the use of interviews, concept mapping, and video-prompted recall for collecting data. Typically, data were triangulated, and conclusions were made regarding teachers’ PCK.

For example, Hashweh (1987, cited in Baxter & Lederman, 1999) assessed teachers’ CK, conceptions of learning, instructional planning, and view of instruction, using a variety of techniques. Hashweh (1987) provided the teachers with three tasks. First, teachers were required to summarize a particular content. Second, they conducted concept mapping of their teaching content, and third, they categorized exam questions according to the common ideas that represented a correct answer. In addition, Hashweh (1987) conducted a clinical interview with the teachers, and finally the teachers were required to respond to a critical scenario to reveal their conception of instruction.

Studies that used multi-method evaluation techniques resulted in discovery of several aspects of PCK. Researchers were successful in documenting PCK in the form of translation of content to the students in the classroom, and also in documenting consistencies or changes in PCK (Baxter & Lederman, 1999).

Hewson and Hewson (1989, cited in Baxter & Lederman, 1999) examined teacher’s conceptions about teaching science, using structured interviews. The teachers
were presented with short written scenarios of teaching science, prior to and after a subject matter course. They sorted the answers into six categories: nature of science, learning, learner characteristics, rationale for instruction, preferred instructional technique, and conceptions of teaching science. The authors identified changes and consistencies in the teacher’s conceptions.

Interviews and case studies were also employed in the English discipline. Grossman (1990) investigated the nature of PCK of secondary English teachers. This study was fundamentally different as it employed case studies of six first-year English teachers rather than preservice teachers. Moreover, albeit all teachers had a strong background in English, three had graduated from the same teacher preparation program, and the other three did not have formal teaching experience. The selection of this particular diverse group of participants assisted in mapping the acquisition of PCK back to the teachers’ undergraduate coursework and in the detection of the influences from professional preparation.

Grossman (1990) conducted five interviews (per teacher) and live observations. The interviews were utilized in order to reveal more information about teachers’ PCK and its origin. The interviews also included tasks that required teachers to draw upon their PCK. One interview included card sorting. The classroom observations focused on the teachers’ teaching practices.

Grossman (1990) attempted to find relations between the English teachers’ PCK and the content they learned in their teacher education course work. She conducted a cross case analysis of the teachers’ knowledge and beliefs regarding the purpose of
secondary school English, their curricular knowledge, and their knowledge about the learners’ beliefs and conceptions regarding English. The three chief question categories were: why should we teach English? What should we teach in English? And, who are the students?

Results indicated that teachers with prior teaching preparation background were able to provide appropriate instruction for students more than teachers who did not have teaching preparation, and who learned mainly from experiences as they were teaching. Furthermore, a mismatch existed between the teachers’ assumptions regarding the students, and the reality of students’ abilities and interests. Grossman (1990) concluded that CK is critical but not sufficient for teaching diverse range of students. Therefore, she recommended subject specific (i.e., PCK) courses as part of teacher education programs. The study of Lee (2002) underscored the importance of a specific methods course.

Lee (2002) investigated how PCK of preservice social studies teachers developed during a methods course that used digital historical resources as instructional material. Data collection methods included interviews, observations of the methods course, and analysis of the activities the preservice teachers completed during the course. The results indicated that the preservice teachers constructed meaningful understanding of the subject matter through the use of the digital resources. Nonetheless, they were not able to transform this knowledge into teaching situations. In addition, the emphasis on CK limited the participants’ ability to plan for instruction. Lee (2002) concluded that preservice teachers need additional experiences in various methods of instruction. Furthermore, developing PCK specifically related to digital resources is critical if one
wants to implement effective instruction using those resources. This further supports the notion of subject specific PCK.

To this point, all of the studies examined the PCK of preservice or first-year teachers. Smith and Neale (1991, cited in Baxter & Lederman, 1999), investigated the PCK of experienced inservice teachers during a four-week summer workshop. They continued to follow the teachers during the school year, using interviews, observation of teaching practices, and journal writing.

The changes in the teachers’ (a) knowledge of the learners’ conceptions about science, (b) teaching strategies, and (c) use of metaphors, analogies, and examples during the lesson, were analyzed. The results indicated that the development of PCK was not likely to occur unless the teachers had acquired a deep conceptual understanding of the subject matter (Driel, 2001). These results were surprising considering that the study employed a multi-method evaluation for a longer duration of time, as recommended by Kagan (1990). Baxter and Lederman (1999) concluded that this finding indicates the complexity and indistinct nature of the assessment of PCK. They also noted that the multi-method evaluations may be time and energy intensive, and extremely difficult to replicate.

Diaries

Penso (2002) investigated the PCK of biology student teachers during their teaching experiences. The participants were required to complete an observation diary, while observing a mentor teacher, and a teaching diary in which they analyzed their own teaching. They were also required to attend to the learners in the class, to identify their
difficulties, and to document what type of clarifications and explanations they required. Sources of student difficulties were classified as generated from the (a) learner, (b) the content taught, (c) the teaching methods the teacher used, and (d) the lesson setting.

Results indicated that the preservice teachers detected many students’ difficulties during the observations of their mentor teacher, and far less number of difficulties during their own teaching. Their ability to identify learning difficulties when observing a lesson did not reflect to their teaching. Penso (2002) attributed this finding to the complexity of teaching experiences and the difficulty of the students to critically analyze the lesson.

Penso (2002) concluded that the conditions under which students acquire professional knowledge are of great importance. Thus, for the acquisition of PCK, student teachers need to experience in schooling, in a specific context, with specific learners. Also, this process should be accompanied by evaluations and reflection for growth to occur.

Diaries were used by Penso (2002) to access preservice teachers’ conceptions and PCK. Another approach for accessing and developing PCK was suggested by Grossman et al. (2005). Grossman et al. (2005) argues for a framework of questions that represent the heart of PCK and should be used in content specific methods classes to enhance the teachers’ PCK. Responding to these questions ought to be an ongoing process that changes along with the teacher’s experiences and shape ones’ understanding of what it means to know the subject matter and to know how to teach it.
Longitudinal Investigation of Pedagogical Content Knowledge in Science

The preceding discussion demonstrates how the general education literature discusses PCK greatly without providing concrete examples of it (Loughran et al., 2001). Marks (1990) also implied that researchers frequently used the characteristics of PCK, but insufficiently clarified it. Notwithstanding, an extensive effort of documenting science teachers’ PCK, and turning it from a tacit to more explicit term, was made by Loughran et al. (2001) from Monash University. Their goal was to find ways “to identify and capture PCK and appropriately represent it to others” (Loughran, Mulhall, & Berry, 2004, p. 373). The researchers’ explicit and systematic approach to portraying the PCK of experienced science teachers continued for more than six years, and resulted in several articles and a book that describes their methodology (Loughran et al., 2001, 2004; Loughran, Berry, & Mulhall, 2006).

Initially, Loughran et al. (2001) used case methodology to learn about the teachers’ PCK. The cases led Loughran et al. (2001) to develop a construct called Pedagogical and Professional-experience Repertoire (PaP-eR). The investigation of PCK included content specific teaching procedures such as role play, laboratory work and demonstrations; discussion with the teachers to learn more about their teaching; and classroom observations to learn about their teaching practices (Loughran et al., 2001, 2004, 2006).

Teachers’ thorough descriptions during the interviews, together with the observation data of their teaching, assisted in constructing the PaP-eR. The final collection of PaP-eRs reflected the teachers’ actual practice, their reflection on the
teaching episode, and the interaction of a group of professional science teachers with those episodes. Only when several PaP-eRs were grouped together, could they clarify some aspects of PCK. This was not possible with a single PaP-eR. Also, some of the Pap-eRs were content specific. Because the relationship between PCK and the thorough PaP-eRs descriptions was too complex, Loughran et al. (2001) then developed the Central Content Representation (CoRe). CoRe is a set of questions that led teachers to discuss specific aspects of PCK. The CoRe questions provided access to science teachers’ understanding of the content, and a more precise attempt to define and capture aspects of PCK (Loughran et al., 2001, 2004, 2006).

Teachers were involved in the construction of CoRe and Pap-eRs and reported that their individual and group engagement in the process had contributed to their practice and experience, and therefore to their professional development. Loughran et al. (2001) estimated these methods could assist teachers in articulating, further exploring and analyzing their own PCK and therefore recommend their use among school teachers (Loughran et al., 2001, 2004). Finally, PaP-eR was defined as a professional development tool that can serve as a resource tool for individual teachers and as a stimulus for discussion among a group of teachers.

Investigating Pedagogical Content Knowledge in Physical Education

This section reviews investigations of PCK in physical education. Studies were selected from a computer search for articles across four search engines (i.e., Eric, Sport Discus, Science Citation, and PsycInfo) using the term pedagogical content knowledge combined with physical education, physical activity, sport, and coaching. The
investigator also searched Dissertation Abstracts, using the words pedagogical content knowledge and physical education, to find dissertations related to PCK. All articles and dissertations that had a main focus of investigating instructors’ or teachers’ PCK were included in this literature review. The investigator then cross checked the reference list of the included articles for the purpose of discovering additional studies that are PCK related and were not revealed during the initial computer search.

The literature search resulted in 19 articles and six dissertations in which the primary research question evolved around the investigation of PCK in physical education. The literature search findings are presented in Table 2.1. All of the studies and dissertations employed a qualitative research methodology, with the exception of four studies that used both qualitative and quantitative methods to examine expert instructors’ PCK (Chen & Ennis, 1995; Doutis, 1997; Givens, 1998; Kutame, 2002). The primary data collection methods included interviews (n=23) and observations of teaching practices (n=20). Field notes (n=6), written reports, observation forms and journals (n=4), post-lesson conferences and weekly meeting reflections (n=2), concept mapping (n=1), and knowledge importance evaluation (n=1) were also used.

Most of the studies were conducted within or with relation to elementary (n=15) and secondary (n=10) education settings, in a variety of contexts such as volleyball, hand dribbling, lacrosse, golf, baseball, and cartwheel. Two studies were conducted in instructional settings, examining the PCK of expert baseball (Givens, 1998) and golf (Benham, 2002) instructors. Benham (2002) conducted the study in instructional settings and Givens (1998) examined PCK in professional and collegiate baseball settings.
<table>
<thead>
<tr>
<th>Authors</th>
<th>Participants</th>
<th>Data collection strategy</th>
<th>Analysis</th>
<th>Research question/ research purpose</th>
<th>Physical education content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rovegno (1992)</td>
<td>7 preservice teachers</td>
<td>Observations, Interviews, Teachers’ written work</td>
<td>Ecological approach to analyze the data</td>
<td>To describe what and how seven preservice teachers learn during a field-based elementary physical education methods course</td>
<td>Elementary PE field based methods course</td>
</tr>
<tr>
<td>Graham, Hopple, Manross, &amp; Sitzman (1993)</td>
<td>3 novice and 3 experienced teachers</td>
<td>Interviews, Field notes, Document analysis</td>
<td>Ethnographic guideline for analysis</td>
<td>To describe and compare the planning and teaching of novice and experienced elementary teachers teaching the same content to the same learners</td>
<td>Dribbling Grades 3-5</td>
</tr>
<tr>
<td>Rovegno (1993)</td>
<td>9 preservice and 5 inservice (first year teachers)</td>
<td>Interviews, Observations, Relevant documents</td>
<td>Constant comparison, Analytic induction</td>
<td>What and how preservice teachers learn about a movement approach that was discrepant from their traditional k-12 experiences</td>
<td>K-8</td>
</tr>
</tbody>
</table>

Table 2.1 Literature search findings of studies that investigated PCK in physical education. Dissertations are italicized.
<table>
<thead>
<tr>
<th>Study</th>
<th>Sample Size</th>
<th>Data Collection Methods</th>
<th>Data Analysis</th>
<th>Research Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rovegno (1994)</td>
<td>2 preservice teachers</td>
<td>In depth interview</td>
<td>Constant comparison and analytic induction</td>
<td>Continue to investigate the nature of PCK and refine understanding relative to how aspect of PCK emerge and persist in context</td>
</tr>
<tr>
<td>Rovegno (1995)</td>
<td>1 preservice teacher</td>
<td>Case study: field observations and interviews</td>
<td>Constant comparison Analytic induction</td>
<td>Describe and interpret: 1. student decision about task content and progression 2. aspects of PCK he used to explain and justify the decisions</td>
</tr>
<tr>
<td>Sebren (1995)</td>
<td>7 preservice teachers</td>
<td>Weekly one hour reflection sessions – audiotaped Observation of the course 3 interviews documents</td>
<td>Constant comparison</td>
<td>To analyze and describe preservice teachers’ reflection and knowledge development during a field-based elementary physical education methods course.</td>
</tr>
<tr>
<td>Study</td>
<td>Participants</td>
<td>Methods</td>
<td>Data Analysis</td>
<td>Research Questions</td>
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<tr>
<td>Graber (1995)</td>
<td>20 preservice teachers, 7 teacher educators, 8 cooperating teachers</td>
<td>Interviews</td>
<td>Inductive analysis and comparison</td>
<td>1. To examine how student teachers believed they incorporated PCK into their lessons</td>
</tr>
<tr>
<td>Chen &amp; Ennis (1995)</td>
<td>3 experienced teachers</td>
<td>Participant observation, Knowledge importance evaluation, Pathfinder concept mapping</td>
<td>Constant comparison</td>
<td>Examine the subject – PCK transformation process that was associated with teacher’s curricular decision making</td>
</tr>
<tr>
<td>Study</td>
<td>Participants</td>
<td>Data Collection Methods</td>
<td>Analysis</td>
<td>Research Questions</td>
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<tr>
<td>Barrett &amp; Collie (1996)</td>
<td>4 teachers</td>
<td>Videotaping of 4-6 lessons</td>
<td>Constant comparison of students’ performance Analytic induction</td>
<td>To describe PCK discovered within the context of children learning lacrosse from teachers learning to teach it</td>
</tr>
<tr>
<td>Schempp, Manross, Tan, Fincher (1998)</td>
<td>10 teachers with expertise in at least 1 PE subject</td>
<td>Extended interviews. 4 interviews per teacher focusing on 2 content areas (expert and non-expert)</td>
<td>Constant comparison</td>
<td>To investigate the influence of subject matter expertise on the PCK of physical education teachers</td>
</tr>
<tr>
<td>Jenkins &amp; Veal (2002)</td>
<td>8 preservice teachers</td>
<td>Observation Post lesson conference Daily written reports</td>
<td>Constant comparison</td>
<td>Describe the kinds of teachers’ knowledge exhibited by preservice teachers during peer coaching activities And how the roles of a teacher and a coach in the peer coaching experience contribute to the development of teacher knowledge during elementary physical education field based methods course</td>
</tr>
<tr>
<td>Study</td>
<td>Participants</td>
<td>Data Collection</td>
<td>Data Analysis</td>
<td>Research Aim</td>
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<tr>
<td>Chen (2002)</td>
<td>3 experts and 3 preservice teachers</td>
<td>2 formal interviews, 18 videotaped lessons</td>
<td>Constant comparison</td>
<td>To compare expert and student teachers on the variables of constructivist PCK as they used movement approaches to teach educational games involving dribbling to elementary children.</td>
</tr>
<tr>
<td>Tsangaridou (2002)</td>
<td>1 preservice elementary teacher</td>
<td>Observations, Documents, Journals, Interviews</td>
<td>Constant comparison, Analytic induction</td>
<td>Describe the enacted PCK of preservice elementary classroom teacher</td>
</tr>
<tr>
<td>Kutame (2002)</td>
<td>1 experienced teacher</td>
<td>Semi structured interviews, Systematic observations (30 minutes lesson), Vide and audio taping of lessons, Field notes</td>
<td>Qualitative and systematic strategies</td>
<td>To examine an experienced elementary physical education teacher’s PCK</td>
</tr>
<tr>
<td>Study</td>
<td>Participants</td>
<td>Methods</td>
<td>Data Analysis</td>
<td>Findings</td>
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<td>-------------------------------------------</td>
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<tr>
<td>McCaughtry &amp; Rovegno (2003)</td>
<td>4 preservice teachers</td>
<td>Interviews, Field observation, Document analysis</td>
<td>Constant comparison</td>
<td>Using the developmental theory to analyze how four preservice teachers develop PCK during a middle school volleyball unit</td>
</tr>
<tr>
<td>Rovegno, Chen, and Todorovich (2003)</td>
<td>4 experienced teachers</td>
<td>Videotape observations of 3 lessons, Formal and informal interviews</td>
<td>Grounded analysis</td>
<td>To describe the enacted PCK of accomplished teachers in a specific content</td>
</tr>
<tr>
<td>McCaughtry (2004)</td>
<td>1 middle school teacher</td>
<td>Case study – 4 months, In depth interview, Observation, Field notes</td>
<td>Constant comparison</td>
<td>Teacher understanding of emotions related to their decisions about content</td>
</tr>
<tr>
<td>Study</td>
<td>Participants</td>
<td>Data Collection Methods</td>
<td>Analysis Method</td>
<td>Research Focus</td>
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<tr>
<td>Chen (2004)</td>
<td>4 preservice teachers</td>
<td>15 weeks observations, field notes, informal and formal interviews, document collection</td>
<td>Constant comparison</td>
<td>To describe salient aspects of PCK that preservice teachers acquired and found problematic</td>
</tr>
<tr>
<td>Jenkins, Garn, &amp; Jenkins (2005)</td>
<td>14 female preservice teachers</td>
<td>Observations, Peer coaching form (praise statement and observation notes)</td>
<td>Inductive analysis</td>
<td>To identify what and how preservice teachers observe when peer coaching during an early field experience</td>
</tr>
<tr>
<td>Doutis (1997)</td>
<td>2 experienced teachers</td>
<td>Interviews, Field notes, Observations</td>
<td>Case and cross case analysis</td>
<td>Examine what instructional practices PE teachers employ in teaching the target content and what are the teachers pedagogical theories (and/or educational beliefs) of volleyball and to what extent are they manifested in their practice</td>
</tr>
<tr>
<td>Study</td>
<td>Participants</td>
<td>Methods</td>
<td>Data Collection</td>
<td>Research Questions</td>
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<tr>
<td><strong>Givens</strong> (1998)</td>
<td>3 expert baseball instructors</td>
<td>Qualitative and quantitative data from videotapes, Interviews and stimulated recall interviews</td>
<td>Arizona state observation instrument, Coaching analysis instrument</td>
<td>To examine, describe and compare types of PCK used by 3 expert skill instructors in three contexts</td>
</tr>
<tr>
<td><strong>McCaughrty</strong> (2001)</td>
<td>2 secondary teachers</td>
<td>Classroom observations, Interviews for 10 weeks</td>
<td>Constant comparison</td>
<td>To investigate 2 secondary PE teachers PCK of students’ experiences</td>
</tr>
<tr>
<td><strong>Whipple</strong> (2002)</td>
<td>Preservice teachers</td>
<td>Interviews, Documented analysis</td>
<td>Constant comparative methods looking at course syllabi, texts, handouts and interview transcripts</td>
<td>To investigated whether or not, and if so, how the preservice teachers viewed they had acquired and applied content and PCK through the completion of the elementary component</td>
</tr>
<tr>
<td>Study</td>
<td>Participants</td>
<td>Data Collection Methods</td>
<td>Data Analysis Methods</td>
<td>Purpose of Study</td>
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<tr>
<td>Benham (2002)</td>
<td>2 expert golf instructors</td>
<td>Repeated observations, Video taping, Simulated recall audio tape interviews, Document analysis, Stimulated recall</td>
<td>Case studies were developed</td>
<td>To describe and analyze the PCK of expert golf instructors</td>
</tr>
<tr>
<td>Schincariol (2002)</td>
<td>2 preservice teachers</td>
<td>Interviews, Observations, Document analysis, Stimulated recall, Conference analysis</td>
<td>Grounded theory analysis</td>
<td>To examine and describe knowledge development in student teachers during a secondary teaching experience in familiar or unfamiliar content</td>
</tr>
</tbody>
</table>

Table 2.1 Literature search findings of studies that investigated PCK in physical education. Dissertations are italicized.
Participants in the PCK studies were mainly preservice teachers (in 13 of 21 studies) who participated in a field based elementary or secondary methods course. Ten studies investigated experienced teachers as participants. One study included both preservice and experienced teachers, and another study involved novice and experienced teachers.

The purpose of this section was to assess: (a) how PCK has been investigated in physical education and (b) to integrate the recommendations that have been made relative to the study of PCK in physical education. To achieve this purpose, the investigator organized the articles around five questions: (1) how has PCK been defined in physical education studies? (2) What have been the major methods used to investigate PCK in physical education? (3) What were the major findings relative to research among preservice teachers? (4) What were the major findings relative to research among inservice teachers? (5) What recommendations have been proposed for the inquiry of PCK in physical education? The author grouped the findings into "inservice" and "preservice" categories, according to the participating teachers in each study. Denoting the second category by the word "inservice" was made only for the purpose of distinguishing the inservice from the preservice category. Nevertheless, the critical characteristic that distinguished the inservice from the preservice teachers was the selection of experienced teachers as opposed to the selection of student teachers, or teacher candidates who participated in a methods course at the time of the study.

How has PCK Been Defined in Physical Education Studies?

A common definition of PCK was initially postulated by Shulman (1986), expanded in 1987, and broadened in 1990 by Grossman (1990) and Marks (1990). The
physical education literature utilized the frameworks by Shulman (1986, 1987), Grossman (1990), and Marks (1990) to conceptualize PCK. Table 2.2 provides details on the year of publication, the authors and the framework they utilized for their study.

**Shulman’s Definition as a Framework**

Nine studies adopted Shulman’s definition of PCK as a framework for their research (Barrett & Collie, 1996; Chen, 1994; Chen & Ennis, 1995; Doutis, 1997; Givens, 1998; Graber, 1995; Graham, Hopple, Manross, & Sitzman, 1993; Kutame, 2002; Rovegno, 1993). These studies focused on the subject matter in physical education, and how teachers acquired and used it. The main rationale was that the teachers’ understanding of the content impacted their teaching (Barrett & Collie, 1996; Chen, 1994; Chen & Ennis, 1995; Doutis, 1997; Givens, 1998; Graber, 1995; Graham et al., 1993; Kutame, 2002; Rovegno, 1993). More specifically, PCK is a unique understanding of particular forms of CK that are teachable to others (Graber, 1995). Graham et al. (1993) argued that such understanding is functional and yet to be acquired by preservice and novice teachers. Graham et al. (1993) explained that functional understanding of the content refers to descriptive terms, key words, demonstrations and effective practice setting that shape the content to be interesting and beneficial to the learners.

Rovegno (1994), however, asserted that Shulman’s definitions (1986, 1987) were insufficient. The definitions were not research based and not consistent (Rovegno, 1994). The definitions were heuristic and did not interact or overlap with one another. Other studies (e.g., Chen, 2002; McCaughtry, 2004; Schempp, Manross, Tan, & Fincher, 1998) utilized Grossman’s heuristic as a framework.
<table>
<thead>
<tr>
<th>Year of Publication</th>
<th>Conceptual framework/</th>
<th>Shulman</th>
<th>Marks and/or Marks and Grossman</th>
<th>Grossman</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td></td>
<td></td>
<td></td>
<td>Rovegno</td>
</tr>
<tr>
<td>1993</td>
<td>1. Graham, Hopple, Manross, &amp; Sitzman</td>
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<td>2. Rovegno</td>
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<td>1994</td>
<td>3. Chen</td>
<td>2.</td>
<td>Rovegno</td>
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<td>5. Graber</td>
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<td>1997</td>
<td>7. Doutis</td>
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<td>2001</td>
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<td>McCaughtry</td>
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<td>4.</td>
<td>Chen</td>
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<td>5.</td>
<td>Tsangaridou</td>
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<td>6.</td>
<td>Whipple</td>
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<tr>
<td>2003</td>
<td>4. Rovegno et al.</td>
<td>7.</td>
<td>Schincariol</td>
<td></td>
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<tr>
<td></td>
<td>5. McCaughtry &amp; Rovegno</td>
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<tr>
<td>2004</td>
<td></td>
<td>8.</td>
<td>McCaughtry</td>
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</tbody>
</table>

Table 2.2 Chroniclcal presentation of conceptualizations of PCK in physical education studies

*Grossman’s Definition as a Framework*

Eight studies (Benham, 2002; Chen, 2002; McCaughtry, 2001, 2004; Schempp, et al., 1998; Schincariol, 2003; Tsangaridou, 2002; Whipple, 2002) utilized Grossman’s
definition as their conceptual framework of PCK (i.e., knowledge of content, students’ understanding of that content, instructional strategies and media, curriculum, and the purpose of teaching). The authors of these studies share the fundamental assumption that the knowledge categories are not secluded from one another and do not develop in isolation. Such studies focused on how curricular knowledge, knowledge about students’ cognition, emotions, and physical abilities, and knowledge of content, blend together to facilitate learning (Benham, 2002; Chen, 2002; McCaughtry, 2001, 2004; Rovegno, 1994; Schempp et al., 1998; Schincariol, 2003; Tsangaridou, 2002; Whipple, 2002). McCaughtry (2001, 2004) was specifically interested in how teachers came to know students and their emotions. McCaughtry relied on Grossman’s (1990) framework in general and on John Dewey’s (1938) educational philosophy more specifically to conceptualize PCK.

Mark’s and Grossman’s Definitions as a Framework

Other studies in physical education preferred a more comprehensive definition of PCK by Marks (1990), whose broad contextual conception captured how a teacher's knowledge integrates content, context, how children learn, and classroom teaching (Rovegno, 1992; Sebren, 1995). Several researchers (McCaughtry & Rovegno, 2003; Rovegno, 1994; Rovegno, Chen, & Todorovich, 2003) mentioned both Marks (1990) and Grossman (1990) when presenting their conceptual framework of PCK. According to these authors, teaching cannot be explained by a single knowledge base (McCaughtry & Rovegno, 2003). Thus PCK is the integration of knowledge of content, of learners relative to the content, of instructional strategies, curriculum, purposes for teaching and
teacher’s values about the subject matter (Gudmundsdottir, 1990; McCAughtry & Rovegno, 2003; Rovegno, 1994; Rovegno et al., 2003).

Cochran, DeRuiter, and King (1993) built on Grossman (1990) and Marks (1990) to propose a model of PCK development among preservice teachers. The model is constructivist, in which preservice teachers construct new knowledge with previous experiences related to teaching. Pedagogical content knowledge in this model is not a new type of knowledge, but rather the product of integration and transformation of four other types of knowledge: knowledge of environmental contexts, of pedagogy, of subject matter, and of students. The five areas of knowledge are described with circles that overlap, and are denoted by edge errors that point outward as a symbol for the growth of knowledge during the teacher’s experiences (Cochran et al., 1993).

Researchers such as Jenkins, Garn, and Jenkins (2005) and Jenkins and Veal (1993) believed that the development of PCK is interactive across context, pedagogy, subject matter, and students, and therefore adopted Cochran’s et al. (1993) model as their framework. The researchers’ investigation also employed preservice teachers, which made the Cochran et al. (1993) model even more suitable as a framework for their research (Jenkins et al., 2005; Jenkins & Veal, 1993).

Summary

The preceding discussion on how the physical education literatures have defined PCK demonstrates that the definitions by Shulman (1986, 1987) and Grossman (1990) were the most widely adopted frameworks. A few studies (McCaughtry & Rovegno, 2003; Rovegno, 1992; Rovegno et al., 2003; Sebren, 1995) utilized the model suggested
by Marks (1990) or discussed the interactive and integrative approach, basing their PCK premise on both Grossman (1990) and Marks (1990). Cochran et al. (1993) conceptualized PCK relative to preservice teachers, and two studies (Jenkins et al., 2005; Jenkins & Veal, 1993) based their premise on the model suggested by Cochran et al.

The selection of the theoretical framework for PCK also shifted over time. The nine studies that adopted Shulman’s definition occurred mostly during the 1990’s (1993-1997). The last author to solely rely on Shulman’s definition was Kutame in 1997, yet this work was published in 2002. These studies focused mainly on the "missing paradigm," on the importance of knowing the subject matter, and on the blending of CK with the general pedagogical knowledge into PCK.

During the 1990’s, some initiatives (McCaughtry & Rovegno, 2003; Rovegno, 1992, 1994; Rovegno et al., 2003; Sebren, 1995) of adopting other models of PCK were more integrative and interactive in nature. The main premise of those studies was that a single knowledge base cannot account for teaching. Pedagogical content knowledge was believed to be an integration of several knowledge bases such as curricular knowledge, CK, knowledge of the learners, of instructional strategies, and of purpose and values of teaching. The first utilization of a different framework than Shulman’s was by Rovegno in 1992.

Seven out of eight studies that were published from 2000 and on derived their definition of PCK almost solely from Grossman (1990). These studies (Benham, 2002; Chen, 2002; McCaughtry, 2001, 2004; Schempp et., 1998; Schincariol, 2003; Tsangaridou, 2002; Whipple, 2002) have demonstrated that the recent physical education
literature asserted that a clear demarcation between PCK and other knowledge bases is not possible. Instead, these scholars preferred to adopt the interactive model suggested by Grossman (1990) when investigating PCK.

What Have Been the Major Methods Used to Investigate PCK in Physical Education?

All of the physical education studies and dissertations reviewed for this section were qualitative in nature. Few studies involved qualitative data as primary data and quantitative data as secondary (i.e., Chen & Ennis, 1995; Doutis, 1997; Givens, 1998; Kutame, 2002; Rink & Werner, 1989). Qualitative data collection methods included observations and field notes, interviews, document analysis, weekly reflections, knowledge importance path finder, concept mapping, conference analysis, written reports and journals, and completion of peer coaching form. Table 2.1 specifies the data collection method that was utilized in each study. The current section will discuss the primary data collection methods, observation and field notes, and interviews.

The observation and field notes data collection methods were highly used. Observations were conducted in 23 of the studies. Researchers observed preservice teachers (Chen, 2002, 2004; Graham et al., 1993; Jenkins & Veal, 2002; McCaughtry & Rovegno, 2003; Rovegno, 1992; 1993; 1994; 1995; Schincariol, 2002; Sebren, 1995; Tsangaridou, 2002; Whipple, 2002) and inservice teachers (Barrett & Collie, 1996; Benham, 2002; Chen, 2002; Chen & Ennis, 1995; Doutis, 1997; Givens, 1998; Graham et al., 1993; Kutame, 2002; McCaughtry, 2001; Rovegno et al., 2003), who taught content such as basketball, ball games unit, volleyball, badminton, and dribbling, for elementary and secondary students. Practices such as the content of learning tasks, explanations,
tasks’ progressions, demonstrations, feedback, the organization of class, and when possible, the students’ verbal and motor responses were observed (McCaughtry, 2004; Rovegno, 1995). Kutame (2002) and Doutis (1997) used the modified tasks structure observation system to code and analyze the teacher’s practices and the students’ responses. Givens (1998) utilized the Arizona State Observation Instrument (ASUOI) to collect data on batting instructions. The ASUOI included observations on various instructional and managerial behaviors such as use of first name, questioning, modeling, and praise. Observations were not only on teachers’ practices, but also on their planning and preparation for class (McCaughtry & Rovegno, 2003). Field notes were also taken during the observations (Rovegno, 1992).

Interviews were utilized in 20 of the studies. The interviews were typically comprised of open ended questions, and were conducted prior to, during, or after the conclusion of the observation period (Chen, 2002, 2004; Chen & Ennis, 1995; Doutis, 1997; Givens, 1998; Graber, 1995; Graham et al., 1993; Kutame, 2002; McCaughtry, 2001; McCaughtry & Rovegno, 2003; Rovegno, 1992, 1993, 1994, 1995; Rovegno et al., 2003; Schempp et al., 1998; Sebren, 1995; Schincariol, 2002; Tsangaridou, 2002; Whipple, 2002). The interviews ranged from single one-shot interviews (Chen, 2004; Kutame, 2002) to 38 interviews conducted over the span of four months (McCaughtry, 2004).

The teachers were asked about their past subject matter experiences and background, their history as learners, their conceptions of students’ learning, the variables that impact their decision making, their teaching strategies, and what they would do.
differently if they were to teach a similar unit of instruction (Chen, 2002, 2004; Chen & Ennis, 1995; Doutis, 1997; Givens, 1998; Graber, 1995; McCaughtry, 2001; McCaughtry & Rovegno, 2003; Rovegno, 1992, 1993, 1994, 1995; Schempp et al., 1998; Schincariol, 2002; Sebren, 1995; Tsangaridou, 2002; Whipple, 2002).

In a series of interviews, Schempp et al. (1998) asked the participants to plan two hypothetical instructional units for middle school, one in their area of expertise, and the other in a non-expert subject matter. For both units, the participants were required to specifically describe how they would organize and implement the unit, elaborate on the equipment needed, teach the skills and knowledge, and anticipate problems. The teachers were also questioned about their expectations of students. Schempp et al. (1998) were trying to assess the alignment between the teachers’ reports and their actual practices. Students (and not only teachers) were also interviewed. Kutame (2002) conducted a focus group debriefing interview session with the learners to assess the understanding they acquired as a result of the teacher’s practices.

Only rarely did studies utilize a quantitative data collection method in addition to interviews, as it was not the purpose of the investigation. Givens (1998) collected both qualitative and quantitative data on expert baseball instructors’ PCK. Kutame (2002) and Doutis (1997) examined the teacher’s instructions using a modified task structure observation system (Rink & Werner, 1989). They reported data such as the type of tasks, time distribution during the lesson, frequency and duration for practice tasks, task communication data, selection of cues, and feedback for students and students’ responses to the practice tasks. Chen and Ennis (1995) utilized the pathfinder networking to
generate the teachers’ knowledge. The pathfinder is a concept mapping approach that allows analyzing the perceived relatedness between selected items. As such, the data reported similarities between CK terms coefficients.

Nine studies involved preservice teachers as participants, and nine entailed the inquiry of PCK among inservice teachers. Finally, four studies (Chen 2002; Graber, 1995; Graham et al., 1993; Rovegno, 1993) investigated the PCK of both preservice and inservice teachers. Studies among preservice teachers examined how the PCK of those teachers developed in the context of a field-based elementary physical education methods course (Chen, 2004; Jenkins & Veal, 2002; Rovegno, 1992; Sebren, 1995). The elementary methods courses exposed students to the skill theme approach suggested by Graham, Holt/Hale and Parker (1998; Chen, 2004); employed the planning-teaching-reflecting of teaching as the primary structure and content (Rovegno, 1992); or were conceptualized, organized, and evaluated around the concept of the teacher as a decision maker in three chief areas: management, content, and teaching strategies (Sebren, 1995). In two studies (Jenkins et al., 2005; Jenkins & Veal, 2005), preservice teachers were trained in peer coaching, implemented during the methods course. The examination of PCK development was in the coaching oriented methods course. The preservice teachers were paired and served as teachers or observers. When one teacher was teaching, the other was coaching, observing the teaching practices, and providing positive and corrective feedback during a post conference.

The remainder of the studies examined the development of PCK of preservice teachers in different contexts: during secondary school internship (Schincariol, 2002),
and during student teaching in elementary (Rovegno, 1994, 1995), middle (McCaughtry & Rovegno, 2003), or high school (Rovegno, 1995). In the secondary school internship, Schincariol (2002) specifically examined the PCK of preservice teachers who taught two instructional units they perceived as familiar and unfamiliar. Whipple (2002) examined PCK in context of the completion of the elementary education components of a physical education teacher education program. Finally, Tsangaridou (2002) investigated the PCK of a preservice classroom teacher learning to teach physical education in elementary school, during her teaching experience.

Studies among inservice teachers employed participants who taught in elementary school (Barrett & Collie, 1996; Doutis, 1998; Kutame, 2002; Rovegno et al., 2003), middle school (Chen & Ennis, 1995; McCaughtry, 2004; Schempp et al., 1998), and high school (McCaughtry, 2001). Other studies examined the PCK of expert skill instructors (Benham, 2002; Givens, 1998). Years of teaching ranged from one to over 20 years. The selection of the inservice teachers varied. Investigators selected participants according to their expert characteristics (Benham, 2002; Chen & Ennis, 1995; Givens, 1998; Rovegno et al., 2003), sufficient number of years of teaching (Rovegno et al., 2003; Schempp et al., 1998), experience, and quality of teaching (Doutis, 1998; McCaughtry, 2001, 2004). Barrett and Collie (1996) investigated selected elementary physical education specialist during an eight-hour Lacrosse teaching workshop.

Four studies examined the PCK of both preservice and inservice teachers (Chen, 2002; Graber, 1995; Graham et al., 1993; Rovegno, 1993). Rovegno (1993) selected participants who were in their final years of the physical education teacher education
program, and first-year teachers who held an elementary school position. Graber (1995) interviewed student teachers, cooperating teachers, and teacher educators who were willing to participate in a study examining their PCK, general pedagogical knowledge and beliefs about physical education teacher education programs and their current practices. Chen (2002) selected student teachers and expert elementary physical education teachers, to compare how they used a movement approach to teach educational games involving dribbling. Graham et al. (1993) occupied three experienced elementary school teachers and their three student teachers. All of the participants were asked to teach the same skill, hand dribbling, to third, fourth, and fifth grade classes.

Summary

Overall, the studies examining PCK in physical education employed interviews, observation, and field notes as primary data collection methods. The participants of these studies were preservice and inservice teachers. The preservice teachers were studied typically in the context of elementary or secondary methods course, or during their student teaching period. The researchers in those studies inquired about the development of PCK throughout the methods course. Other studies employed inservice teachers, who were selected most often for their teaching qualities, experience, and expertise in the area of physical education. Only four studies included both preservice and inservice teachers to compare between the development, acquisition, and demonstration of PCK.

What Were the Major Findings Relative to Research Among Preservice Teachers?

Preservice teachers reported the development of PCK as a salient factor in the process of learning to teach (Rovegno, 1992; Schincariol, 2002), and on aspects of school
culture (e.g., lack of administrative support for physical education) as prominent to their PCK (Rovegno, 1994). Chen (2004) found that preservice teachers acquired four aspects of PCK in the context of learning the skill theme approach: (a) New conceptions of instructional methods such as providing maximal successful activity time to each student, and providing creative and exploratory learning experiences; (b) developing and presenting learning tasks that include both movement variety and movement quality in these tasks; (c) understanding children’s developmental level and proscribing appropriate learning tasks (Chen, 2004; Sebren, 1995); and (d) gaining knowledge of instructional strategies. Teachers used demonstrations, metaphors, examples, and pedagogical strategies to present the content to the learners (Chen, 2004).

Inadequate PCK for teaching was linked to weak CK (Chen, 2004; Graber, 1995), difficulties providing appropriate feedback (Rovegno, 1995; Whipple, 2003), inaccurate prediction of how students learn (Rovegno, 1995), and inappropriate discrimination of skill level (McCaughtry & Rovegno, 2003; Rovegno, 1992). The inaccurate prediction of students’ level was followed by inadequate lesson planning and difficulties executing the lesson plan (Graber, 1995; McCaughtry & Rovegno, 2003). Conceptions of knowledge and learning, then, can help explain and influence teachers’ actions during the lesson (Rovegno, 1995). Furthermore, CK is critical to the development of PCK (Rovegno, 1995; Schincariol, 2002). The importance of CK was strongly supported by Tsangaridou (2002) who found that preservice teacher’s conceptions of learning and understanding of the CK influenced the content decisions and actions. Whipple (2003) found that CK was important for the ability to provide specific feedback. Chen (2004) reported a similar
finding, noting that PCK was problematic due to weak CK. Schincariol (2002, p. 261) found that “the possession of general pedagogical knowledge and CK does not necessarily translate into the possession of PCK.”

Rovegno (1994) explained further aspects of PCK. As preservice teachers in high school began to learn the aspects of the school’s culture, discipline, lack of administrative support, and students and teachers’ subcultures, they reverted to application tasks (Rink, 2006) and simply had the students play games. Such scenario indicates a “curricular zone of safety” (Rovegno, 1994, p. 272) and represents how PCK develops in the relationships among the teacher, the activity of teaching, and the school culture. In other words, Rovegno (1994) concluded that PCK is constituted by culture.

Improved PCK was linked to more acute observations of children’s movement, and enhanced capacity to match tasks with students’ abilities (Jenkins et al., 2005; Jenkins & Veal, 2002; McCaughtry & Rovegno, 2003; Rovegno, 1992). Guided and systematic observation of teaching practices and the learners one is about to teach was found to be effective. Coaches and preservice teachers became familiar with students, how they learn, and their difficulties (Jenkins et al., 2005; Jenkins & Veal, 2002). The development of PCK appeared as a shift in focus from a general level of content to a more detailed level of what and how the preservice teachers wanted their students to learn (Rovegno, 1992). Also as PCK developed, the teachers tended to avoid blaming students for lack of success, while acknowledging deficiencies in their own teaching knowledge. This shift was different than findings by Tsangaridou (2002) who indicated that the student teacher blamed herself when teaching had failed. A shift from not recognizing
students’ emotions (such as boredom, motivation, lack of success) to a better understanding of students’ emotions was also recognized (McCaughtry & Rovegno, 2003). Finally, the development of PCK was also reflected by enhanced use of professional vocabulary learned in methods classes, and transferred into action during the actual teaching (Jenkins et al., 2005; Jenkins & Veal, 2002). For instance, preservice teachers and their assigned coaches increased the use of words such as assessment, easy and harder drills, progressions, and on task (Jenkins et al., 2005).

In contrast to the findings of improvement in PCK of preservice teachers (McCaughtry & Rovegno, 2003; Rovegno, 1992), Graber (1995) noted that student teachers had difficulties reporting their PCK. Furthermore, the student teachers claimed they did not receive any specific instructional training relative to the CK they were to teach in physical education (Graber, 1995). Sebren (1995) found a lack of development of PCK of preservice teachers who participated in an elementary methods course. The preservice teachers could not respond pedagogically to their learners (Cheh, 2004; Sebren, 1995). Sebren (1995) argued that the preservice teachers’ PCK was declarative, one that developed throughout reflections. Declarative knowledge was different than PCK in practice. The preservice teachers lacked the knowledge of how to appropriately respond to students, and what to do to assist students to perform what the teachers were trying to teach. Nevertheless, Tsangaridou (2002) reported on a classroom teacher who was training to teach elementary physical education, and demonstrated she was able to transform CK to PCK in a comprehensible way to the students, perhaps because of her
good understanding of the CK. She used demonstrations and explanations to facilitate students’ learning. She also provided students with ample opportunities to respond.

**Summary**

The research described in the current section suggests that methods classes and field teaching experiences provide preservice teachers with opportunities to develop some aspects of knowledge about teaching, about the content, and about the learners. Nonetheless, preservice teachers repeatedly reported difficulties and lack of ability to appropriately respond the students’ action during the lesson. Based on the findings, there are two chief factors critical to the development of PCK: familiarity with the CK, and familiarity with the learners and their conceptions. Unfamiliarity with these two factors resulted in inappropriate lesson plans and weak demonstration of PCK. Yet when preservice teachers were more familiar with the CK and the learners, they reported an improved ability to respond to the learners, assign appropriate learning tasks, and provide appropriate feedback (Chen, 2004; Jenkins et al., 2005; Jenkins & Veal, 2002; McCaughtry & Rovegno, 2003; Rovegno, 1992, 1995; Sebren, 1995; Tsangaridou, 2002; Whipple, 2003).

*What Were the Major Findings Relative to Research Among Inservice Teachers?*

Inservice teachers reported they acquired CK from classes, workshops, text books, and other curricular material. For their planning, they used equipment and teaching aids, regardless of their level of expertise in the subject matter (Barrett & Collie 1996; Graham et al., 1993; Kutame, 2002; Schempp et al., 1998). Novice teachers mostly used books and classes as resources for planning. Experienced teachers primarily relied
on their previous experiences with children (Graham et al., 1993). The CK inservice teachers valued as primary goals was the acquisition of basic skills and knowledge (Schempp et al., 1998). Teachers reported they felt students improved their technical skills more than their game play skills (Doutis, 1997).

Inservice teachers demonstrated an understanding of the teachability of the CK (Chen & Ennis, 1995). They identified core ideas that are teachable by including or excluding concepts and skills from the curriculum. All of the teachers in the study by Chen and Ennis (1995) had the understanding of teachable concepts and skills and agreed on those concepts and skills. Despite the same CK, the teachers had different curricular goals for students learning. Although they all possessed PCK, the PCK was personalized, differing from one teacher to another. Therefore, the delivery of the content was also different (Chen & Ennis, 1995; Doutis, 1997). The teachers used diverse activities and drills to teach the same skills and concepts (Chen & Ennis, 1995; Rovegno et al., 2003). The teachers’ presentations included metaphors, images, and stories to make the content more comprehensible for the students (Rovegno et al., 2003). The teacher who taught how to perform the cartwheel reported that prescribing simple progressions that were appropriate to the students’ skills and abilities resulted in successful teaching of the students (Kutame, 2002).

The curriculum employed by inservice teachers included CK and skills the teachers perceived as "basic," hence teachable, in their school setting. More advanced skills of the sport the teachers taught were excluded from the curriculum and were considered to be difficult to teach in a school setting for a specific group of learners.
McCaughtry (2004), on the other hand, asserted that the teacher’s understanding of the students’ emotions influenced her selection and ordering of the content. Understanding students’ emotions was critical to the teacher’s understanding of teaching in general, and of PCK in particular.

Several researchers discussed about teachers’ various ways of limiting the content to be presented to the students. For example, Rovegno et al. (2003) found that experienced teachers used only small numbers of learning cues to improve students’ performance. The “less is more” concept derived the teachers’ use of learning cues (Rovegno et al., 2003). Chen and Ennis (1995) found that a teacher taught eight volleyball skills, while using a total of 12 learning cues for those skills (almost 1:1 skill-learning cue ratio). Graham et al. (1993) found that experienced teachers used more cues than novice teachers.

Chen and Ennis (1995) reported that teachers who taught volleyball used a total of 121 terms. The wealth of terms indicates the teachers’ rich content knowledge in volleyball. Kutame (2002), similarly to Chen and Ennis (1995), concluded that the inservice teacher who participated in his study had rich CK. Kutame (2002) made this conclusion because the teacher in his study was able to present the content in ways that facilitated learning, had great ability to provide cues and prompts, to detect errors, and to provide congruent feedback. The teacher also selected, organized, and presented the cues appropriately and accurately (Kutame, 2002). Schempp et al. (1998) asserted the teachers in their study exhibited rich progressions of skills and concepts, and described those in detail. Kutame (2002) noted that the content rich teacher in his study was only partially
capable of identifying critical and technical elements of the skill. The teacher used verbal instructions most of the time. He did not use teacher demonstrations of the cartwheel, and instead, did little use of students’ demonstrations. Kutame (2002) concluded that a combination between strong PCK and CK brought about high rate of students’ success.

Interestingly, the research has revealed a gap between the teachers' expectations and the curricular decisions they made. The gap indicates that teachers' understanding of the CK to be taught was primarily determined by their personal perception of students’ learning, competency, and ability. In that case, the teachers were reluctant to teach more advanced skills because they believed that the students were not yet capable of learning those (Chen & Ennis, 1995; Schempp et al., 1998). This is an example for teachers’ perceptions of students’ learning as a factor that significantly dominated the curriculum (Chen & Ennis, 1995).

Other practices employed by inservice teachers were teaching students to monitor their own learning (i.e., self-regulate), to analyze and critique their performance, and to make decisions regarding their performance (Rovegno et al., 2003). The inservice teachers made connections between skills and learning cues, and the tactical aspects of games. The teachers also made connections between the content (i.e., skill) and the game, instead of presenting arbitrary information. Furthermore, the teachers connected the CK to other content, and to students’ lives (Chen & Ennis, 1995; McCaughtry, 2004; Rovegno et al., 2003).

When teaching their expert areas, teachers reported on students’ motivation as the greatest barrier for learning. In the non-expert subject matter, teachers reported difficulty
locating an appropriate number of activities to facilitate learning. The teachers were confident they could devise activities to overcome learning difficulties when teaching their expert areas. Yet, in the context of teaching their non-expert area, they were concerned about their limited ability to anticipate students’ ability and find solutions for their performance as they encountered problem. This outcome very much resembled the concerns reported by preservice teachers. Another similarity to preservice teachers was when inservice teachers selected content for their non-expert area simply because they were able to transport it into the lesson, and not because it was the appropriate progression to use for learning purposes (Rovegno, 1992; Schempp et al., 1998).

Both novice and experienced teachers had written lesson plans. The former over-planned while the latter under-planned, although it is hypothesized that experienced teachers’ preparation includes mental planning prior to the lesson. Novice teachers heavily consulted the lesson plan while teaching. Often is seemed that the novice teachers were more focused on teaching the content than on teaching the learners. Experienced teachers however, relied heavily on their past experiences when planning for the lesson (Graham et al., 1993). Particularly when teaching their expert areas, experienced teachers reported no need for preparation, a situation also called “plan independence” (Graham et al., 1993; Schempp et al., 1998). They modified their instruction according to their learners (Graham et al., 1993).

Experienced teachers exhibited more confidence and enthusiasm when they taught their expert area than when they taught their non-expert area. For the latter, they seek additional resources such as consulting with other colleagues who already taught the
content or were experts in it. In their expert areas, the teachers were also confident that they could organize the skills and activities in a way that will accommodate many environmental variations. Yet, they expressed more concern relative to planning and teaching their non-expert areas, and searched for assisting resources. In contrast, other elementary teachers, non-experts in volleyball, were confident they could teach the game well enough to elementary school students (Doutis, 1997). Finally, the use of instructional strategies to accommodate the range of the learners’ skills and abilities was much more effective when teachers taught their expert areas (Schempp et al., 1998).

**Summary**

The literature indicates that inservice teachers critically consider the CK and its teachability to students, and make curricular decisions based upon these considerations. Thus, inservice teachers consider both CK and students’ conceptions when selecting content for their curriculum (Chen & Ennis, 1995; Schempp et al. 1998). Yet, some teachers were found to have misconceptions about students’ abilities (Schempp et al. 1998). Teachers’ PCK was found to be personal, as they delivered the same CK differently. The teachers also had high ability to provide abundant examples, progressions, and learning cues that enhance learning (Chen & Ennis, 1995; Doutis, 1997). Experienced teachers were more student driven. Novice teachers were more content driven (Graham et al., 1993). When teaching their expert area, teachers were more confident in teaching, more enthusiastic, independent of planning, and were able to accommodate for variations in students' learning. When teaching their non-expert areas however, the teachers they were less confident. They reported limited ability to
incorporate appropriate activities into the lesson, and lack of competency in assisting students to overcome learning difficulties as those occurred (Schempp et al., 1998).

What Recommendations Have Been Proposed for the Inquiry of PCK in Physical Education?

Advanced knowledge domains such as knowledge about content, about teaching, and about the learners ought to precede the acquisition of PCK (Kutame, 2002; Sebren, 1995). Methods courses that provide the opportunities for such acquisition may be a suitable means for the inquiry and for the development of PCK (Chen, 2004). Those courses should center on the subject matter to be taught in schools (Kutame, 2002). Schincariol (2002) recommended examining carefully what is presented in methods classes and how is it being interpreted and implemented by the students.

Additionally, the teacher’s ability to detect and to correct errors, while communicating it appropriately to the learners, was considered to be PCK. Kutame (2002) therefore proposed that teacher educators should also emphasize skill analysis training. Chen and Ennis (1995) acknowledged that preservice teachers should gain substantial PCK. The acquisition can be accomplished during the performance course in a teacher education program (Chen & Ennis, 1995; Whipple, 2002). Yet Kutame (2002) pointed out that PCK does not automatically develop as a result of the acquisition of other knowledge domains in a teacher education program. Therefore PCK needs to be directly taught (Schincariol, 2002).

Peer coaching experiences may also contribute to the development of PCK (Jenkins et al., 2005; Jenkins & Veal, 2002). Participants of the peer coaching sessions
reported not only that they enjoyed the coaching experience, but they also improved their teaching practices (Jenkins & Veal, 2002). Despite the social validity of peer coaching, it is still unclear whether the coaching experiences are worthwhile relative to time and energy investment (Jenkins et al., 2005). Jenkins and Veal (2002) recommended further examination of how preservice teachers’ knowledge develops during peer coaching in other subject matters. Lastly, Schincariol (2002) argued that PCK develops as a result of repeated teaching of the same instructional unit and increased familiarity with the content knowledge. Consequently she recommended an investigation of teachers teaching an unfamiliar instructional unit and the time it takes them to become more familiar and more comfortable with the content. Both Whipple (2002) and Schincariol (2002) advocated for longitudinal studies to explore how PCK develops.

As early as 1992, Rovegno recommended an experimental focus of PCK within individual/task/environment interactions across various contexts. Her call was followed by various attempts to examine PCK, mostly using qualitative methods. Rovegno’s (1992) suggestion is valuable, yet may be a premature one as PCK in the early 90’s was yet to be operationally defined, and therefore could not have been measured. This was true in 1992, and still holds true for 2006, more than a decade later. Kutame (2002) and Schincariol (2002) recommended that future inquiries of PCK ought to consider the teacher’s prior knowledge and students’ understanding of the content taught. Two of the research sub-questions of the current investigation attempt to address the recommendations made by Kutame (2002) and Schincariol (2002). Schincariol (2002) also recommended research that will examine how teachers come to know about
students’ conceptions and misconceptions, what clues they might rely on, and what questions they should ask to obtain this information.

Several researchers espoused different ways of examining and discussing PCK. For instance, Graham et al., (1993) asserted that teaching experience is critical to PCK development. Therefore researchers should continue exploring the differences between novice and expert teachers. This type of comparative research would allow novice teachers to achieve expertise sooner. While Graham et al. (1993) discussed PCK development, Barrett and Collie (1996) focused on the identification and examination of PCK. They suggested that PCK can be identified by describing students’ performance in relation to the teacher’s actions. Accordingly, PCK can be examined if one understands the link between students’ performance and teacher’s actions. McCaughtry (2001, 2004) argued that teachers’ understanding of students’ emotions is an integral part of PCK and therefore should be investigated. McCaughtry (2004) also proposed adding interviews of students to the current methodology employed in PCK studies, to validate the teacher’s conceptions of students’ emotions.

Research on preservice classroom teachers who teach physical education is scarce. Tsangaridou (2002) recommended conducting more research in the context of regular classrooms, to further explore the concept of PCK. Such exploration may assist in the design of pedagogical courses that improve the PCK of physical education for classroom teachers.

Most of the recommendations for research on PCK in physical education evolved around the development of PCK, while only few addressed a refinement of the study of
PCK. Researchers in physical education acknowledged the merit of teacher education programs in contributing to the development of PCK among preservice teachers (Chen, 2004; Kutame, 2002; Sebren, 1995), via method courses (Chen, 2004), via the employment of peer coaching in those courses (Jenkins et al., 2005; Jenkins & Veal, 2002), or via other classes in the teacher education program (Kutame, 2002).

Recommendations for future research of PCK in physical education are scarce. Early in 1992, Rovegno recommended studying PCK experimentally. Nonetheless all of the studies conducted since then were qualitative in nature, perhaps owing to the lack of operational definition of PCK and the difficulty of measuring PCK as a variable. Other researchers recommended further inquiry of teacher’s knowledge, student’s knowledge, and teacher understanding of students’ emotions (Kutame, 2002; McCaughtry, 2004). Pedagogical content knowledge can be discovered by examining students’ performance relative to the teacher’s responses, incorporating interviews with students to the current traditional methodology of investigating PCK, and further exploring PCK through the differences between novice and experienced teachers. Whipple (2002) recommended observations as a supplement to support or refute interviews.

Researchers argue that expertise (i.e., frequent demonstration of appropriate PCK) is context specific and therefore should be studied in a particular context (Benham, 2002; Givens, 1998), with participants from diverse developmental levels (Givens, 1998). Therefore, the investigation of PCK should be conducted in limited scope and in a specific context (Benham, 2002). Givens (1998) suggested that inquiry in coaching settings may discover more about effective practices in physical education settings.
Further, Whipple (2002) argued that studying PCK in the same context under similar conditions would contribute to the PCK as acquired by preservice teacher.

This part of the literature review provided lean recommendations for the study of PCK in physical education. Although the studies were conducted among teachers with a range of experiences and expertise, none of the studies attempted to operationally define PCK and its ability to be observed and measured. For the majority of the studies, this was not one of the research objectives.

**Critique of How Pedagogical Content Knowledge Has Been Conceptualized and Investigated**

This section provides a critical review of the way PCK has been conceptualized and investigated in the general education and in the physical education literature. The critique of the literature will be followed by a proposal for revised definition of PCK.

Pedagogical content knowledge was initially identified as one knowledge domain in addition to CK and curricular knowledge. All three knowledge domains were identified by Shulman (1986) as required for teaching. The uniqueness of PCK among the three was that PCK represented the blending of CK with pedagogical knowledge. In 1987, PCK was one of seven knowledge domains required for teaching. At that time, PCK was refined by Gudmundsdottir and Shulman (1987) and Marks (1990) to be derived from three knowledge domains, and not only two as described in 1986. The PCK was now derived from CK, pedagogical knowledge, and knowledge of the learners and previous PCK experiences. Grossman (1990) conceptualized PCK differently. According to Grossman (1990), PCK was derived from four knowledge domains: (a) Conceptions of
purposes for teaching, (b) knowledge of students’ understanding, (c) curricular knowledge, and (d) knowledge of instructional strategies.

The extension of the PCK definition by Gudmundsdottir and Shulman (1987), and by Grossman (1990) is commonly used in the general education and in the physical education literature, which provides an indication of its acceptability (Bullough, 2001; Segall, 2004). Nevertheless, none of those definitions have been operationally defined. The relevant questions become: “How can PCK be identified when one observes teaching?” “Can PCK be observed?” “Can PCK be measured?” And “How does one determine whether the PCK demonstrated was appropriate or inappropriate in a specific context?”

Methodological Issues Relative to Pedagogical Content Knowledge

The absence of an operational definition for PCK has, understandably, impacted the methods used to investigate PCK. All of the studies of PCK in the general education as well as in the physical education literature adopted the qualitative methodology which typically involved teacher questioning using inferential techniques, concept mapping, card sorting, diary writing, or a combination of methods (Baxter & Lederman, 1999; Driel, 2001; Lee, 2002; Loughran et al., 2001, 2004; Penso, 2002). The methodology in all of the physical education studies on PCK was qualitative as well observations, field notes, interviews, document analysis, weekly reflections, knowledge importance path finder, concept mapping, conference analysis, written reports and journal, and completion of peer coaching form (e.g., Chen, 2002, 2004; Graham et al., 1993; Jenkins & Veal, 2002; McCaughtry & Rovegno, 2003; Rovegno, 1992, 1993, 1994, 1995; Schincariol,
Seldom have studies incorporated quantitative data in addition to interviews (e.g., Chen & Ennis, 1995; Givens, 1998; Doutis, 1997; Kutame, 2002; Rink & Werner, 1989).

Summary

The preceding literature review has resulted more in descriptions of PCK and recommendations that (a) one ought to have more of PCK and that (b) teacher education programs ought to teach PCK. All researchers agree that PCK is an important dimension of teaching, with significant implications for teachers’ training. Nevertheless, each study concludes with a recommendation of what one ought to do versus what one should do. The studies conclude that CK is important and related to PCK yet an explanation as to how is CK related to PCK is still absent. It is also still unclear what PCK exactly is. General education as well as its physical education counterpart is still at the descriptive phase of the inquiry of PCK. Pedagogical content knowledge lacks an operational definition that allows for measurement. An operational definition is a prerequisite to valid observation, measurement, and experimentations that may result in a better understanding of PCK. Such a step would allow Rovegno’s (1992) recommendation to occur, if one agrees that for a better understanding of a phenomenon, one has to manipulate the environmental conditions (Cooper, Heron, & Heward, 2007; Skinner, 1953). The lack of operationalization is an impediment to understanding PCK.

From the various definitions of PCK postulated and refined by Shulman (1986), by Gudmundsdottir and Shulman (1987), Marks (1990) and by Grossman (1990), one can conclude the following: PCK cannot be investigated in isolation (Grossman, 1990;
Marks, 1990). Pedagogical content knowledge involves features such as the previous
experiences teachers bring with them into the educational setting; their purpose of
teaching; their familiarity with the learners, with instructional strategies, and with the
CK; the pedagogical knowledge; and the curricular knowledge.

The difficulties of observing and measuring PCK led the author to modify the
definition of PCK to make it operational, and to formulate a model that explains the
development of PCK. The PCK modified definition and the model were substantially
informed by the author’s epistemological beliefs. The following sections will explain the
modified PCK definition, the theoretical framework that informed the definition and that
underpinned this study, and the re-conceptualization of PCK development that followed.

An Operational Definition of Pedagogical Content Knowledge

While PCK may be a product of blending of several knowledge domains, it is
critical to operationally define PCK, from an experimental point of view, to be able to
observe it and measure it. Therefore, the author proposed modified definition of PCK:

*Pedagogical content knowledge is the act of selecting content from one’s knowledge base
for the purpose of teaching in a specific context.* The act of selection from one’s
knowledge base can take several forms: (a) selection of content to be included in the
lesson plan, (b) enactment of the content in the actual act of teaching, and (c) repeated
interactions with the same content. The first form is selection of the content to be
included in the teachers’ lesson plans as part of planning. Selection is the choice of drills,
activities, and “the modes of teaching, organizing, managing, and arranging the lesson”
Lesson plans are considered to be a legitimate data source for gauging the teachers' content knowledge.

Second, enactment of content in the act of active teaching refers to the choices the teacher makes relative to how to represent the content to the learners. These choices include, but are not limited to, representation of the content using analogies, questioning, demonstrations, and explanations. Studies investigating PCK in the physical education literature examined teaching practices such as demonstrations, questioning, examples, types of tasks provided, and the use of learning cues (e.g., Doutis, 1997; Kutame, 2002).

The final form of selection involves practice and refinement of the content in the form of repeated interactions with the same content as directly derived from Shulman’s (1986) definition. Teachers’ repeated engagement in an instructional unit develops PCK that is specific for that particular unit of instruction (Givens, 1998), and fosters the development of specific PCK. An example would be when a teacher teaches the same basketball lesson four times a day. If the teacher is reflective, it is likely that the last lesson delivered is better than the first one, as a function of repeated teaching of the same content, and increased familiarity of the teacher with the learners.

The act of selecting what to teach is influenced by the variables identified by Grossman (1990): (a) conceptions of purposes for teaching. For example, the teacher’s conception may be that students should learn fundamental motor skills at the lower grades of elementary school; (b) knowledge of students’ understanding. An example is knowing whether the students have played the sport before, understanding their developmental level, appropriately discriminating their skill level and proscribing
appropriate learning tasks to them (Chen, 2004; McCaughtry & Rovegno, 2003; Rovegno, 1992; Rovegno, 1995; Sebren, 1995); (c) curricular knowledge, which refers to types of curriculum in physical education; (d) knowledge of instructional strategies such as using the exploration form, direct instruction, or peer tutoring; And lastly, (e) knowledge of the context. Surprisingly enough, knowledge of the context was not identified as an influencing factor on PCK by any of the PCK investigators in the general education arena. The reason may be the unique nature of the physical education setting that often includes considerations which are not applicable to the general classroom. Those considerations include the type and amount of equipment, space in the gym, indoor or outdoor instructional unit, weather, sharing space and equipment with other teachers, and number of children in the class.

The act of selecting what to teach and then teaching it is followed by a process of adaptation to students’ characteristics (Shulman, 1987). This tailoring process includes, but is not limited to attending to, students’ responses and difficulties, their conceptions and misconceptions, demographic characteristics (e.g., sex, age, and social class), aptitude, interests, and attention. Adaptation includes and results in appropriate modification of the instruction to the students’ characteristics. At the micro level, the adaptation might occur when the teacher delivers instruction that results in an individual student’s misunderstanding. In that case, the teacher will utilize a different method (e.g., demonstration, analogy) of conveying the message to the student, to better illustrate the content. At the macro level, adaptation represents the reflection of the teacher on his/her teaching, and the subsequent changes the teacher incorporates into future teaching. The
The proposed operational definition was substantially informed by the author’s behavioral epistemological beliefs and her history and past experiences as a behavior analyst. In the following section the author presents the theoretical framework that underpinned this study, and explains PCK through the behavioral lens.

The Theoretical Framework of This Study

The theoretical framework that underlies this research is behavior analysis. Behavior analysis’ goal is to understand and to improve human behaviors (Cooper et al., 2007). This study was conducted according to the assumptions and methodology that characterize behavior analysis. One of the basic assumptions of behavior analysis is that there are interactions and relationships between the behaviors of the individuals and their environment (Cooper et al., 2007). The next section will explain what behavior is and what the environment is, and will describe the relationship between behavior and environment from a behavioral perspective.

The Relationship between Behavior and Environment

This section refers only to operant behaviors, as respondent behaviors were not a focus of the current investigation. Operant behavior is an activity or movement that is a result of the interaction between the human being and the environment. It can be measured directly or indirectly, and results in detectable and measurable changes in the environment (Johnston & Pennypacker, 1993). Human beings emit overt (i.e., outside the body) and covert (i.e., inside the body) behaviors (Skinner, 1953, 1974). For example, a teacher’s demonstration of the long jump is a behavior emitted outside the body. A preservice teacher running through the lesson plan in her mind prior to teaching it is an
example for behavior that takes place inside the body, often called thinking. Thinking typically cannot be detected by the naked eye; however, it is still an operant behavior, just like any other behavior that occurs outside of the body (Skinner, 1974).

The environment is the world surrounding the individual (Skinner, 1953; Cooper et al., 2007). The term stimulus describes an aspect of the environment, and differentiates it from another aspect (i.e., stimulus). A stimulus can be a condition, an event, or alteration in the physical world. Similar to behavior, a stimulus can occur inside or outside of the body, and it can be described (Cooper et al., 2007). For example, the hands of the watch are a stimulus for the teacher to end the lesson.

Contingencies in the Environment

There are causal relationships between the environment and the individual, also known as the three term contingencies. Therefore, the environment individuals experience during their lives is a major influence on their behavior. The role of this environment is mediated through learning. The stimuli of the environment that immediately precedes the behavior are antecedents, and those that occur immediately after the behavior are consequences (Johnston & Pennypacker, 1993).

When describing the functional relationship between the environment and the individual in the classroom, it is essential to clearly define the target behavior of the individual. There are two possibilities to analyze the functional relationships: (a) defining the student’s behavior or (b) defining the teacher’s behavior, as the target behavior. Analyzing a student’s behavior typically includes the behaviors of the teacher or other students in the classroom as antecedents. The target behavior is the student’s response.
The teacher’s or the other students’ response to the target behavior are the consequences of this event. For instance, the teacher provides a task to be completed (i.e., antecedents), the target students respond by kicking a ball while the teacher talks (i.e., behavior), and the teacher reprimands the student (i.e., consequence).

In the current investigation, analysis of the teacher’s behavior was of primary focus. In such analysis, the antecedents may describe what students do (i.e., antecedents), how the teacher responds (i.e., target behavior), and what students do following the teacher’s response (i.e., consequences). For instance, a student kicks a ball while the teacher provides instruction (i.e., antecedents), the teacher reprimands the student (i.e., behavior), and the student ceases from kicking the ball and listens to the instructions (i.e., consequence). Such analysis results in an antecedents, responses, and consequences definitive, and specifies the conditions for their occurrence (Bijou, Peterson, & Ault, 1968).

To illustrate the three term contingency and casual relationships between the individual and the environment, please consider the following example. During an ultimate Frisbee lesson, the physical education teacher looks at his watch and notices that there are only five minutes left before the bell rings. The time on the watch is an antecedent for the following behavior: The teacher then instructs the students to stop playing, to bring the equipment back to the cart, and to sit on the bench. The students follow the teacher’s instruction which is the consequence of this episode.

Skinner (1953) asserted that the behavior-environment relationship can result in increase of the behavior, decrease of the behavior, or maintenance of the behavior.
Reinforcement ensues when the occurrences of the behavior increase. Punishment was
delivered when the occurrence of behavior decreases. The occurrence of behavior also
decreases when the reinforcer is no longer delivered. This process is called extinction.

*Selection by Consequences*

Related to the principles of reinforcement and punishment and to the three-term
contingencies is the concept of selection by consequences (Skinner, 1981). The behavior
operates on the environment to produce consequences (Skinner, 1953). In other words,
the teacher provided specific instructions because he wanted to finish the lesson. If this
behavior of instructing the students to cease from action resulted in the desired
consequence (i.e., the students indeed stop playing and followed the teacher’s
instruction), then the behavior was reinforced. Presumably, this behavior will be repeated
again under the same circumstance (i.e., students are playing; the teacher provides verbal
instruction to stop). Nevertheless, if the students had not responded appropriately to the
instruction (e.g., continued to play instead of ceased playing), the teacher may select a
different method of desisting the activity, such as providing colorful stickers to the first
team that returns the equipment and sits on the bench. The key principle is that behaviors
that are followed by reinforcing consequences get selected and survive in the person’s
repertoire of behaviors. Behaviors that are not reinforced undergo the process of
extinction (Cooper et al., 2007; Johnston & Pennypacker, 1993; Skinner, 1981).

Selection by consequences is illustrated in the following example as well. The
physical education teacher teaches students to execute an underhand toss by instructing
them to do a “rainbow toss” (i.e., toss the ball like a rainbow in the sky). For this
particular teacher, this specific instruction works great. The young children understand exactly what the teacher means and perform the toss correctly, without forcing her to be too technical in explaining the toss. The teacher therefore uses the “rainbow” term every time she teaches this toss. In other words, this particular behavior got selected and is enacted under similar instructional settings.

Factors Influencing Behavior

Past experiences influence the person’s life. The contingencies people operate under and behaviors they execute are impacted by their life history. Phase 1 (focus group) and 2 (individual interviews) of the current investigation were designed for the purpose of revealing, to the extent possible, the contingencies that the teachers operate under and cannot be observed, and to learn about their past histories. Several possible factors influence behavior: current contingencies, motivating operations, and history of reinforcement (Cooper et al., 2007; Skinner, 1953).

Current Contingencies

Current contingencies influence the individual’s behavior. When the environmental event that follows a behavior increases the probability that the behavior will be executed again in the future, a contingency of reinforcement was established, and reinforcement was delivered. Other contingencies involve events that immediately follow a behavior, and make the behavior less likely to occur again. In these contingencies, punishment was delivered (Johnston & Pennypacker, 1993; Skinner, 1953).

The “rainbow” toss example that resulted in successful performance of the toss by the students, illustrated a reinforcement of the teacher’s behavior. On the other hand, had
the students responded with confusion to the teacher’s instruction, resulting in an incorrect performance, then a punishment would have been delivered to the teacher’s instruction. In that case, it is likely that the teacher would avoid this type of instruction in the future when teaching the underhand toss.

**Motivating Operations**

Motivating operations influence teachers’ behavior. For instance, when a student teacher knows his supervisor will arrive to observe his class, he may be more motivated to demonstrate good teaching. Or in a volleyball lesson, when the teacher allocates one minute and wants to see which of the teams can make the largest number of overhead passes within the available time. The teams may be more motivated now to complete as many passes as possible. Yet, if one team member is less skilled than the other, the team’s motivation to pass quickly and accurately may decrease. If the teacher suddenly joins that team and assists in passing, she may increase the team’s motivation to perform.

The above example illustrates how motivating operations momentarily increase or decrease the frequency of overhead passes (i.e., behavior) and the effect of reinforcement. As demonstrated, behavior is influenced by various stimuli that momentarily increase or decrease the effectiveness of reinforcement, and therefore momentarily make the behavior more or less frequent. Specifically, it refers to motivation related concepts such as deprivation, satiation, and motives (Michael, 1982; Laraway, Sncerski, Michael, & Poling, 2003). Motivating operations may involve a single or multiple and simultaneous motivating affects (Laraway et al., 2003).
A teacher’s behavior is also influenced by other factors that do not necessarily exist in the current instructional setting. Teachers are influenced by their previous experiences and history of reinforcement.

**History of Reinforcement**

The 12 years of experience as a physical education student in school play a major role in influencing the preservice teacher’s current behavior. For instance, the teacher may select teaching practices that were employed by his favorite physical education teacher; choose content that she experienced as a student and may even organize the class in a similar way to what he experienced as a physical education student. The preceding scenario exemplifies that the history of reinforcement consists of ones’ life experiences, successive behaviors that were emitted under certain circumstances, and the consequences of those behaviors (Cooper et al., 2007). For example, the history of reinforcement of a physical education teacher can include (but is not limited to) the subject matter the teacher enjoyed participating in as a student; the athletic scores she achieved in physical education lessons; her family’s value of physical education; major athletic and Olympic events she watched during her life and that influenced her conception and attitude towards physical education; her ability to teach the specific content; and witnessing the experience of others as related to participation in physical education.

The concept of history of reinforcement is supported by Grossman (1990) who discussed the apprenticeship of observation as one of the influences of the development of PCK. Grossman (1990) argued that the experiences one undergoes in school as a
student influences the individual as a prospective teacher in selecting strategies for
teaching the content, and moreover, selecting the content to teach. The way the teachers
teach is directly tied to way they were taught. The prospective teachers’ knowledge of the
students is also influenced by their memories of themselves as students. The preceding
discussion illustrates how Grossman (1990), although not a behaviorist, discussed the
importance of previous experiences, which, in behavioral terms, is considered as the
histories of reinforcement. The following discussion illustrates PCK from the behavioral
perspective.

Pedagogical Content Knowledge from a Behavioral Perspective

The investigation of PCK within the behavioral framework requires the
explanation of PCK from a behavioral perspective. The explanation of PCK will pertain
to the definition of PCK as postulated by Shulman (1986), and will infrequently refer to
the new definition of PCK that was presented in the third section of this chapter.

Shulman, Grossman, Marks, and Gudmundsdottir, all included the term “knowledge” in
the definition of PCK. It is essential to explain what knowledge is, and how can
knowledge be observed and measured.

Knowledge and Pedagogical Content Knowledge as a Behavior

In order to investigate PCK, one has to define that knowledge, and how the
researcher can verify that one possesses that particular knowledge. Skinner (1974)
explained that the evidence for knowing is in the possession of behavior. For instance, a
student is said to know how to read, if he can actually do it, if he can read. A teacher
knows how to teach tennis when she executes behaviors (i.e., instructions) that assist
unskilled students to successfully execute tennis strokes. Thus evidence of knowledge exists when it is demonstrated. Shulman’s (1986) definition of PCK specifies various forms of behaviors, such as analogies, illustrations, examples, explanations, and demonstrations that are related to PCK. These behaviors can be functionally defined and as such become observable and amenable to measurement as target behaviors. These behaviors are objective, observable, clear and unambiguous, and contain boundaries as to what is to be included and excluded from the definition (Cooper et al., 2007).

It is important to note that not only the behaviors mentioned in Shulman’s (1986) definition of PCK (e.g., analogies, illustrations, examples, explanations, and demonstration) indicate the existence of PCK. Other behaviors may also exist and be used by teachers to deliver the content to the students in a comprehensible way. The new definition of PCK that is the act of selecting from one’s knowledge base for the purpose of teaching, is more specific and functional, but also more inclusive relative to behaviors that fall under the umbrella of PCK.

Teachers who are said to have PCK possess various forms of teaching practices (e.g., illustrations, examples) that relate to PCK in a particular area of knowledge. These forms of behaviors (i.e., teaching practices) may be topographically different; however, they share some commonalities and produce the same consequence. These functionally similar behaviors are known as response class (Cooper et al., 2007; Johnston & Pennypacker, 1993).

Shulman (1986, 1987) argues that there is not one single way to represent the content to the students. Instead, there are ample functional representations that the teacher
should be able to use. In other words, every teaching act that represents the transformation of knowledge from the teacher to the student should be considered as PCK. Researchers in the field of physical education found that PCK develops with experience (Rovegno, 1992, 1998; Schempp, 1993). Teachers learn how to adapt the content to their students, how to appropriately modify tasks, and how their students respond and learn particular content. The more experience the teacher acquires, the more the PCK develops (Rovegno, 1992, 1998; Schempp, 1993). In conclusion, for the purpose of the current investigation, PCK was considered as the act of selecting what to teach and how to teach it. Pedagogical content knowledge was a response class of any teaching behaviors (e.g., verbal instruction, analogies, and metaphors) whose function is to represent content to students in a comprehensible way.

The definition of PCK by Shulman (1986) includes the consequences of PCK in the form of students’ understanding. Pedagogical content knowledge are “the ways of talking, showing, enacting, or otherwise representing ideas so that the unknowing can come to know, those without understanding can comprehend and discern, and the unskilled can become adept” (Shulman, 1987, p. 7). Examination of PCK then should also include the aspect of students’ understanding of the knowledge that was delivered. In that case, a more precise inclusion criterion for PCK response class is behaviors of representing knowledge to the students that specifically results in students’ understanding (i.e., correct performance in physical education class).

This analysis was conducted in the current investigation in the following form: The appropriateness of the practice (i.e., the task and the way it was delivered to the
students) was evaluated by measuring student’s performance. For example, had the teacher provided a task that was correctly accomplished by more than 80% of the students, one could argue that the teacher exhibited an appropriate use of PCK during a particular event.

*Thinking as a Behavior*

As mentioned at the beginning of the theoretical framework section, Skinner (1974) considered behaviors outside as well as inside the body (e.g., the act of teaching versus thinking about teaching). Skinner argued that behavior is a behavior, regardless of its occurrences inside or outside the body. In both cases the behavior is occasioned by an environmental stimuli or condition, and therefore discrimination between the two is unnecessary. In other words, according to Skinner (1974), an environmental stimulus occasions a behavior (whether it is a behavior inside or outside the body), whereas thinking in itself does not occasion behaviors outside the body. Thinking, like other external behaviors, is occasioned by environmental stimulus (Skinner, 1953, 1974). This is the fundamental difference between a behavioral perspective and other epistemological beliefs. Other epistemologies consider thinking as a stimulus that occasions external behavior and therefore has a substantial role in interpreting and understanding teachers’ behaviors. Yet according to the behavioral perspective, thinking as well as other behaviors, is occasioned by a stimulus within the environment.

Thinking is one of the behaviors that falls under the definition of PCK response class. For example, when a teacher reviews the lesson plan, organizes it in his mind, and examines its possible consequences, he is thinking. These are covert behaviors that
cannot be detected by the naked eye, but they do represent a form of selection of content
to teach, and therefore represent PCK. Nevertheless, these behaviors will become
observable when: (a) the teacher records his thoughts on a lesson plan, and/or when (b)
the teacher actually executes the behaviors she thought about. For this reason the current
investigation relies, to a large extent, on observations of teachers’ practices.

*The Development of Pedagogical Content Knowledge*

Pedagogical content knowledge is a body of knowledge that develops similarly to
any other knowledge possessed by individuals. There are several processes that impact
the development of a teacher’s PCK. The PCK and its response class are influenced and
shaped by (a) direct contact with contingencies of reinforcement, and also by (b) contact
with described contingencies (Skinner, 1974). Other processes that impact the
development of PCK are the (c) history of reinforcements, (d) other historical influences
such as teacher’s training, (e) experience and expertise, (f) generality, (g) creativity, and
(h) motivating operations.

*Direct exposure to contingencies of reinforcement.* During this process, the
teacher had in fact performed the behavior under particular conditions, and was exposed
to a particular consequence. If the behavior came in contact with positive consequences
(i.e., contingencies of reinforcement), it is likely that the teacher will respond likewise in
the future, under similar conditions. For instance, imagine a teacher who uses an analogy
such as “run like Superman” to teach the concept of fast and slow. If this form of
information delivery results in students’ fast runs, then the behavior (i.e., the instruction
of “run like Superman”) had come in direct contact with contingencies of reinforcement
In that case, one would argue that this was a demonstration of appropriate PCK for teaching a particular content (i.e., concept of fast and slow), for a particular group of students.

**Contact with described contingencies.** Contact with described contingencies is quite different than direct contact with contingencies of reinforcement. A person comes into contact with described contingencies when the person is said to have knowledge about rules, instructions, directions, or laws. For example, a person may say he knows football because he read the rules of the game, and argued with the referee’s call while watching the game on television. These are described contingencies. It is different than coming into direct contact with the contingencies in the form of actually *playing* football. Contact with described contingencies frequently occurs in teacher education methods classes where student teachers are taught how to teach a subject matter. For example, the teacher education instructor exposes the preservice teachers to described contingencies when he mentions "lowering the elbow is a common error you may see your students perform. Usually, when I say scratch back all of the students perform it and avoid the error." In other words, the instructor exposed the preservice teachers to described contingencies by (a) informing them what error they might see their children perform, and (b) by sharing with them an instruction that was found to be effective in previous teaching of the same content. As soon as the teacher actually uses this behavior when teaching students, then the behavior is already in contact with direct contingencies of reinforcement (Siedentop & Eldar, 1989). Similarly, providing lesson plans to student
teachers is also a method of exposing them to described contingencies of reinforcement. These contingencies become direct when the preservice teacher executes the plan.

*History of reinforcement – students’ performance.* The exposure to contingencies, either direct contingencies or described ones, results in a consequence. Over the course of years of teaching experiences, PCK response class that result in reinforcement, are more likely to maintain or even increase in frequency. Responses that do not result in reinforcement undergo extinction or punishment (Cooper et al., 2007).

Pedagogical content knowledge response class should be evaluated according to students’ performances. Similarly, the teacher’s selection of practice to deliver the content can be reinforced or extinct or punished. For instance, if students respond correctly to the teacher’s demonstration of leaping, the teacher will most likely use demonstration to teach leaping in the future. If students respond incorrectly and with confusion to technical verbal explanation of leaping, it is less likely the teacher will verbally explain this skill again. The verbal instruction behavior for the skill of leaping was punished, perhaps leading into extinction.

*Historical influence-teacher’s training programs.* Teacher education programs provide CK, PCK, knowledge of learners and context, as well as learning professional values and practices (Metzler & Tjeerdsma, 2000). Grossman (1990) identified this knowledge acquisition as disciplinary background that influences the development of PCK. Graduates of effective teacher education programs in physical education achieved a level of competency in physical education subject matter (Tjeerdsma, Metzler, & Walker, 2000). Cooperating teachers, who actually observe student teachers more than any other
personnel, report that they achieved satisfactory level of pedagogical knowledge and 
practice on many aspects of effective teaching (Metzler, Tjeerdsma, & Mozen, 2000).

Graham (1991) noted that personnel in teacher education program play a positive 
role in teacher development of perspectives. In addition, valuable programs were those 
that provided student teachers with carefully constructed and implemented teaching 
experience (i.e., practicum). Siedentop and Eldar (1989) also assumed that effective 
teacher education program results in effective teaching. They explained that teachers’ 
training process represents exposure to described contingencies (student teachers learn 
what to do under which circumstances and why) rather than direct contact with 
contingencies that shape their teaching behaviors. Likewise, Good, McCaslin, Tsang, 
Zhang, Wiley, Rabidue Bozack, and Hester (2006) found that teacher education programs 
improved the teaching level of their graduates.

Expertise and Experience. “Teachers acquire pedagogical content knowledge 
from actual classroom experience” (Grossman, 1990, p. 15). The terms experience and 
expertise were previously discussed. Experiences indicate behaviors that were shaped by 
direct contingencies of reinforcement. Experienced teachers were found to be controlled 
to a greater degree by students' performance and environmental events, rather than by a 
lesson plan (Siedentop & Eldar, 1989).

Expert teachers can detect subtle occurrences that non-experts may have difficulty 
detecting and thus make finer discriminations during the lesson. In other words, expert 
teacher behave and respond differently to different events. For example, an incorrect 
gripping of a tennis racket may go unnoticed among novice teachers. The same error will
be immediately discriminated by an expert teacher or a tennis coach. The novice teacher may inappropriately identify other errors, and intervene (i.e., demonstrate PCK) incorrectly and improperly. The example illustrates the fine stimulus control the expert is under, and the expert’s ability to detect performance that the novice was not able to.

The expert teacher may select various ways to intervene to facilitate learning. The knowledge of the learner greatly impacts the selection of intervention for enhancing learning and correct performance. For instance, in a soccer lesson, the veteran teacher may ask all students to kick the ball to the goal from a 10 feet distance. The teacher could identify when a child has difficulty shooting from that distance, which results in deterioration of the appropriate technique. In this case, the teacher may ask the student to kick to the goal from a closer range. In a different case, the teacher may assist the student in improving his technique. This is to illustrate that the former error was generated from the large distance from the goal. The latter stemmed from incorrect technique. Making distinctions between an unrealistic kicking range and an improper technique are discriminations that experienced teachers are capable of doing. On the other hand, these discriminations are often inchoate among novice or less experienced teachers.

This example illustrates how expert teachers have developed a richer repertoire of responses to slightly different contextual situations. Siedentop and Eldar (1989, p. 259) put it in simple words: “they [i.e., experts] not only see things differently but they have more ways to respond to what they see.” Moreover, the notion of ample responses by expert teachers is closely related to the ample ways of transforming knowledge to the students, as indicated by Shulman (1986). Additionally, experts have plenty experience in
specific context of a particular subject matter and therefore their responses are much
faster than other teachers. Their quick response to environmental events indicates they
have reached the automaticity stage (Siedentop & Eldar, 1989).

Generality. Generality explains how teachers learn a teaching practice (or any
other behavior) and are able to implement it in a different setting that was not the
instructional one. For example, a preservice teacher who taught her undergraduate peers
to play spider tag, and then teaches it to third grade students at school; A teacher who
experienced a 1V1 modified “bouncing volleyball” game (the player can allow the ball to
bounce once before passing it over the net) during a professional development workshop
and decides to incorporate it into his volleyball instructional unit for the fourth graders;
and lastly, a teacher who regularly used the “bouncing volleyball” with her fifth grade
students, and decided to similarly modify a tennis game, allowing two bounces before
hitting the ball over the net. All of the examples describe how teachers generalize a
behavior from the instructional setting in which they acquired the behavior, to a different
setting. In such cases, the teachers behave similarly in different contexts.

In behavioral terms, generality exists when the behavior appears in other settings
than the original training setting, if it maintains over time even after the training has
ceased, and if it extends to other similar behaviors that were not directly trained (Baer,
Wolf, and Risley, 1968). When the teacher does implement the modified tennis game,
due to the modified volleyball game she usually includes in her volleyball unit, a
generalization was made. Ample teaching practices are generalized from one setting to

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another, from one instructional unit to another, and therefore generalization may also impact on the development of PCK.

Creativity. Although teachers are influenced by their previous experiences and history of reinforcements, they can also be creative. Creativity is best exhibited in the television show *Whose Line is It?* In this show, the actors are required to modify and adjust their behavior to predetermined but anonymous contextual conditions. The actors constantly change their behavior, find innovative ways to respond, and often behave in ways they never did under unfamiliar conditions. Essentially, the actors on the show have learned to be reinforced by demonstrating novel creative behaviors.

A teacher is said to be creative when he finds an innovative way to obtain students’ attention, or when he discovers a better way (i.e., more understandable) to teach the cartwheel, without learning, reading, or observing that behavior previously. In behavioral terms, creativity is a trait that is attributed to an individual when he or she emits a behavior that was never been seen, heard, learned, or observed before by that individual. In other words, this particular behavior has not been previously exposed to either direct or described contingencies (Skinner, 1974). For example, a creative teacher purposely explores various ways to teach a child how to hold both hands together and leveled when performing an underhand pass in volleyball. The exploration process may include non-conventional methods to represent the instruction differently in a way that the students would comprehend it. Therefore, the teacher may tape the student’s hands, or any other way that the author of this document cannot think of, due to her limited creativity…
Skinner (1974) defined this explorative behavior and use of non-conventional methods an “accidental” behavior. He argued that the accidental behavior is selected by its reinforcing consequences. If the behavior results in positive consequences, there is a greater chance it will survive and persist. Therefore, if taping the student’s hands assist in enhancing correct performance, it is more likely that this teaching behavior will be selected and used again in the future under similar conditions. Moreover, Skinner (1974) argued that people who have creativity as a trait continue to try to produce mutations of behavior (i.e., accidental behavior) because more often than not those behaviors result in positive consequences. This explains why the actors on Whose Line is It? continuously participate on the show. They have a long history of being reinforced for exhibiting creative behaviors.

Motivating operations. Motivating operations, as mentioned before, impact the behavior by momentarily altering the reinforcing or punishing value of the consequences (Horner & Harvey, 2000; Laraway et al., 2003). Motivating operations may influence teaching practices that are under deprivation or satiation conditions. For example, repetitive and unsuccessful instructional attempts to teach a child how to throw a ball into a target create a deprivation and the behavior of instruction goes under extinction. Motivating operations will increase the effectiveness of the reinforcement, resulting in successful teaching (Horner & Harvey, 2000).

In summary, PCK from a behavioral perspective is a response class of behaviors that are functionally emitted for the purpose of conveying the subject matter to the learners in comprehensible ways. The processes that influence the development of PCK
are contingencies of reinforcement (either direct or described), motivating operations, the 
ability to generalize and to be creative, as well as history of reinforcement, other 
historical influences such as teachers’ training, and experience and expertise teacher 
acquire and possess. Based on those processes that contribute to the development of 
PCK, and on the importance of past experiences and their (hopefully) positive 
consequences, the investigator re-conceptualized PCK and proposed a model that 
describes the development of PCK. The model, similarly to the modified definition of 
PCK, was substantially informed by the author’s epistemological beliefs and 
conversations with teacher education professors such as Daryl Siedentop, Phillip Ward, 
and colleagues such as Paul Stuhr.

A Model of Pedagogical Content Knowledge

The investigator suggests referring to PCK as a class of behaviors that develop on 
a continuum, where one end is immature and the other is mature. The notion of heuristic 
continuum of PCK development from immature to mature forms was suggested in 
informal conversation with Inez Rovegno. In addition, investigators in physical education 
who investigated PCK used words such as "strong," "weak" and "immature" PCK (Chen, 
2004; McCaughtry & Rovegno, 2003; Rovegno, 1992; Tsangaridou, 2002). The use of 
these words is a further support to the notion of conceptualizing PCK on an 
immature/mature continuum ends. Yet, the meaning of immature/mature should be 
explained.

All teachers utilize various teaching practices, and in the process of teaching, they 
select the content and decide how to teach it. If one accepts the new definition of PCK,
that is, the act of selecting from one’s knowledge base for the purpose of teaching, then
every teacher exhibits a form of PCK. The forms of PCK vary (i.e., immature/mature or
variations in between those two ends) presumably in correspondence with the teacher
being a preservice, novice, experienced, or expert teacher. Thus, the PCK for every
teacher can be situated on the continuum from immature to mature, regardless of the
teachers’ years of teaching or level of expertise (Ward, Ayvazo, & Stuhr, 2006).

One scenario involves a preservice teacher who presumably has limited amounts
of CK, limited knowledge of the learners, and only few teaching experiences. The PCK
of this preservice teacher will be situated closer to the immature end of the continuum.
Further, the act of selecting the content to teach may be an incorrect one. If left
uncorrected, a teacher can repeatedly select inappropriate content to transform to the
students, or transform an appropriate content improperly. Selecting inappropriate content
or transforming content improperly may happen for experienced teachers, but is more
likely to be characterized by preservice and novice teachers, particularly when involving
content the teachers are unfamiliar with. On the other hand, the PCK of an expert teacher
who has already had numerous experiences in teaching the subject matter to a group of
learners, and who already knows the learners, will be situated closer to the mature end of
the continuum (Ward et al., 2006).

As previously mentioned, PCK is content specific (Barrett & Collie, 1996;
Givens, 1998). It might be more or less mature contingent upon the teachers’ CK and on
their familiarity with the learners. For example, the PCK of a teacher who had already
taught basketball for fifth grades on numerous occasions will be situated close to the

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mature end of the continuum. Nevertheless, the PCK of the same teacher, teaching lacrosse to eighth graders for the first time, with no prior lacrosse teaching experience, is immature when compared with the fifth grade basketball PCK (Ward et al., 2006).

The variability of PCK on the continuum can be specified even further. For instance, an expert teacher for beginner’s basketball has a mature form of PCK for teaching beginners basketball. Yet, it is possible that the same teacher has an immature PCK relative to teaching college basketball. Consequently, the PCK of teaching college basketball will be considered to be more immature, as compared with PCK for beginner’s basketball (Ward et al., 2006).

The preceding examples indicate a distinction between preservice teachers with less experience, to experienced teachers, to teachers who have expertise in a particular subject matter. In other words, the re-conceptualization of PCK as a variable that fluctuates from immature to mature, contingent upon CK, knowledge of the learners and other factors. If one accepts that notion of the continuum, one could situate teachers’ PCK on the continuum and assess its development.
CHAPTER 3

METHOD

The main research question of this study was: How does the pedagogical content knowledge (PCK) of experienced teachers differ in the teaching of their stronger and weaker units of instruction? The study was organized into three phases. All three phases were based on the behavioral framework discussed in Chapter 2. Phases 1 and 2 used interviews to begin to understand: (a) the teachers’ learning history relative to PCK; (b) to examine the possible contingencies the teachers’ behavior was operating under, that cannot be found by observing the immediate teaching context; and (c) to discover additional variables related to PCK that can be tracked when observing the teachers’ practices. Phase 3 used direct observation of two teachers delivering two instructional units that they identified as their stronger and weaker instructional units. All three phases of the study were derived from the main research question. Each phase, however, had its own research question. Figure 3.1 diagrams the three phases of the study. As this investigation is descriptive in nature, the next section explains the assumptions of descriptive studies.
Assumptions of Descriptive Studies

The goal of the science of behavior is to understand phenomena under study. The understanding of behaviors occurs in three levels (Cooper, Heron, & Heward, 2007). First, describing the behaviors under study (i.e., descriptive study). Second, predicting the occurrence of behaviors (i.e., correlational study), and third, controlling the behaviors of...
interest (i.e., experimental study). The purpose of a descriptive study is to answer the question “how”? (Bijou, Peterson, & Ault, 1968). A descriptive investigation, such as the current one, can report the manner in which teachers deliver instruction to their students.

A descriptive investigation involves systematic observations of behaviors of interest. Systematic and accurate description of the behavior enhances the scientist’s understanding of it (Cooper et al., 2007). The descriptive knowledge results in a collection of facts that are quantified and categorized, and is essential for any scientific discipline (Cooper et al., 2007; Johnston & Pennypacker, 1993). The discipline under study in this dissertation is education.

Bijou et al. (1968) discussed some key assumptions related to the nature of descriptive studies. First, they noted that the primary data in a descriptive study is the observable interactions between the individual and its environment (Bijou et al., 1968; Skinner, 1953). Behaviors are not isolated from the environmental events that surround them. Therefore, the data to be recorded in a descriptive study contain the behaviors of interest and other environmental occurrences related to those behaviors (Bijou et al., 1968). For instance, merely describing that the teacher delivered a new task to the students is insufficient. More accurate is to describe that the teacher provided a new forward roll task after 90% of the students reported they successfully completed the previous forward roll task.

Second, behavioral data are inductively derived (Bijou et al., 1968). In other words, the raw data recorded and collected by scientists are the basis for postulation of law and concepts. Bijou et al. (1968) noted that descriptive data can also provide
information on the relations that occur between the behavior and other environmental events. Descriptive studies, however, do not provide data to explain the functional relationships between those events.

Phase 1

Six teachers participated in a focus group interview. The purpose of the focus group was: (a) to begin to understand the teachers' learning history relative to PCK; (b) to examine the possible contingencies the teachers’ behavior is operating under, that cannot be found by observing the immediate teaching context; and (c) to discover additional variables related to PCK that can be tracked when observing the teachers’ practices.

Research Questions

The three research sub-questions of this phase were derived from the main research questions of the study. The questions were:

1. How do teachers describe how they acquired their CK and PCK relative to their stronger and weaker units?
2. What teaching practices do teachers identify as their PCK?
3. How do teachers ensure the content delivered is appropriate to the students’ developmental level?

Research Strategy

A focus group was utilized to answer the research sub-questions in this phase. Focus group is a data collection method that had become widely used in the social and health sciences (Kidd & Parshall, 2000). The focus group involves a small group of people that are willing to share their thoughts, opinions, and experiences (Glitz, Hamasu,
& Sandstrom, 2001; Krueger & Casey, 2000). Conducting a focus group interview with teachers involves questioning and listening to their descriptions of their experiences and teaching practices. The focus group relies on the dynamics of the group interaction to discover the similarities and differences in the participants’ opinions (Kaplowitz & Hoehn, 2001; Kidd & Parshall, 2000).

The focus group held particular advantages for this phase of this study. First, the focus group allowed a range of thoughts and opinions of the teachers about their CK and PCK and how CK and PCK were acquired. The range of opinions can contribute to the understanding of the commonalities and differences that exist between the teachers’ opinions (Barbour, 2005), in light of their past experiences, as related to PCK. Agreements among the teachers who express similar statements may indicate a validation of their statements and increase the believability of those data. Nonetheless, caution should be taken, as verbal agreement may be influenced by other variables such as discomfort expressing opinions that are different than the ones expressed by the group (Barbour, 2005). Lastly, the focus group data may assist in further planning or decision making (Glitz et al., 2001) regarding phase 2 and phase 3 of the current investigation.

Selection of Participants

Six teachers (four females, two males) were purposely recruited to participate in this study. The number of years of teaching ranged from 4-36 with an average of 20 years. Four of the teachers were elementary school (grades k-8) teachers, who at the time of the study were teaching at the college level. The other two teachers were teaching at
the secondary school level (grades 9-12) at the time of the study. Table 3.1 provides information on the teachers (all names are pseudonyms).

<table>
<thead>
<tr>
<th>Characteristics / Teachers</th>
<th>Ryan</th>
<th>Marie</th>
<th>Beth</th>
<th>Ashley</th>
<th>Joe</th>
<th>Sarah</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>M</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>Age</td>
<td>33</td>
<td>64</td>
<td>58</td>
<td>37</td>
<td>34</td>
<td>45</td>
</tr>
<tr>
<td>Number of years teaching</td>
<td>12</td>
<td>36</td>
<td>36</td>
<td>4</td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>Number of years teaching K-12</td>
<td>4</td>
<td>30</td>
<td>30</td>
<td>4</td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>Where are you currently teaching at? (elementary/secondary/college level)</td>
<td>College</td>
<td>College</td>
<td>College</td>
<td>College</td>
<td>High school</td>
<td>High school</td>
</tr>
<tr>
<td>Type of school where you currently teach (e.g., urban, suburban)</td>
<td>Urban university</td>
<td>Urban university</td>
<td>Urban university</td>
<td>Urban university</td>
<td>Suburban</td>
<td>Suburban</td>
</tr>
<tr>
<td>Number of years teaching at the current school</td>
<td>1</td>
<td>6</td>
<td>6</td>
<td>1</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Grade levels you teach in the current school (if applicable)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>9-12</td>
<td>9-12</td>
</tr>
</tbody>
</table>

Note: N/A = Not applicable

Table 3.1 Characteristics of the participants in the focus group interview
The teachers were identified as participants for this study based on recommendations of physical education teacher education supervisors and faculty at The Ohio State University (OSU). The university supervisors had many years of experience in a variety of schools and teachers within the central Ohio region and therefore could provide recommendations of teachers who may have had the characteristics mentioned above. In addition, these teachers were involved in the past with teacher effectiveness studies conducted by graduate students and faculty from OSU. Together, the multiple years of experience of supervision and the involvement of the teachers in teaching effectiveness studies validated the selection of those teachers as professionals who have expertise in the physical education domain.

**Question Development**

The investigator developed open ended questions and follow-up prompts to encourage maximum discussion (Glitz et al., 2001). The questions focused on teachers’ (a) past experiences in sports and in teaching, (b) their acquisition of CK, (c) their application of the knowledge to their students, and (d) their practices following students’ correct or incorrect performance (See Appendix A). Additionally, the questions attempted to discover any key variables that teachers identify as their PCK, and that are observable.

The question development process included two phases. First, the questions were reviewed by two experts in the area of interviewing and teaching effectiveness, for face and content validity purposes. The questions were revised and refined as recommended by the experts. Second, the investigator tested the questions in pilot interviews with three physical education teacher education doctoral students who were also experienced
elementary and secondary teachers. The pilot interview participants had similar teaching experience as two of the teachers who participated in the panel.

**Interview Procedures**

The discussion group took place in a meeting room at the university. The interview was 90 minutes long. Participants sat around a rectangle table, and had name cards in front of them, to allow the use of names during the discussion. The investigator, who was also the interviewer, placed a microphone at the center of the table, and moderated the discussion according to the guiding questions. The investigator posed the questions sequentially, encouraging all teachers to share their opinions and to engage in the discussion. Occasionally, the investigator prompted the teachers for further comments. Two faculty members were also present during the focus group interview. One took notes and occasionally prompted the participants and presented follow-up questions.

**Data Analysis**

The data analysis in this phase was derived by the research questions of the phase. The data were transcribed verbatim and read. On the second reading, the investigator highlighted in three colors the key comments that addressed each of the three research questions. The interview questions were refined subsequent to pilot interviews, and before the execution of phase 1. In phase 1, the refined interview questions were found to address the research questions well. The investigator shared the analysis with the faculty member who was present in the focus group, and they both agreed that no change of questions was necessary for the phase 2 interview. Finally, the investigator made
conclusions regarding each research question in the following manner: She read all comments of one color pertaining to one research question. Then she drew conclusions based on the prevalent comments the same color. The investigator followed the same process for the other two research questions as well.

Phase 2

Two teachers participated in both phase 2 and 3 of the study, but not in phase 1. The teachers were contacted prior to the beginning of phase 2, first by email and followed by a phone conversation. Subsequent to their general permission to cooperate with the investigator and participate in this study, the investigator followed the required procedures for gaining access to the elementary school settings.

Gaining Access

Permission for conducting this research was obtained from the Institutional Review Board (IRB) at The Ohio State University (IRB # 2006E0550). After IRB approval, the investigator contacted the Office of Outreach and Engagement, who was responsible of contacting the schools of the participating teachers and for obtaining their permission to conduct this study. The teachers informed the principal about their willingness to participate in the study. After the schools’ permission was obtained, the investigator was notified, and together with the participating teacher made the final arrangement for conducting the study.

Both teachers signed an informed consent form (See Appendix B), and the investigator also sent consent forms to the parents (See Appendix C). The teacher explained the research to the students, and asked for their assent to participate in the
study (See Appendix D). All of the participants in the study (i.e., teachers, parents, and participants) were ensured that the data would be kept confidential and accessible only to the primary investigator and her assistants. At the conclusion of the consent and assent process there were only two refusals for participation in the study (i.e., in Kayla’s class).

The two teachers participated in an individual interview in this phase. The purpose of the interview questions was the same as the purpose of those in the focus group: (a) to learn about the teacher’s learning history relative to PCK; (b) to examine the possible contingencies that influence the teachers’ behavior and that cannot be found by observing the immediate teaching context; and (c) to discover additional variables related to PCK that can be tracked when observing the teaching episodes.

*Research Strategy*

The interview is a personal intimate encounter in which the interviewer elicits comments about behaviors to be (or that were) observed, interactions, and rituals. During the interview the investigator tries to encourage the teachers to share as much information as possible in their own words (DiCicco-Bloom & Crabtree, 2006).

*Selection of Participants*

Two female elementary physical education teachers were selected to participate in phase 2 (individual interviews) and 3 (lesson observations) according to the criteria for participant selection as described in phase 1 of the study. Table 3.2 provides information on the teachers (all names are pseudonyms).

Elementary school teachers were selected for phase 2 and 3 because the instructional units in elementary school tend to be more structured than the ones taught at
the secondary level. Also, the physical education teacher education (PETE) university supervisors at OSU suggested that the elementary school physical education teachers are more effective teachers than middle or high school physical education teachers. The elementary teachers also tend to emphasize teaching of content more than the emphasis placed on content in secondary schools.

<table>
<thead>
<tr>
<th>Characteristics/ Teachers</th>
<th>Kayla</th>
<th>Taylor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Female</td>
<td>Female</td>
</tr>
<tr>
<td>Age</td>
<td>46</td>
<td>36</td>
</tr>
<tr>
<td>Number of years teaching</td>
<td>21</td>
<td>14</td>
</tr>
<tr>
<td>Number of years teaching K-12</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>Where are you currently teaching at?</td>
<td>Elementary</td>
<td>Elementary</td>
</tr>
<tr>
<td>(elementary/secondary)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of school where you currently teach (e.g., urban, suburban)</td>
<td>Suburban</td>
<td>Suburban</td>
</tr>
<tr>
<td>Number of years teaching at the current school</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Grade levels you teach in the current school</td>
<td>K-5</td>
<td>K-5</td>
</tr>
</tbody>
</table>

Table 3.2 Characteristics of the participants in the individual interview

The investigator met with the teachers several times prior to the beginning of the study. The purpose of the meetings was: (a) to visit the teachers at their working environment; and (b) to informally observe the teacher instructing the designated class to be observed. The investigator also aimed to develop initial levels of rapport with the teachers during those preliminary meetings by conversing with the teachers on: (a) topics related to physical education outside of school; (b) topics that were not related to physical education; and by (c) sharing personal information about herself with the teachers. The
rapport is an essential component of the interview and later assisted in establishing a safe and comfortable interview environment for the teachers to share their personal experiences (DiCicco-Bloom & Crabtree, 2006).

**Question Development**

The questions for the individual interviews were the same as those for the focus group. The process of question development is discussed in phase 1 of the study. The only difference between the questions in phase 1 and 2 was that the interviewees in phase 2 were specifically required to relate in their answers to their stronger and weaker instructional units as they answered the interview questions. The interview with each one of the teachers was conducted prior to the beginning of the first instructional unit. The investigator met with Taylor for another interview prior to the beginning of her stronger instructional unit as Taylor changed her identified stronger instructional unit from gymnastics to floor tennis.

**Interview Procedures**

To ensure that the interview setting was comfortable for the teachers, the investigator met with each teacher at a location and time of their choice (DiCicco-Bloom & Crabtree, 2006). Nonetheless, the investigator asked the teachers to select a location that was moderately quiet for audio taping purposes. The meeting with each teacher took place at her office in school. Taylor’s interview was 75 minutes long, and Kayla’s interview was 52 minutes long.

During the interview, the interviewer (i.e., investigator) sat across from the teacher and used an audio recorder to record the interview. The interviewer posed the
questions sequentially, and encouraged each teacher to share their experiences.
Occasionally, the investigator asked questions that emerged from the dialogue between her and the teacher (DiCicco-Bloom & Crabtree, 2006).

Data Analysis

The investigator provided the teachers with a print-out of the interview’s transcript verbatim prior to the beginning of the first instructional unit they taught. The investigator gave the teachers a week to review the transcripts and to make changes or additions to them if necessary. After one week the investigator collected the transcripts from the teachers. Taylor made several grammatical corrections and one addition to the transcript. Kayla was satisfied with the transcript of her interview and did not make any changes/additions to it. The investigator then completed the required changes to the transcripts according to the Taylor's request. The analysis of the interviews was the same as the analysis described in phase 1 of the study. The analysis of phase 2 was impacted by the researcher's bias, as she already analyzed the data from phase 1.

Phase 3

Description of the Phase

This phase included observations of the two teachers who participated in phase 2. Data were collected for both teachers during their teaching of the two instructional units they previously identified as stronger and weaker. Different variables were collected in two main foci: teacher’s instruction and students’ responses. Data on teaching effectiveness was also collected for both teachers using the ALT-PE data collection method. The ALT-PE instrument was selected because time-dependent variables were
previously reported in the literature as indication for teaching effectiveness (Metzler, 1989). Figure 3.2 diagrams the foci of data collection in phase 3.

![Diagram of the foci of data collection for phase 3]

**Phase 3 – Direct Observations Data Collection**

- Kayla
- Taylor

**ALT-PE to determine effectiveness**

**Teacher’s instructions – 6 research questions**

**Students’ responses – 2 research questions**

Figure 3.2 A diagram of the foci of data collection for phase 3

### Selection of Participants and Setting

The participants of this phase were the teachers who participated in phase 2 of the study. Each teacher was observed teaching the same class for both instructional units. This section describes each teacher’s school, the physical education setting, and the participating class.

**Kayla’s Setting and Class**

Kayla was teaching in a suburban elementary school (K-5). According to this school district’s data, the school has an enrollment of 405 students. The majority of
students were white (69%), 19% were African-Americans, 7% were multiracial, 3% were Hispanic, and 2% were in the unspecified category.

Physical education lessons, on a rotating schedule with music and art, ranged from once to twice per week. The lessons were 40 minutes long, and delivered in an approximately 70x35 feet gymnasium, located inside the school building, with only three walls (the fourth one was open to the hallway). The unique location of the gymnasium (inside the building and open on one end), did not hinder the students' attention during the physical education lesson, as identified by Kayla, by the investigator and by the observers. The gymnasium was fully equipped for the instructional units she taught. For example, it had a climbing wall, two basketball goals, and a stereo that was usually used during the warm up. The students typically had a ball, a golf club, or any other one object per two students. The physical education lesson would typically start with a warm up routine that included stations. The stations involved activities such as stretches, laps around the court, and crunches. Kayla typically concluded the lesson by briefly summarizing the lesson and sending the students to get a drink.

Kayla identified the fifth grade as the target class for observations. The fifth grade class was selected for two reasons: (a) Kayla identified this was a class in which she was comfortable teaching and being observed; and (b) the observers were able to arrive to the school at the day and time the lesson was delivered. The designated class had 24 students (11 boys and 13 girls). The majority of the students (n=22) returned their signed informed consent to the teacher.
This investigation began with observation of five lessons of the golf instructional unit that was identified by Kayla as her weaker unit. Kayla identified volleyball as her stronger instructional unit. Prior to the beginning of the study Kayla mentioned she would teach 1-3 lessons of tennis and other net games activities that would lead to volleyball. After finishing teaching her golf unit Kayla informed the investigator she would teach a net games instructional unit, beginning with five lessons of volleyball, two lessons of badminton, and two lessons of tennis. As Kayla noted her stronger instructional unit was volleyball, the investigator observed four volleyball lessons, followed by two badminton lessons, for a total of six lessons. The observation on Kayla’s stronger unit of instruction was then concluded. Kayla planned to deliver two more tennis lessons as part of this net games unit yet those lessons were not observed nor reported in this study.

Taylor’s Setting and Class

Taylor was also teaching in a suburban elementary (K-5) school. School district data indicate the school had an enrollment of 557 students. The majority of students were white (83%), 14% were Asian or Pacific islanders, and 3% were multiracial.

Physical education lessons were typically taught once per week, for 40 minutes, in an approximately 85x45 feet gymnasium. Taylor was teaching sports such as disc golf outside the school building, contingent upon suitable weather conditions. Taylor’s gymnasium was fully equipped for the instructional units she taught. For example, the students had at least one ball for each two students, one rope per student, 12 boards that allowed 24 students to play floor tennis at the same time, one paddle per student, pedometers for each child, and jersey shirts for each student for team sports units. Taylor
used a stereo that was audible in the gymnasium. The physical education lesson typically started with a warm up routine which included the students wearing pedometers, performing jump rope exercises, and stretching in their teams. The lesson was typically concluded with the students reporting on their personal page the number of steps they achieved during the lesson, their performance, and their social behavior. The students as a class would also vote thumbs up or thumbs down if they deserved to be awarded class points.

Taylor identified the fifth grade as the target class for observations. The fifth grade was selected from the same reasons that Kayla’s fifth grade class was selected. The designated class had 24 students (11 males and 10 females). All of the students returned their signed informed consent to the teacher.

This investigation began with observation of six lessons of invasion games, identified by Taylor as her weaker unit. This unit was composed of three ultimate Frisbee lessons, two team handball lessons, and one soccer lesson. Then, the investigator observed five lessons of floor tennis that was identified by Taylor as her stronger unit of instruction. Initially, Taylor had identified gymnastics as her stronger unit of instruction; however, facility reservation difficulties prevented her from teaching the gymnastics unit as planned.

*Determining the Effectiveness of the Teachers*

The participating teachers in this phase were recommended by the university supervisors as effective elementary physical education teachers. To support the selection of those particular individuals as effective teachers, the researcher collected data on their
students, using the systematic observation tool, Academic Learning Time in Physical Education (ALT-PE; Siedentop, Tousignant, & Parker, 1982). The ALT-PE data collection process is described in the following section.

*Academic Learning Time Physical Education*

As teachers’ PCK blends with their CK and pedagogical skills (Shulman, 1986), it was important to demonstrate that the participating teachers were, in fact, effective teachers. Academic Learning Time was selected as a measurement tool for examining those teachers’ effectiveness. The purpose of ALT-PE was to measure the percent of time the students were involved in learning with appropriate rates of success (Parker, 1989; Siedentop et al., 1982). Although ALT-PE contains more variables, only the following variables were observed and measured, as they were the most appropriate for the objective of this study. Figure 3.3 is an example of the ALT-PE data collection sheet for three students, for the duration of 42 minutes. The actual ALT-PE data were collected for the entire duration of the lesson.

*Transition.* Time the student spent in managerial and organizational activities that are related to instruction (Parker, 1989).

*Management.* Time spent in business activities that are not related to instruction (Parker, 1989).

*Knowledge.* Time the student spent in receiving knowledge about physical education content (e.g., rules, how to execute technique or tactic, guideline for appropriate and inappropriate behaviors, and the subject’s history; Parker, 1989).
ALT-PE Coding Sheet

Teacher___________________ Grade____________ Date______________ Activity_____________________
Start__________ Finish___________ Observer/IOA_____________________
Target students: (1)_________________________(2)__________________________(3)_____________________
Student:______________

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|

Student:______________

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|

Student:______________

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|

Figure 3.3 Example of ALT-PE data collection sheet for three students, for the duration of 42 minutes
**Activity.** Time that is devoted to motor engagement in physical education activities (e.g., skill practice, scrimmages, games, fitness, warm up; Parker, 1989).

**Waiting.** Time when the student has already completed a task, and has a period of no activity and no movement between activities (Parker, 1989).

**Off task.** Time the students are engaged in the activity that was not prescribed by the teacher (Parker, 1989).

An interval recording system was used to collect data and Interobserver Agreement (IOA) on the students’ performance. According to this system, the observer records the presence or absence of a behavior within each interval of time (Cooper et al., 2007). In ALT-PE, the observers observed a behavior for a length of time, and then made a decision as to which category best represented the behavior of the student during the observed time. The observer used an observe/record format, for a 10 second interval. They observed a particular student for 5 seconds, and then recorded the behavior for another five seconds (Siedentop et al., 1982; Parker, 1989).

The ALT-PE was used in this study only as supporting data to demonstrate the teachers’ effectiveness. Therefore, the investigator asked the teacher to identify, to her best knowledge, three students of different levels of ability (high, medium, and low skilled). The ALT-PE data collected for these students during the entire duration of one lesson in each instructional unit of each teacher. The first interval (i.e., 10 seconds) focused on student 1, the second interval on student 2, and the third interval on student 3 (Parker, 1989). Each of the three students thus was observed once per 30 seconds.
A five seconds observe/record interval was selected for several reasons: (a) it allowed the observer to observe each student’s behavior twice a minute; (b) the shorter the interval, the more samples were collected, the greater the validity of the observations was; and lastly, (c) the shorter the interval, the easier it was to select the behavior that characterizes the interval (Siedentop et al., 1982).

The researcher selected the lesson for ALT-PE data collection based on two criteria. First, ALT-PE was collected only on mid unit lessons, and not on the first and/or the last lesson of the unit, because the content presented in the first and the last lesson of the unit may be different than the content that would be typically conveyed in the other lessons. For example, more time may be devoted to introducing the sport, the unit, and rules associated with it in the first lesson, or more time may be devoted to game plays and application tasks in the last lesson of the unit. Second, for ALT-PE purpose, a person operated the camera and followed the three target students as they moved around the gymnasium. Therefore, selecting the lesson for collecting ALT-PE data was also based on the availability of assistants to join the researcher on site.

The data were reported by a percentage measure of response. The total amount of time spent in each category was divided by the total amount of class time, multiplied by 100 (Parker, 1989).

Dependent Measures Phase 3

The eight research sub-questions of this phase were derived from the main research question of the study. Six of the questions focused on the teacher’s instructions and two more questions addressed the students’ responses. This study was exploratory in
nature. As such, the investigator considered that other variables may be of interest for measurement after repetitive observations, and therefore reserved the right to add dependent variables contingent upon the videotaped product. In addition and in relation to the quantitative data, the investigator also considered anecdotal observations that also contributed to the understanding and interpretation of the phase 3 data.

Research Questions Related to Teacher’s Instructions

The following sub-questions were asked:

1. What was the percentage of each type of content task used in the teacher’s stronger and weaker unit of instruction?
   a. In what order were the types of tasks presented in the stronger and weaker instructional units?

2. Which instructional forms were used by the teachers to represent the content to the students?

3. How many tasks were provided to the class, to a small group, and to the individual student?

4. What types of cues were used by the teachers to represent the content?
   a. How many times were those types of cues used during the lesson and unit?

5. Which antecedents preceded the teacher’s presentation of the task to an individual student?

6. What types of adaptations (from the initial tasks provided) were made by the teachers to enhance the students’ performance?
   a. How many adaptations were made?
Research Questions Related to Students’ Responses

7. What percentage of the students performed the teacher’s task correctly?

8. To what extent were the adaptations made for individual students appropriate?

Definition and Measurement of the Variables

This section reviews each research sub-question and the definitions of the dependant variables, and explains how those were measured. The data collection process took place only during the main and the concluding part of the lesson, and did not include the warm-up activity. Data on most variables were permanently recorded on videotapes. Only the data on the appropriateness of tasks provided to the entire class were collected live on site. All of the coding forms were pilot tested prior to the beginning of the study.

Research sub-question 1: What was the percentage of each type of content task used in the teacher’s stronger and weaker unit of instruction? The measured variable was the percentage of occurrences of each type of content task. There are four types of content tasks: informing, extension, refinement, and application (Rink, 2006).

Informing. “The initial task in the progression of a skill” (Rink, 2006, p. 115). For example, mimic the motion of throwing, without a ball (Rink, 2006).

Extension. A task that increases the level of difficulty of a previous task. For example, progressing from motion of throwing without a ball to the same motion with a ball (Rink, 2006).

Refinement. A task that expresses additional focus on the quality of performance. For example, focusing on moving the elbow back prior to moving the arm forward (Rink, 2006).
Application. A task that centers on assessment of form or on how to use the movement, rather than just how to do the movement (Rink, 2006). For example, using the skill of throwing within a team handball game.

In addition, tasks were also coded as a review tasks of the same type (i.e., informing, extension, refinement, application), when those tasks had already been presented by the teacher. The review tasks were denoted by the letter R prior to the first letter that represents the type of task (e.g., RE represents review extending task).

An event recording system was used to collect data on the number of times each type of task was used (See Figure 3.4). In this system, the observer tallied every task as it occurred (Cooper et al., 2007). These data were videotaped and reported by a percentage measure of response. The number of times each type of task was provided during the unit was divided by the total number of tasks in the unit and the result was multiplied by 100.

Question 1a centers on the sequencing of learning tasks. The question was: In what order were the types of tasks presented in the stronger and weaker instructional units? As mentioned above, the appropriate sequencing of tasks is highly important for content development. However, the sequence of tasks as an independent set of data does not add information on the suitability or the appropriateness of that particular sequence. Therefore a cross analysis was conducted to determine an appropriate order for teaching the content, one that results in students’ learning. In other words, the sequence of tasks data, as they were chronologically delivered to the students, was cross-analyzed with the data of students’ performance of the delivered task.
## Example of PCK Components Coding Sheet – General

Teacher: Kayla Grade: 5’th grade Date: 1/15/07 Activity: Volleyball Start: 10:00A Finish: 10:45A Lesson #: 2 out of 6
Observer: Shiri IOA: ________ Observer/IOA (please circle one)

<table>
<thead>
<tr>
<th>Task #</th>
<th>Task (narrative format)</th>
<th>Type of task</th>
<th>Time</th>
<th>IF</th>
<th>Cues</th>
<th>RC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Please pass the ball underhand from one to another, just like we did last week</td>
<td>RI</td>
<td>10:15</td>
<td>10:19</td>
<td>V +D</td>
<td>T</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hands together</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>T</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Now please underhand serve the ball to your partner and continue with underhand passing</td>
<td>E</td>
<td>10:22</td>
<td>10:34</td>
<td>V</td>
<td>T</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Arms straight Step and hit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>T</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>T</td>
<td></td>
</tr>
</tbody>
</table>

IOA: 90% 100% 95% 90% 100%

**Type of task:**
- I – Informing
- E – Extension
- R- Refinement
- A- Applying

**Instructional form:**
- RI - Review Informing
- RE – Review Extension
- RR – Review Refinement
- RA – Review Applying
- V – Verbal instructions
- D – Demonstration
- M – Metaphor
- W – Written assignment
- T – Technical
- M – Metaphorical
- V – Visual
- I – Individual

**Cues:**
- T – Technical
- M – Metaphorical
- V – Visual

**Recipient of tasks:**
- C – All class
- SG – Small group
- I – Individual

Note: IF=Instructional forms, RC=Recipients

Figure 3.4 Example of coding sheet for the general components of PCK
The data were presented in a table and on a line graph together with the data on the appropriateness of tasks to the whole class. Analysis of the data for this question was based on the event recoding system used in sub-question 1. These data were visually inspected.

Research sub-question 2: Which instructional forms were used by the teachers to represent the content to the students? Three main forms of instructing were coded, as demonstrated in Figure 3.4. The instructional forms were: verbal instructions, demonstrations, and metaphors.

Verbal instructions. Occurred when the teacher used a word or several words to tell, explain, or prompt to occasion students’ response (Cooper et al., 2007). Typically, verbal instructions are sufficient when the students already have experience with the skill and its terminology. If not, teachers need to aid instructions with demonstrations (Rink, 2006).

Demonstrations. A visual communication, when the teacher nonverbally modeled how to perform or how not to perform the task (Cooper et al., 2007; Rink, 2006).

Metaphors. Occurred when the teacher transferred name or attributes of one subject to the other (Newman, 2001; White, 1996). For example, when a teacher says "use a rainbow toss," she attributes the arched characteristic of the rainbow to the toss she would like her students to use.

Following the observations, another instructional form was added: written assignment.
Written assignment. In one of the units in this study students, were provided with an individual task sheet that included a sequence of tasks to perform. Students recorded their scores on the task sheet over four lessons.

Finally, this research question analyzed the instructional forms used when providing tasks to the entire class and therefore physical guidance was not included as one of categories. An event recording system was used to collect data and IOA on the teacher’s instructional form (See Figure 3.4). According to this system, the observers tallied which instructional forms were demonstrated during the delivery of each task. These data were collected from the analysis of the videotapes (Cooper et al., 2007). The data were reported using percentage measure of response. The number of times each instructional form was used per lesson was divided by the total number of times instructional forms were used during the instructional unit and the result was multiplied by 100.

Research sub-question 3: How many tasks were provided to the class, to a small group, and to the individual student? This measure was reported by percentage of occurrences. Collecting data on the recipients of a task shed light on the teacher’s instruction, whether the teachers remained at the whole class level instruction, or more individualized instructions.

The observers coded a delivery of task when two criteria were fulfilled: (a) the recipients of the task (e.g., class, small group, or individuals) were not engaged in the activity at the time the task was delivered; and (b) there was a close proximity between the recipients (i.e., specifically small group and individuals) and the teacher. Instructions
were not coded as delivery of an additional task when the teacher was distant from the student, or when the students were still active, because in these cases, students typically paid less attention to the teacher's instruction. Tasks were prescribed to the class, a small group, or to an individual student.

Class. When the task was prescribed to the whole class.

Small group. When the task was prescribed to two students or more, but not to the whole class.

Individual. When the task was prescribed only to a single student.

An event recording system was used to collect data and IOA on the recipients of the teacher’s instructions (See Figure 3.4). According to this system, the observer tallied each task as it occurred and its target (i.e., individual, small group, all class). Those data were reported by a frequency measure of response of the number of tasks that were provided to individuals, small group, and to the whole per unit of instruction. These data were collected from the analysis of the videotapes (Cooper et al., 2007).

Research sub-question 4: What types of cues were used by the teachers to represent the content? A cue is a key word or a phrase that communicates the critical elements of a movement to the learner. A good cue is brief and critical to the skill that is being performed (Frongske, 2001; Rink, 2006). Three different types of cues were coded. Negative cues such as “do not bend your arms” were not coded as they communicated what the learner should not do rather than what they should do. The types of cues were: technical, metaphorical, and visual (Kutame, 1997).
**Technical cue.** Key word or a phrase that emphasized a technical characteristic of the skill to be performed. For example, “elbow up” in basketball shot, or “hand-hand-foot-foot” for a cartwheel performance (Kutame, 1997).

**Metaphorical cue.** Key word or a phrase that communicated the critical elements to the students using characteristics of another subject (Kutame, 1997). The use of the words “pancake catch” is an example for the teacher’s use of metaphorical cue.

**Visual cue.** Objects or other aids that the teacher used to occasion correct response. For example, hand foot cues or taped line on the ground to occasion correct hand foot placement during a cartwheel performance (Kutame, 1997).

An event recording system was used to collect data and IOA on cues used by the teacher (See Figure 3.4). According to this system, the observer tallied each cue as it occurred. Those data were reported by a frequency measure of response, using two analyses: (a) the average number of each type of cue that was used per lesson (e.g., "follow through" and "bend knees" are two types of technical cues); and (b) the average number of each type of cue was used (i.e., sub-research questions 4a). These data were collected from the analysis of the videotapes (Cooper et al., 2007).

**Research sub-question 5:** Which antecedents preceded the teacher’s presentation of the task to an individual student? When observing the interactions that take place in the classroom, it is possible to conduct a pinpoint functional analysis of the students and/or the teacher’s behaviors. A functional analysis identifies the environmental conditions that immediately precede a teacher’s response (or a student’s response, contingent on the researcher’s interest in the behavior under investigation), and the
consequences that immediately follow that response. Research sub-question 5, 6, and 8 completed a functional analysis of the teacher's behavior, as illustrated in Figure 3.5.

Antecedents: Student's behavior

Behavior: Teacher's adaptation

Consequence: Student's behavior

Figure 3.5 A functional analysis of the teacher's behaviors

Antecedent stimuli were defined as “environmental conditions or stimulus changes that exist or occur prior to the behavior of interest” (Cooper et al., 2007, p.28). The antecedents were: student’s correct or incorrect performance, a student being off task, or other behaviors. The antecedents were recorded as demonstrated in Figure 3.6.

Correct. Performance that met the teacher’s stated criteria. For example, dribble the ball from line A to B with your right hand. Correct performance is recorded if the student follows the teacher’s instructions.

Incorrect. Performance that did not meet the teacher’s stated criteria. For example, the student dribbles the ball with the left hand when the requirement was to dribble using the right hand.

Off task. When the student was engaged in another activity he or should not be engaged in. The student is not engaged in the activity assigned by the teacher (Siedentop et al., 1982).

N/C. Not codable was recorded each time the antecedents were not detected by the camera and therefore could not be coded.
**Example of Adaptation PCK Coding Sheet – Individual**

Teacher: Taylor Grade 5th grade Date 2/15/07 Activity: Floor tennis Start: 11:00A Finish: 11:50 Lesson #: 2 out of 5

Observer: Shiri IOA: ______ Observer/IOA (please circle one)

<table>
<thead>
<tr>
<th>Task</th>
<th>Time</th>
<th>Antecedents</th>
<th>Adaptations</th>
<th>Type of adaptation</th>
<th>Appropriateness of adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Start</td>
<td>End</td>
<td>Total</td>
<td>Description of adaptation</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3:20</td>
<td>6:20</td>
<td>3:00</td>
<td>IC Serve the ball from the right, let the ball bounce once and then hit it again, make sure you side is to the target</td>
<td>RT</td>
</tr>
<tr>
<td>3</td>
<td>6:45</td>
<td>9:25</td>
<td>2:40</td>
<td>OT Remember to have your side to the target</td>
<td>R/B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**IOA**

<table>
<thead>
<tr>
<th>Antecedents:</th>
<th>Type of Adaptations:</th>
<th>Appropriateness of adaptation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>I – Incorrect performance</td>
<td>MC – Modifying complexity</td>
<td>A – Appropriate</td>
</tr>
<tr>
<td>C- Correct performance</td>
<td>DT - Assigning a different task</td>
<td>I – Inappropriate</td>
</tr>
<tr>
<td>OT – Off task</td>
<td>RT – Restating the task</td>
<td>NOTR – No opportunity to respond</td>
</tr>
<tr>
<td>O – Other</td>
<td>R/B – Refining or breaking skill down</td>
<td>N/C – Not codable</td>
</tr>
<tr>
<td>N/C – Not codable</td>
<td>EX- Extending the task</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CC – Changing competition conditions</td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.6 Example of coding sheet for adaptation tasks for individual students
Other. Any other student’s response that could not be classified as correct, incorrect, or off task was classified as other, and was recorded in a narrative format.

Although partial, the process of observation as described above is known as functional analysis of behavior. The functional analysis provides a representation of temporal relations between the teacher’s responses and the antecedents that occasioned those responses. The unit of analysis was the modified task delivered by the teacher. An event recording system was used to collect data and IOA on the antecedents that preceded teacher’s instructions to individual students (which is part of the functional analysis observation procedure, See Figure 3.6). According to this system, the observer tallied each antecedent that preceded the teacher’s instruction to an individual as the event occurred. The antecedent data were reported by a percentage measure of response.

The number of times each type of antecedent occurred was divided by the total number of antecedents that were coded during the entire instructional unit and the result was multiplied by 100. The data were then graphically presented and visually inspected. The percentage data provided a better interpretation of the most common of the observed antecedent stimuli that preceded a teacher’s adaptation of task for individuals. The data were collected from the analysis of the videotapes (Cooper et al., 2007).

Research sub-question 6: What types of adaptations (from the initial tasks provided) were made by the teachers to enhance student’s performance? Adaptations make the task appropriate to the individual (Rink, 2006). Adaptations were recorded when prescribed to the individual student, according to the following categories: (a) modifying task complexity, (b) assigning a different task, (c) extending up or breaking
the skill down, and (d) changing competition conditions (Rink, 2006; Siedentop & Tannehill, 2000). These categories were specifically determined from a pedagogical lens and based on pedagogical books authored by Rink (2006) and Siedentop and Tannehill (2000).

Modifying task complexity. Modifications to different factors of the task results in reducing or increasing its complexity. This category refers to modifications made only under the following conditions: (a) space (e.g., changing the dimensions of the playing area may change the game's complexity); (b) equipment (e.g., using beach balls in volleyball alters the game’s complexity); (c) number of participant (e.g., increasing the number of participants results in increased complexity); and (d) rules (e.g., hitting an underhand serve in tennis reduces the complexity of the game; Siedentop & Tannehill, 2000).

Different task. The teacher assigns a different task to the student, than the one that is performed by the entire class. For example, changing the striking task practiced by the entire class to a kicking task performed only by a single student (Rink, 2006).

Extending/breaking the skill down. The teacher simplifies the task by asking the student to perform only some elements of it; or the teacher expand the task’s complexity by adding elements to the skill that is being practiced. For example, practicing running and dribbling while the entire class practices dribbling and walking. This category includes changes to the elements of the task that do not fall under change of the following conditions: competition conditions, space, equipment, number of participants, and rules of the game.
Competition conditions. The teacher moves the students from competitive to non-competitive situations and vice versa (Rink, 2006). For example, practicing the sprint from the start line to the finish line, and then practicing it under timed conditions.

At the completion of the first instructional unit of each teacher, the investigator refined the adaptation categories, based on the received data. The changes were as follows. Three categories remained as is (i.e., competition conditions, different task, and modifying task complexity). One category was changed (i.e., extending/refining the skills), and two categories were added (i.e., restating the task, change of position).

Extending/refining the skills down was divided into two distinct categories: extending, and refining/breaking the skill.

Extending the skill. The teacher expands the task’s complexity by adding elements to the skill that is being practiced. For example, practicing running and dribbling while the entire class practices dribbling and walking. This category included changes to the elements of the task that do not fall under change of the following conditions: competition conditions, space, equipment, number of participants, and rules of the game.

Breaking the skill down/Refining. The teacher simplifies the task by asking the student to perform only some elements of it, or by emphasizing only some elements of it. For instance, while practicing the complete underhand pass in volleyball, the teacher asks the student to try hitting the ball with the arm platform rather than with the palms. This category included changes to the elements of the task that do not fall under change of the
following conditions: competition conditions, space, equipment, number of participants, and rules of the game.

Two categories were added with the completion of the first instructional units of the two teachers: restating the task and change of position.

Restating the task. The teacher repeats the entire task in other forms than the ones used when the task was delivered to the entire class (e.g., physical guidance), using other words and perhaps in a different order. This category is different than breaking the skill down or refining as it includes repetition of all elements of the task that should be performed rather than only one element.

Change of position. Prior to the initiation of a response, or the beginning of a trial, the teacher intervenes by changing the location of the body, or parts of the body, in the environment, to occasion a more correct response. For instance, (a) the teacher identifies that the student is gripping the handle incorrectly and changes it; or (b) prior to throwing the ball to the target, the teacher moves the student so that she would be positioned exactly in front of the target.

An event recording system was used to collect data and IOA on the adaptations used by the teacher (See Figure 3.6). According to this system, the observer tallied each adaptation as it was made. Those data were reported by a frequency measure of response, the number of each type of adaptation that was made per lesson, and per unit. These data were collected from the analysis of the videotapes (Cooper et al., 2007).
Sub-question 7 and 8 center on students’ responses to the teacher’s instructions.

Research sub-question 7: What percentage of the students performed the teacher’s task correctly? This question pertained to an analysis of tasks prescribed to the whole class only. The purpose of this analysis was to determine the appropriateness of the tasks the teacher assigned to the class. Coding and analyzing the data of this question was a two-fold process. First, students’ responses were categorized to: correct, incorrect, and not codable (See Figure 3.4). Second, tasks were classified as appropriate or inappropriate based on students’ performance.

**Correct.** Performance that met the teacher’s stated criteria (i.e., process criterion, product criterion, or both). For example, the teacher instructed to bump the ball over the net with arms straight. The researchers adhered to the teacher's stated criteria in determining whether the students' performance was correct. If the student bumped the ball over the net yet with bent arms, the performance was incorrect. Performance was correct only if the student exhibited both criteria, as these are the criteria the teacher stated in the task. The other categories will be explained in reference to this scenario.

**Incorrect.** Performance that did not meet the teacher’s stated criteria. For example, the student bumped the ball with straight arms yet not over the net.

**Not codable.** Was coded when the observers were not able to observe the students’ behavior in the time allotted for performing the task.

**Appropriate.** A task was appropriate if it was followed by a correct performance demonstrated by 80% or more of the students in the class.
Based on the correct/incorrect performance data, the researchers determined whether the task was appropriate.

*Inappropriate.* A task was inappropriate if it was followed by a correct performance demonstrated by less than 80% of the students in the class.

The data for this research question were collected live on site. An event recording system was used to collect the data and IOA on the students’ performance (See Figure 3.7). According to this system, the observer recorded the behaviors of all students in the class (i.e., a “snap shot” of the occurrences in the class). The observation of students’ performance began 30 seconds after the teacher’s signal to begin the activity, and only if more than half of the class had already began practicing the task. In any case, coding did not begin prior to the passing of 30 seconds from the onset of the teacher’s signal to begin practicing.

The observers scanned the class and recorded each student’s performance. After recording the behavior of one student, the observers moved on in a specified direction (i.e., left to right) to observe another student (Siedentop et al., 1982). To balance the elapsed time until the investigator records the last student’s performance, the observation was conducted from right to left on one task (students on the left side received more time to practice the task before their behavior was recorded), and from left to right on the next task (students on the right received more time to practice the task). When two observers were collecting data for IOA purpose, one of them led and paced the observation by verbally indicating which individual to observe (e.g., “the girl in the green shirt”). The
behavior was then coded. The observers alternated the leading role with each task that
was provided.

Example of PCK Coding Sheet – Appropriateness of Whole Class Tasks

Teacher: Kayla Grade: 5th grade Date: 1/15/07 Activity: Golf Start: 10:00A Finish: 10:45A
Lesson #: 2 out of 6 Observer: Shiri IOA: ______ Observer/IOA (circle one)

<table>
<thead>
<tr>
<th>Students/Task #</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>V</td>
<td>V</td>
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<tr>
<td>3</td>
<td>V</td>
<td>V</td>
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<td>V</td>
<td>V</td>
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<td>X</td>
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<tr>
<td>% C</td>
<td>85</td>
<td>88</td>
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</tr>
</tbody>
</table>

IOA: V - Correct performance, X - Incorrect performance
~ - Not codable

Figure 3.7 Example of coding sheet for appropriateness of whole class tasks

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The data were reported by a percentage measure of response. The number of students who performed the task correctly and incorrectly were divided by the number of students in the class and multiplied by 100. The data were collected live on site and were supported by a permanent video camera record (Cooper et al., 2007).

Research sub-question 8: To what extent were the adaptations made for individual students appropriate? Following sub-question 6, which examined the modifications the teacher made for individual students, this question examined whether those adaptations were appropriate or inappropriate for the student.

*Appropriate.* Adaptation was appropriate if it resulted in student’s correct performance.

*Inappropriate.* Adaptation was inappropriate if it resulted in student’s incorrect performance.

*Not codable (N/C).* Was recorded when either of the cameras did not capture the student’s performance during the time interval immediately after the task was delivered to the student.

After collecting and coding data of the first instructional unit of both teachers, the investigator added another category: no opportunity to respond (NOTR).

*No opportunity to respond (NOTR).* Was recorded when the student was on task but did not have the immediate opportunity to respond to the task that was provided by the teacher. This category included the following examples. After the delivery of an adaptation task, it was the other partner’s turn to practice. Therefore, the students switched roles. During the team game play, the student did not receive the ball again
during the time interval he/she was observed, or the teacher did not initiate a replay of the situation that required correction; during the volleyball game, the student served incorrectly and was corrected by the teacher, yet the ball switched to the possession of the other team.

A partial-interval recording system was used to collect data and IOA on the appropriateness of the adaptations to individual students (See Figure 3.6). This process was examined via observations on the student’s performance. In this system, the observer simply recorded the presence or the absence of correct performance during a 10-seconds interval. The 10 seconds were measured from the moment the teacher finished providing the task to the student. The underlying assumption of this research question was that a modified task is delivered to improve performance and to occasion an immediate correct response. Thus a student should be able to initiate a correct response promptly. Yet if a modified task still results in an incorrect performance, then the task was inappropriate. Therefore the investigator used a 10 seconds interval for determining the appropriateness of the adaptation for an individual student.

The data were reported by a percentage measure of response. The ratio between appropriate adaptation and the total number of adaptations was calculated and reported. These data were collected from the analysis of the videotapes (Cooper et al., 2007).

Observation Procedures

The following section describes the equipment used in this study, participants’ reactivity, the observers and procedures of training them, and IOA procedures.
Equipment

Both teachers taught the lessons inside the gymnasium. The investigator videotaped the lessons of both teachers using two video cameras, to ensure a permanent record of the data. One person was holding the primary camera and was videotaping the teacher for the entire lesson (denoted by “1” in Figure 3.8). In Kayla’s gymnasium, the video-grapher was positioned at the corner and occasionally was required to move along the side lines to the right or to the other corner for a better view of the teacher (denoted by dotted line in Figure 3.8).

Participant Reactivity

In Taylor’s gymnasium, the primary camera person was positioned mostly at the stage area, and occasionally at the front of the gymnasium, along the sideline, for better view (See “1” and dotted lines in Figure 3.8). Both teachers wore wireless microphones and their verbal and non-verbal behaviors were recorded. The secondary camera was typically following the students in the class and particularly those who receive adaptation tasks from the teacher, and served as a backup for the primary camera. The ALT-PE data were videotaped using this camera as well. This camera was positioned in a way that allowed the greatest view and sample of the students in the lesson. At both sites, the camera was held stationary on a tripod, and was located in the least obtrusive way at the right hand corner of the gymnasium (See “2” in Figure 3.8).

The presence of observers and video cameras at the setting may influence the participants’ (i.e., teacher and students) behaviors, a process also known as participant reactivity (Cooper et al., 2007). The investigator and the observers made all efforts to
remain as unobtrusive as possible and to minimize the participants’ reactivity. For that, the following procedures were followed:

**Figure 3.8 Diagram of the camera’s location in Kayla and Taylor’s gymnasium**

1. The investigator met and conversed with the teachers both informally and formally (i.e., phase 2 interview) several times prior to the beginning of the study. The rapport with the teachers may have decreased their reactivity to the investigator.

2. On each lesson, the observers arrived prior to the arrival of the students into the gymnasium, and left after the class ended. This routine decreased the possibility the observers’ presence disturbed the classroom.

3. The investigators and the observers did not hold conversations with the teacher nor with the students during the lesson.
4. The investigator, observers, and the video cameras were all located outside the designated lesson area, in the least obtrusive position possible.

Description and Training the Observers

Four observers assisted in videotaping the lessons at the school settings. Three observers assisted in coding the data of the main research questions. One observer, who also assisted in videotaping the lessons, assisted in coding the ALT-PE data. All of the observers were doctoral students enrolled in the Sport and Exercise Education program at The Ohio State University, with a specialty in physical education teacher education. All of the observers were trained in each of the observation instruments used in this study to an accuracy criterion of 95-100%.

Each variable had a protocol that included the following procedures:

1. **Academic Learning Time Physical Education.** The procedures were:

   a. Knowledge of definitions. The observer was provided with the definitions of the different variables of ALT-PE, and was required to learn those independently. The investigator then met with the observer to discuss the definitions and to make clarifications if necessary. The observer was already familiar with the ALT-PE coding system as he participated in another project that used this instrument for coding.

   b. Written test. The observer took a written test that included behavior descriptions from a physical education lesson. The observer was required to categorize those descriptions according to the ALT-PE categories (See Appendix E).
c. Videotape coding. The observer watched a 15-minute videotape of a physical education lesson. The observer and the investigator observed and recorded the behavior of a single student for five minutes. Then they observed and recorded the behavior of three students for 15 minutes.

d. As ALT-PE data were coded infrequently for a total of four times, the investigator reviewed the definitions with the observer prior to each data coding session, relative to the content knowledge that was taught in the observed lesson.

2. Type of content tasks. The procedures were:

a. Knowledge of definitions. The observers were provided with the definitions of the types of content tasks, and were required to learn those independently. The investigator then met with the observers to discuss the definitions and to make clarifications if necessary.

b. Written test. The observers took a written test that included a sequence of tasks in a physical education lesson. They were required to categorize the tasks to the different types of task categories (See Appendix F).

c. Videotape coding. The observers watched a 20-minute videotape of a physical education lesson. Similarly to the written test, they were required to categorize the teacher’s task to the different types of task categories.

3. Instructional forms. The procedures were:

a. Knowledge of definitions. The observers were provided with the definitions of the instructional forms, and were required to learn those independently. The
investigator then met with the observers to discuss the definitions and to make clarifications if necessary.

b. Written test. The observers took a written test that included statements that described different forms of information delivery and were required to differentiate between the forms (See Appendix G).

c. Videotape coding. The observers watched a 20-minute videotape of a physical education lesson. They were required to identify and code the teacher’s instructional forms.

4. Recipients of tasks. The procedures were:

a. Knowledge of definitions. The observers were provided with the definitions of an individual, a small group, and the entire class. They learned the definitions and discussed them with the investigator.

b. Videotape coding. The observers watched a 20-minute videotape of a physical education lesson and were required to determine the recipient of each task.

5. Types of cues. The procedures were:

a. Knowledge of definitions. The observers were provided with the definitions of the types of cues, and were required to learn those independently. The investigator then met with the observers to discuss the definitions and to make clarifications if necessary.

b. Written test. The observers took a written test that included statements that described different types of cues teachers use. They were required to categorize the cues according to the different categories (See Appendix H).
c. Videotape coding. The observers watched a 20-minute videotape of a physical education lesson and were required to identify and code the cues the teachers use.

6. Analysis of antecedents. The procedures were:

a. Knowledge of definitions. The observers were provided with the definitions of antecedent, response, and consequence, and were required to learn those independently. The investigator then met with the observers to discuss the definitions and to make clarifications if necessary.

b. Videotape coding. The observers watched a 20-minute videotape of a physical education lesson. The investigator instructed the observers to look at one specific teacher’s target behavior for five minutes, and to code the antecedents for it. During the latter 15 minutes, the observers were required to code the antecedents to events in which the teacher modified the initial task for individuals.

7. Adaptations of tasks. The procedures were:

a. Knowledge of definitions. The observers were provided with the definitions of the different types of adaptations of tasks, and were required to learn those independently. The investigator then met with the observers to discuss the definitions and to make clarifications if necessary.

b. Written test. The observers took a written test that included scenarios describing different adaptations and were required to identify and code the type of adaptation that was made (See Appendix I).
c. Videotape coding. The observers watched a 20-minute videotape of a physical education lesson and were required to code the type of adaptations made by the teacher.

8. Students’ performance. The procedures were:

a. Knowledge of definitions. The observers were provided with the definitions of a correct and incorrect response, and were required to learn those independently. The investigator then met with the observers to discuss the definitions and to make clarifications if necessary.

b. Videotape coding. The observers watched a 20-minute videotape of a physical education lesson. For the first 5 minutes, they were required to code the trials performed by a single student, according to the teacher’s stated criteria of the task. During the latter 15 minutes, the observers coded how many students were performing the task correctly.

9. Adaptation appropriateness. The procedures were:

a. Knowledge of definitions. The observers were provided with the guidelines of how to determine whether an adaptation to an individual was appropriate. They learned the guidelines independently and then met with the observers to discuss the guidelines and to make clarifications if necessary.

b. Videotape coding. The observers watched a 20-minute videotape of a physical education lesson. They coded single student’s performance for 10-second after the student was given a task. The observers determined whether or not the task was
appropriate for the students based on the behavior (i.e., correct/incorrect performance or off task) that best represented the 10 seconds interval.

Additionally, the investigator reviewed all of the variables and definitions prior to the beginning of the data collection of the second instructional unit of both teachers. Particular emphasis was given to reviewing and explaining the new categories that were added to the coding of type of adaptations and adaptation appropriateness variables.

**Interobserver Agreement**

The method of data collection in phase 3 of the study was observations of the recorded videos and therefore IOA was required. Interobserver agreement is established when comparing the judgments of two observers who observe the same event or behavior simultaneously. The agreement is the assessment of the extent to which the observers agreed in recording the occurrences and non-occurrences of the event or behavior. The higher the agreement, the more confidence one has in the accuracy of the data. The IOA was calculated by dividing the agreements by the total of agreements and disagreements of the occurrence of the target behavior or the event and multiplying the result by 100 (Cooper et al., 2007).

The unit of analysis of the research sub-questions was the tasks provided to the students. Therefore IOA was obtained on the occurrences of the teacher and the students’ behaviors during the distinct tasks, and was organized and reported according to three categories. First category was IOA data for the general PCK components represented in research sub-questions 1-4. Second category was IOA for research sub-question 7. The IOA for these data was obtained and reported separately from the other variables as this
dependant variable was collected live on site and unconnectedly to the IOA collected for all other variables in this study. The third category was IOA for the adaptation PCK variables represented in research sub-questions 5, 6, and 8. The IOA data for this set of variables was obtained and reported separately as these data referred to adaptations to individual students only, while the other sets of data referred to whole class instructions and students’ responses in that context.

To increase IOA reliability, three different researchers conducted IOA on the primary investigator’s observations. These researchers typically did not observe consecutive lessons of the same teacher. This procedure ensured that the observers did not change their observation or evaluation of student’s or teacher’s performance as the study progressed. The IOA was performed on 33% or more of the different sets of data that were collected, with the exception of Taylor’s stronger instructional unit in which IOA was conducted on only 13% of the tasks. The acceptable criterion for IOA was set to 85%.

Another issue related to human observation is observer drift. The observers' interpretation of the definitions of the events or target behaviors may change over time, and that may change their coding (Cooper et al., 2007). To control observer drift, the investigator and all of the observers revisited the definitions of the target behaviors and events of interest prior to each instructional unit observed.

Data Analysis

Based on the behavioral methodology, the dependent variables were directly and repeatedly measured. The measurements resulted in data that were plotted in graphs or
tables for analysis purposes. Graphs are the primary vehicle in behaviors analysis to organize and interpret the data collected, and to communicate it to others. The graphs are visually inspected and analyzed for evaluating the behavior of interest (Cooper et al., 2007).

In this study, data were visually displayed using lines graphs, bar graphs, and tables. The line graph is formed of a two dimensional area. Each data point plotted in this area represents the relationship between two variables (i.e., dimensions). The one is the dependent variables, a quantifiable dimension of a target behavior (e.g., success level of the class). The other is the independent variable, typically time or environmental dimension (e.g., tasks presented in the instructional unit). The data were plotted on the graph for visual analysis, and reveal the presence and changes of the target behavior, its level, trend, and variability (Cooper et al., 2007).

The bar graph, also known as histogram, was used for a graphic summary of the behavioral data. Bar graphs in this study were used for displaying and comparing sets of data that do not have a common underlying dimension. The bar graphs allowed the presentation of a summary of the teacher’s performances (e.g., type of tasks used). In contrast to the line graphs that allowed the evaluation of changes in behavior over time; bar graphs were primarily used in this study for summarizing large amounts of data in a simple format (Cooper et al., 2007).

The graphs and tables were visually analyzed to determine the variability, level, and trend of the data. Variability is created when multiple measures of the target behavior yield different outcomes. The larger extent of different outcomes, the more variability
exists in the data. Level is formed by a set of behavioral measures that converge around the vertical axis of the graph. Trend is formed by the overall direction the data take. The trend is typically described using degree (i.e., increase, decrease), and magnitude (e.g., rapid, gradual). The visual analyses of the graphs included examination and comparison of the changes in level and trend of the target behaviors. Subsequently, proper conclusions were drawn (Cooper et al., 2007).

Table 3.3 summarizes all variables that were measured in phase 3 of this study, how the data were collected and how they were reported. The results are presented in chapter 4.
Table 3.3 A summary of all research sub-questions, type of variables measured, data collection method and how data were reported

<table>
<thead>
<tr>
<th>#</th>
<th>Research sub-questions</th>
<th>Type of variables measured</th>
<th>How data were collected</th>
<th>How data were reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>What was the percentage of each type of content task used in the teacher’s stronger and weaker unit of instruction?</td>
<td>Informing</td>
<td>Event recording</td>
<td>Percentage measure. E.g. 30% of the tasks were informing task</td>
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<td></td>
<td></td>
<td>Extension</td>
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<td>Graphic presentation</td>
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<td></td>
<td>Refinement</td>
<td></td>
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<td></td>
<td></td>
<td>Application</td>
<td></td>
<td></td>
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<tr>
<td>a.</td>
<td>In what order were the types of tasks presented in the stronger and weaker instructional units?</td>
<td>Same</td>
<td>Same</td>
<td>Table presentation</td>
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<tr>
<td>2</td>
<td>Which instructional forms were used by the teachers to represent the content to the students?</td>
<td>Verbal instructions</td>
<td>Event recording</td>
<td>Percentage measure per unit. E.g., 70% of the tasks were delivered verbally</td>
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<td>Demonstrations</td>
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<td>Graphic presentation</td>
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<td>Metaphors</td>
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</tr>
<tr>
<td>3</td>
<td>How many tasks were provided to the class, to a small group, and to the individual student?</td>
<td>Recipients of tasks:</td>
<td>Event recording</td>
<td>Percentage measure per unit. E.g., 85% of the tasks were delivered to the whole class</td>
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<td>Graphic presentation</td>
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<td></td>
<td>Small group</td>
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<td></td>
<td>Individual</td>
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<tr>
<td>4</td>
<td>What types of cues were used by the teachers to represent the content?</td>
<td>Technical cue</td>
<td>Event recording</td>
<td>Frequency measure, average per lesson. E.g., the teacher provided 24 different technical cues, and 14 visual cues</td>
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<td></td>
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<td>Metaphorical cue</td>
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<td></td>
<td></td>
<td>Visual cue</td>
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Cont
### Table 3.3 Cont

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<th>Question</th>
<th>Event</th>
<th>Recording</th>
<th>Measure Type</th>
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<tbody>
<tr>
<td>a. How many times were those types of cues used during the lesson and unit?</td>
<td>Same</td>
<td>Same</td>
<td>Frequency measure, average per lesson. E.g., the teacher stated technical cues 72 times, and visual cues 32 times</td>
</tr>
<tr>
<td>5 Which antecedents preceded the teacher’s presentation of the task to an individual student?</td>
<td>Antecedents that precede teacher’s instructions to individual students: Correct performance Incorrect performance Off task Other</td>
<td>Event recording</td>
<td>Percentage measure per unit. E.g., 60% of the antecedents were students’ incorrect performance</td>
</tr>
<tr>
<td>6 What types of adaptations (from the initial tasks provided) were made by the teachers to enhance students’ performance?</td>
<td>Modifying task complexity Providing a different task Extending the skill Breaking the skill down/refining Changing competition conditions Restating the task Changing position</td>
<td>Event recording</td>
<td>Percentage measure per unit. E.g., 74% of the modifications were breaking the skill down, and 26% were restating the task</td>
</tr>
<tr>
<td>7 What percentage of the students performed the teacher’s task correctly?</td>
<td>Correct Incorrect Not codable</td>
<td>Event recording</td>
<td>Percentage measure per task. E.g., 81% of the students performed the first task correctly</td>
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</table>

**STUDENTS’ RESPONSES**

<table>
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</thead>
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<td>Cont</td>
<td>Cont</td>
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</tbody>
</table>
Table 3.3 Cont

<table>
<thead>
<tr>
<th>8</th>
<th>To what extent were the adaptations made for individual students appropriate?</th>
<th>Appropriate</th>
<th>Inappropriate</th>
<th>Not codable</th>
<th>No opportunity to respond</th>
<th>Partial-interval recording</th>
<th>Percentage measure per unit. E.g., 84% of the adaptations were appropriate, and 16% were inappropriate</th>
<th>Graphic presentation</th>
</tr>
</thead>
</table>

Table 3.3 A summary of all research sub-questions, type of variables measured, data collection method and how data were reported
CHAPTER 4

RESULTS

The results of the study are reported in this chapter in the following manner. First, the results of phase 1 (i.e., focus interview) and 2 (i.e., individual interviews) are organized according to the three main research sub-questions of those phases. The report on the results of phase 3 begins with ALT-PE data as an indication on the teachers’ effectiveness, followed by a report on Interobserver Agreement (IOA). Next, the results of phase 3 are reported according to the eight research sub-questions of this phase. Under each research sub-question in phase 2 and 3, Kayla's results are presented first, followed by Taylor's results.

Phase 1

Six teachers (four females and two males) participated in a focus group interview. Their answers to the interview questions were grouped into categories under the research question they were addressing. The answers that pertained to research questions 1 and 2 were classified based upon the number of participants who discussed those practices. The three research sub-questions of phase 1 were:
1. How do teachers describe how they acquired their CK and PCK relative to their stronger and weaker units?

2. What teaching practices do teachers identify as their PCK?

3. How do teachers ensure the content delivered is appropriate to the students’ developmental level?

_How Do Teachers Describe How They Acquired Their CK and PCK Relative to Their Stronger and Weaker Units?_

The teachers made key comments on nine practices that they believed impacted their acquisition of CK and PCK relative to their stronger and weaker units. All practices emphasized engagement in athletic activities that in their view contributed to their CK and PCK. Table 4.1 summarizes the participants who discussed each practice. The nine practices were:

1. _Introduction to Sport and Physical Activity via the Family_

   Ashley, Marie, Beth, and Joe identified their parents as an influencing their exposure to, passion for, and interest in sports and physical activity. Ashley’s first exposure was to softball at age four: “My mom wanted to keep me busy, so yes I played softball.” Ashley’s parents influenced her engagement in sports also at a later age: “In high school I played tennis. I began playing tennis with my parents on the playground and out in the park.” Marie reported a similar exposure to sports: "I had started with basketball because my dad welded a basketball rim and put it on the farm. That is where I started because we had no girls' sports when I was in school and my dad loved sports." Similarly, Beth was raised by a family in which both parents were athletic and engaged in
sports such as badminton and swimming. Beth’s father supported her passion for running and planned a running training schedule for her. Joe indicated that his mom was a major influence on him as a professional, together with the influence of the teacher education program. He stated: “She is my hero and everything she says you do, you do it the right way, and you give it everything you have.” Sarah’s mother on the other hand, was not supportive of Sarah’s engagement in sports. Sarah observed: “At that time it wasn’t believed that sports would help with academics.”

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Table 4.1 The focus group participants who discussed each practice pertaining to research sub-question 1

2. *Introduction to Sport and Physical Activity via the Living Environment*

Sarah, Beth, Ryan, and Ashley indicated that the environment in which they lived was conducive for engagement in athletic activity. Ashley said: “Growing up I played softball, soccer, I swam in the summers and then I guess whatever game I could find in
the neighborhood and/or outreach, I did that, too.” Ryan shared similar experience: "I played everything, backyard football, baseball in the drive way, it was non-stop.” Sarah described the relation between where she lived and her engagement in sports: “I was born and raised in Minnesota so I was born skiing and skating before I could even walk.” Beth also discussed unique farm experiences as a young girl, that later influenced her participation in show jumping:

I was 4 and we took our cows to the state fair, and when we were showing, I would go over to the coliseum and the show jumpers were jumping. And I said that’s what I want to do…This is my other passion. I can’t imagine life without it.

I would do that until I would have to have the crane to put me on and off.

Beth also mentioned she loved watching people water skiing on the river at her city, during her family trips to the zoo. Living in an area with rivers in and around it was an opportunity for Beth to engage in the particular sport of water skiing.

3. Introduction to Sport and Physical Activity via School and Sport Clubs

All teachers referred to their engagement in sport activities in school, on teams, or in clubs. They talked about participation in high school sports such as track and field and field hockey, and participation in teams such as gymnastics, basketball, and soccer. The participation in teams enriched the teachers' background and knowledge in those specific activities, as explained by Sarah: “I was doing gymnastics at a club since I was young…That gave me a great background on movement as well as dance.” Ryan participated in high school sports and in a soccer club team. From there he progressed to
the soccer state team, the regional and the national team. Ryan identified soccer as his stronger unit of instruction.

Not all athletic experiences, however, had added value. For example, Sarah was discouraged by the coach when she failed the tryouts for track and field at her school, although she believed she was fast. The effect of this episode on Sarah was significant: “At that point I was completely discouraged by high school athletics and I never ever tried out for anything after that in my life.”

4. Acquisition of Knowledge via Instructing and Coaching Children

Sarah, Ashley, Ryan, and Joe described their coaching experiences, prior to their official teaching experiences, as influential on the development of their CK and PCK. Joe and Ashley coached several sports and recreational activities. Joe attributed his career in education to his prior experiences in teaching: “The reason I got into education was through teaching swimming.” Joe majored in psychology when he began teaching swimming. Sarah described her experience prior to teaching: “I spent every summer at Ohio camp work for physically handicapped kids and I taught swimming and did all of that outside of school.” Ryan described his involvement in coaching: “I always did coaching in young leagues and recreation groups.” Further, Ryan defined soccer as his stronger instructional unit “just because the experience I have both playing at all levels and coaching in many levels as well.” Ashley also elaborated on her extensive experience prior to teaching:

I coached swimming in the summers at my community pool for several summers and I guess that was my first experience with coaching. Then I had a career in the
recreation field for about 10 years so I coached and taught many recreational activities, sport activities, mainly in leagues, in soccer leagues, I taught little kids and some older kids’ classes and I did tennis class, so I had a lot of teaching experience before I actually taught officially.

5. Acquisition of Knowledge via Physical Education Teacher Education Programs (PETE)

Joe, Marie, Ryan, and Beth described their teacher education programs as important for the acquisition of CK and PCK, because the programs provided exposure to numerous games and activities. Joe referred to the knowledge he acquired: “I got that through the [teacher training] program at the university where I was exposed to many different things and the opportunity to learn about a lot of games.” Ashley was first introduced to team handball in the teacher education programs. Team handball had become Ashley's stronger unit of instruction because it was “modeled very well in my student teaching experience.” Similarly, Beth mentioned her master’s degree program advisor as a significant influence on her teaching.

6. Acquisition of Knowledge via Self-Instruction

Marie, Joe, Sarah, and Ashley described self-instructing as a skill in their repertoire that assisted them in acquiring CK and PCK. Marie claimed: “It’s [CK] all been kind of self-taught.” Ashley explained she could generalize principles from teaching her stronger unit such as soccer, to teaching other invasion games she had less experience in, such as team handball. Ashley described: “I just took what I knew from soccer and from playing lots of ultimate Frisbee and transferred it into that [team handball].” Joe
also reported he could teach content he was not taught or did not play before, by self-
instructing, transferring knowledge from other similar sport content, and by seeking
materials for enhancing his knowledge in the particular game or sport. Joe described:

You know, if someone comes and says you are going to teach this. Ok, fine. Let
me get the book, let me read through, let me understand. I already have a general
knowledge of invasion games, of net games, of tactics that are involved in all of
the games.

Both Joe and Sarah reported taking self-instructing actions when they were
required to teach content they felt less comfortable with. Sarah shared this example:

We were once teaching line dancing and I went out and bought a dance video…I
took the video home. In my living room with my four dogs, two kids, and
husband and I was line dancing for hours so that I would feel comfortable when I
went in to teach line dancing.

Joe continued: “Any unit that you teach can become your best unit as long as you are
willing to put in the time, to do the work, to get what you need, to find the resources
available for you.” Such self-instructing actions improved the teacher's experience with
the content, and compensated for prior lack of knowledge.

7. Contingency Shaped Teaching Experiences

The teachers reported they continued to acquire and develop their CK and PCK
during their daily teaching in school. Sarah, Joe, Ashley, Ryan, and Beth discussed the
contribution of experience and repeated teaching to the development of their stronger
units of instruction. Joe explained:
I feel like I could be strong in any unit, and I think it is just a matter of experience. You get enough exposure to understand the ins and outs and I think that’s where the strength comes from. Exposure, experience, taking the time to learn about the game.

Sarah echoed Joe: “I think that just comes from [what] Joe said exposure and teaching it over and over and over, perfecting it.” Sarah and Joe's stronger units were those they had taught numerous times. Similarly, Ashley identified team handball as her stronger unit, because she had delivered it four consecutive years, to nine classes each year.

Sarah and Joe explained that their CK and PCK developed from repeated teaching, observations of their students’ responses, and analysis of the content for the purpose of selecting the most developmentally appropriate activities for the students. Teaching produced more experience with drills and activities, and enhanced the teacher’s knowledge of the common errors that students may exhibit. Sarah illustrated how the knowledge continues to develop through observations: “I think it just goes with your observation. Just looking at, sending the students out with a task and watching them from the very beginning.”

8. Acquisition of Knowledge via Observations

Sarah, Ryan, and Ashley noted that the observation of master teachers was meaningful in their acquisition of CK and PCK. Sarah shared: “My first unit as a teacher whenever I had to teach something that I wasn’t sure how I would go about teaching…I watched a master teacher during my free periods.” Sarah observed her master teacher and saw “how it [the unit] should be done versus how it could be done.” Ryan agreed that
observing a master teacher teach enhanced his knowledge. Ashley reported teaching her juggling unit as her mentor teacher had taught it: “When I teach juggling, I totally copy it off Mr. Foster” (pseudonym). Ryan and Sarah also discussed the importance of observing negative examples for enhancing their CK and PCK. When he was supervising student teachers, Ryan learned about errors teachers make:

Just observing the last year being in schools, I think even that, I’ve really [learned]…Teachers that I saw understood very well space and what a child or a student can do in that space. Student teachers do not understand they have too many students in small space and nothing can get accomplished. Even an elite athlete in a space that is very small would not be able to complete a task that you are asking them to do.

9. **Other Valuable Practices**

Ryan shared that observation of coaches and participation in professional development workshops and clinics improved his CK and PCK. Ashley asserted handball is her stronger unit partly because it was favorable to the students, and they loved participating in it. Finally, Ryan mentioned that data collected on his teaching (e.g., ALT-PE, general and specific feedback) was conducive for the improvement of his teaching practices.

*What Teaching Practices do Teachers Identify as Their PCK?*

The teachers discussed seven categories as related to their PCK. Table 4.2 summarizes the participants who discussed each practice. The seven categories were:
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Table 4.2 The focus group participants who discussed each practice pertaining to research sub-question 2

1. **Planning**

Joe argued planning was an important characteristic of good teaching. He always over-planned when he was a beginning teacher: “I over planned…and that I think is the key as you are beginning. That planning aspect that is so important.” Joe observed that the over-planning increased his exposure to the content. Beth discussed the importance of planning for individualized and appropriate instruction: “I started doing my lesson plans after I figured out that everybody is not going to go the same place at the same time.” For Sarah, planning still continued as she became an experienced teacher, particularly before teaching weaker units. In these cases, she shared: “I still rehearse at home at night.” Sarah, however, does not plan prior to teaching stronger units: “I know I have reached that point that I know that I am going to school and it just flows.”
2. *Appropriate Teaching Practices*

All teachers referred to specific skills in their teaching repertoires that represent part of their PCK.

*Teaching diverse students.* The teachers reported that their extensive contact with students was imperative because it exposed them to teaching students of various ages and abilities. Sarah described how experience influenced her ability to modify the instruction for the individuals in her class:

> We have seen so many of those students and had taught all of those levels, that that’s what your, if you want to call it your bag of tricks. Here, you know, I can pull this one out for you and for you and I could pull that one out for you.

*Ability to modify instruction.* All teachers discussed the ability to modify instruction for different students, challenging advanced students, and simplifying the instructions for students who are struggling. Sarah, Joe, and Ryan indicated a high comfort level modifying instruction for individual students in their stronger units of instruction. Ryan explained that the ability to provide feedback and to modify instruction is more developed in his stronger unit, while lacking in his weaker unit. Ryan made the following distinction between his stronger and weaker units:

> [With the] general class, I don’t think it [i.e., progressing up or down] would be much different but specific feedback and the ability to give student something different whether it is more of a challenge or less of a challenge; It would take me much longer [when teaching weaker unit] to key in on that.
Beth and Marie asserted that the experience assisted them to reach a level where they knew what to ask of students. Joe agreed and noted that the importance of providing the appropriate instruction at the right time and in the right order was a critical skill. For Ryan, Ashley, and Beth, planning modified instructions occurred even prior to the lesson. Beth gave an example:

I started doing the basic task or whatever it was, and I had a little column that was remedial loop…and then extension. And so that, that was, I didn’t have to think of that, it was there and you know, go get lighter ball, go get you know, have this ready cause some of them are going to need this and that.”

For Ashley, individualized instruction signified “depth” that did not exist in her weaker unit of instruction. Beth and Joe indicated that their modifications for individuals are observable and are infused into every lesson. Depth of instruction, according to Ashley, also referred to appropriate and extensive use of terminology while teaching. In stronger units, Ashley could explain what depth was, yet she could not do so in her weaker units, as she lacked that CK to describe to students the labels and terms of the activity. Ashley noted: “It wouldn’t be depth; it would be skimming the surface on my weaker unit.” Ashley added: “Depth comes from having done it. I know what my body feels like when I do it.”

Use of appropriate games and activities. Beth and Sarah reported they want to create student success. Therefore the games and activities they provide to students should be appropriate, and should be broken down into manageable and teachable parts, to foster success. Due to their experience, Beth and Sarah reported that their experience improved
their ability to select the most appropriate tasks for their learners. Beth said that over time “you know what games work, what distances work when you are teaching, which activities are more appropriate to all levels, not just your novice level versus your experienced level.” Sarah agreed and also reported a high comfort level with the explanations she provided in the stronger instructional unit.

*Appropriate equipment and space.* Selecting and delivering appropriate activities also requires the use of appropriate equipment and space, as noted by Ryan and Beth. Beth emphasized that “having the right equipment to give them the right topography of the skills, so that they can apply the tactic, is golden.” Ryan agreed and added that the value of the appropriate space was important. According to Ryan, setting a proper space for the activity is vital and should be done in a way that would promote the learning of skills and tactics.

*Student demonstrations.* Demonstration was also a teaching skill that related to the teachers' PCK. Ryan and Marie reported asking the students to demonstrate skills and activities when they felt their demonstration would be lacking. Effective demonstrations were less prevalent in Ryan and Marie's weaker units of instruction.

3. *Error Detection and Correction*

The teachers discussed the importance of their ability to select critical elements, to anticipate performance and common errors, and to correct those errors. Critical elements are the "key features of a movement that are necessary for optimal performance (Knudson & Morrison, 2002).
Selection of critical elements. At the beginning of his career, Joe selected critical elements for teaching. With time and experience in teaching the content, Joe acquired a better understanding of how students perform and emphasized more effectively how they could avoid their errors. Thus, for Joe, experience with the content and the learners improved his selection of critical elements for teaching.

Anticipating performance and common errors. Repeated teaching enhanced the teachers' ability to predict their students' performance, and to anticipate the errors they would make. Joe explained: “I already know what is going to happen…This is the common error that is going to come up. You would come to the point where you anticipate the errors and that you teach to the errors from the beginning.” Sarah added that she is always trying to cover as many errors that may occur in her instructions.

Correcting errors. Joe noted that his experience enabled him to anticipate and to correct students’ errors. Joe reported being comfortable and confident when teaching his stronger unit, and less so when teaching his weaker unit. When asked why, he said: “Because I don’t necessarily have all the technical fine points or cues to give them to correct the errors they are going to make.” Nonetheless, given additional time to prepare and to gain some experience in teaching weaker content, Joe declared he could teach the sport well. All of the teachers supported the notion that a beginner is a beginner, regardless of age. Beginners’ errors are similar and thus often predictable. The teachers reported they would be able to teach beginners, even if they were of different age groups than the learners they typically teach (e.g., elementary versus secondary school students).
4. Pacing

Ryan, Joe, Beth, and Sarah discussed the importance of modifying instruction at the appropriate time. Ryan explained: “You are able to more quickly see what is not working and you are very quickly able to come up with a new activity that shapes them in the way you want to shape them.” The ability to quickly identify whether the students are performing what is required is more highly developed in the stronger units than in the weaker ones, which has implications on the pace of the lesson. Ryan explained pacing:

So I may stay in an activity longer, you know, I would make them do something that they are really not going to be able to do, whereas in something that I have experience with, I could just move quickly, say this is not working in my mind and then say ok, we are changing it.

Ryan mentioned that the activities in his stronger unit would flow from one to another. Beth and Sarah expressed agreement. All teachers agreed that it is their expectation that appropriate tasks ought to be performed correctly by the students fairly quickly, or else something is wrong with the instruction. They all reported they are able to observe the class and identify if the students were not successful, and in that case, they all agreed that they would immediately change the activity.

5. Varied Teaching Methods

Sarah said she varies her teaching styles when teaching stronger units. She always searches new activities and novel methods of assessing the students’ performance. She tries to involve the students in "more reflective type activities," which allows them to take responsibility for their learning. Similarly, Joe reported being more comfortable
incorporating peer teaching into his stronger instructional unit and allowing for the knowledge to circulate among the students. Joe said: “A great way to learn a skill is to teach a skill.” Using peer teaching, Joe was able to create a learning community in his lesson. Marie supported this practice because, in her opinion, teachers need to remember that they are there for the benefit of the student. Nonetheless, Joe reported not utilizing peer teaching in weaker content: “If I don’t have the depth of knowledge, I don’t know if I would send a student off to teach the other student unless I felt like I have given them the necessary information to do that.”

6. Experience in Performing the Sport

Ashley and Sarah emphasized the relationship of their ability and experience in playing the sport to their teaching of that particular sport. Sarah practiced line dancing (i.e., weaker unit) prior to the beginning of the unit. Ashley asserted that her depth of knowledge developed, in part, as a consequence of playing the sport. This type of knowing added another layer of knowledge to her instruction. All teachers agreed that doing and participating in the sport matters when it comes to teaching that sport. Beth commented on the relation between playing the sport and teaching it: "I think it really helped." Ryan agreed with Beth: "I have to be involved before I do [teach] it…I need to try it to some level." Nevertheless, Joe noted he did not need participation experience to be able to teach the sport well. For Joe, the exposure to teaching the sport eventually compensated for the participation experience he lacked.
7. The Guilt Factor

Finally, Ryan discussed “the guilt factor” that influenced his ability to teach. Joe and Sarah agreed on the presence and influence of this factor. As mentioned before, Sarah practiced a line dancing activity at home to be able to deliver an adequate line dancing unit to her students. Joe previously shared he was raised by his mother to always be and do the best he can. Ryan referred to master teachers:

There is a guilt factor a little bit when you know what a good lesson looks like and that if you don’t have a good lesson, it was either because of you, you were being lazy, whatever, planning, equipment, that there is a guilt factor for someone that is considered to be a master teacher, that they know.

How do Teachers Ensure the Content Delivered is Appropriate to the Students’ Developmental Level?

Sarah, Ashley, and Joe discussed two issues: (a) visual observations, and (b) the rapidity of their understanding of the situation. First, all three teachers ensured they delivered appropriate instruction through visual observations of their students’ performance. The vehicle of discriminating students’ performance was through observations. When the students were demonstrating correct performance, the teachers considered their instruction to be appropriate for the students’ level. Ashley explained that she was looking for success of more than 80% of the students in any content she taught, and emphasized the rapidity of this discrimination process: “If I observe quickly that I have maybe 80% of the class really successful at what I just gave them, then I may have them practice a little longer to give the other 20% opportunity to show me that they
are getting it.” Sarah also mentioned observations: “I watched them and see what they were doing.” Joe echoed Ashley and Sarah’s comments.

Second, Joe and Sarah emphasized their rapid response to students' performance. Joe was confident in his ability to identify a student’s understanding or misunderstanding. He argued: “Well, you see it. You see it, you send them off and you know right away. You know. It is right there.” Using the words “right away” Joe emphasized the immediate recognition of students understanding or confusion. Sarah agreed and added the criterion of students’ success:

I know right away because they are all successful. Like that first time they go out and like, oh well, it worked and then they are able to start the next, to go to the next thing. So, that’s how you know.

Summary of Phase 1

The focus group teachers reported on varied exposure to sport prior to becoming teachers, which may have later on impacted on the development of their CK and PCK. For example, most of the teachers were raised in families that modeled and supported engagement in sports, and some of them acquired prior instructing or coaching experiences. The teachers reported on various practices such as planning, utilizing appropriate teaching practices, and detecting and correcting errors, as possible indicators for their PCK. Finally, the teachers ensure their instruction is appropriate for the students mainly by observing and analyzing students' performance. The teachers' responses to the interview questions provided the investigator information about their past histories, which was the purpose of the phase 1 interview. Therefore, the investigator, in
consultation with her advisor, decided to remain with the same questions for the individual interviews in phase 2.

Phase 2

Two teachers, Kayla and Taylor, participated in phase 2 and 3 of this study. The research sub-questions in this phase were the same as the ones discussed in phase 1. Under each research sub-question in this section, the key comments (represented by categories) are discussed. Kayla's answers are followed by Taylor's answers. The categories in this phase were created in a similar process to the one discussed in phase 1. The similarity between the phase 1 and phase 2 categories indicates the researcher's bias, as the analysis and conclusions from phase 1 were completed prior to the analysis and conclusions from phase 2.

*How Do Teachers Describe How They Acquired Their CK and PCK Relative to Their Strong and Weaker Units?*

**Kayla**

Kayla's answers to this research sub-question were divided into the following four categories:

1. *Introduction to Sport and Physical Activity via School and Sport Clubs*

   Kayla was introduced to sport activities primarily through school. Kayla reported: “In high school, I competed in basically everything...Back then you pretty much played all the sports.” Kayla played at least seven different sports (e.g., basketball, volleyball) during high school and was still active in a sport league at the time of the study.
2. *Acquisition of Knowledge via the PETE Program and Professional Workshops*

Kayla indicated the PETE program contributed to her teaching skills and specifically referred to her ability to provide specific feedback. Kayla continued to develop her CK and PCK by attending professional workshops. For instance, she participated in a golf workshop that changed her approach to teaching golf:

In golf, the whole program and how to teach the kids was new. All the terminology for brush tic tock for putting, the Y chip Y, I mean, I did not know these [cues] going to teach golf, and not having gone through the first two programs, I would not have taught it this way.

Kayla commented on the contribution of the golf workshop to her teaching:

Because we were trying to get golf equipment, golf equipment, and now I am kind of glad we didn’t get it until we went to this program. Because I don’t think I would have done a very good job, I really don’t.

3. *Acquisition of Knowledge via Self-Instruction*

Kayla engaged in self-instructing chiefly when she taught her weaker content. This was her comment on one of her weaker units: “The other difficult one was lacrosse. Because I knew absolutely nothing about lacrosse. So I had to teach myself how to teach the kids and that was interesting.” The process of self-instructing included searching the internet for lesson plans. Kayla's self-instructing also involved analyzing the terminology of the sport, and practicing the skills, the stations, and the lesson plan before teaching it:

Well, I practice it in as far as laying out the stations that they were going to do and I actually you know in the morning from 8 to 8:30 when I don’t have kids I
would go ahead and practice you know the scooping technique and the cradling
technique and actually running through the lesson plan myself.

Preparation and planning takes place before Kayla begins to teach her weaker unit of
instruction. Preparation and planning however are modest to low in Kayla's stronger units
of instruction. Kayla declared she already possessed this information: “All that
[information] is up in my brain.”

4. *Contingency Shaped Teaching Experience*

Kayla described two experiences that contributed to her CK and PCK: (a) coaching experience, and (b) exposure to students. Kayla identified basketball and
volleyball as her stronger units of instruction. She coached basketball for seven years,
and volleyball for 21 years. Coaching and teaching provided Kayla with many
experiences with students, which she highly valued, particularly in the weaker units. In
weaker units, Kayla typically consults with students who already played the particular
sport, asks them to demonstrate, and practices the lesson with them before delivering it to
the entire class.

*Taylor*

Taylor’s answers were divided into the following five categories:

1. *Introduction to Sport and Physical Activity via School and Sport Clubs*

Taylor was introduced to some sports during elementary school (e.g.,
gymnastics), and played four sports in high school. She was introduced to additional
sports in college (e.g., flag football), and also mentioned she was exposed to tennis
because her father played tennis frequently.
2. ** Acquisition of Knowledge via the PETE Program and Professional Workshops **

Taylor identified the PETE program as one source of knowledge acquisition. For example, Taylor partially attributed her CK and PCK in her stronger instructional unit to the PETE program: “I think that I have spent so much time working on progressions; like, this thing was really emphasized at the [PETE] program.”

Participation in professional workshops also assisted in enhancing Taylor's CK and PCK in particular sports. She participated in gymnastics safety workshop, ultimate Frisbee, and floor tennis workshops, as well as other presentations delivered at professional conferences.

3. ** Acquisition of Knowledge via Self-Instructing **

Taylor reported that self-instructing was another source for enhancing her CK and PCK. She searches the internet prior to every instructional unit she teaches, and retrieves information about the content: “I got on the internet and looked up ultimate Frisbee. I really wanted to see what the actual rules were.” Taylor also reviews the units, lesson plans, reflection logs and assessment forms of previous years to refine and make the current instructional unit more appropriate. Taylor articulated: “I look at what I taught the last couple of years…And I’ll go back to look at my lesson plans.”

4. ** Exposure to and Experience in Teaching **

Taylor argued that her experience teaching and repeated teaching improved her ability to teach the content. The following is an example of how Taylor described her knowledge in her stronger unit: “In gymnastics I already know if it’s [the activity] going to work or not…after 14 years of teaching gymnastics.” Taylor explained gymnastics is
her stronger unit primarily because she teaches more than 40 lessons per year, every year: “They [students] are going to have full six to eight lessons of gymnastics…for every grade.” Moreover, Taylor’s teaching position in another school entailed additional experience in teaching gymnastics. She was also exposed to four other teachers who taught gymnastics. Taylor noted: “I traveled to one other elementary and I saw how that person taught it so I had exposure to, four other elementary teachers and the way they taught it to develop the way that I teach it.” The exposure to other teachers was significant in Taylor’s professional development, as she noted it “definitely” helped her.

5. **Acquisition of Knowledge via Observations and Collaboration with Other Teachers**

Taylor discussed learning from other colleagues as an important influence on her CK and PCK. She collaborates with other physical education teachers, with teachers who present their work in professional conferences, and even with classroom teachers with whom she holds conversations. For example, Taylor discussed her collaboration with a physical education colleague: "Brenda and I are Frick and Frack. Brenda and I are processing things, how can we make things better." Taylor learned with and from Brenda how to teach different subject matters. In a similar collaborative effort, Taylor learned ultimate Frisbee together with her student teacher.

*What Teaching Practices do Teachers Identify as Their PCK?*

**Kayla**

Kayla's answers that applied to this research sub-question were divided into the following four categories:
1. *Appropriate Teaching Practices*

*Planning.* Kayla reported on “More in depth planning with the less comfortable ones [instructional units].” Kayla’s planning included reading the content materials after school hours, and preparing visual aids for the lessons. Kayla described her planning for her weaker instructional unit, golf:

In golf, I put posters up, I put all the words up for them, taking this [the golf instructional materials she received in a workshop] home and looking at the set up and everything. Reading it, going through the core information the kids need to know. You know I can’t see myself taking a volleyball book home.

*Use of instructional materials.* As previously mentioned, Kayla used specific visual instructional materials while teaching her weaker unit. Those instructional materials included posters showing the critical elements of the skill. Kayla asserted the instructional materials are valuable: “I look at them several times as I am going through my lesson.” However, Kayla does not use instructional materials in her stronger unit of instruction.

*Demonstrations.* Kayla described the following teaching practices: “I definitely try to explain it to them, show it to them, and then the younger kids, I actually have them mimic the motion.” When Kayla is uncomfortable demonstrating, she asks competent students to demonstrate the skills to the class. In content Kayla teaches for the first time, she also practices (e.g., examining the equipment, trying out the skill or tactic) to become more comfortable with the content.
Knowing the students. Kayla repeatedly discussed the importance of knowing the students and their skill level and background. Before she began teaching her weaker unit of instruction, she asked the students: “Did anybody hear of lacrosse and do you know anything about lacrosse, did you ever watch a lacrosse game?” Kayla believes questions are a legitimate and effective method of learning about students: “Well, you can ask a lot of questions as far as initially finding out if they have played it before, if they play it now, or do they like it.”

Ability to modify instruction. Kayla also identified modifying instruction as a PCK practice. She described instructional modifications in volleyball: “I’ll divide the net into half and half and there will be 3V3.” Kayla also modifies instruction by simplifying skills, breaking them down, and by asking questions to clarify students' understanding. Kayla reported (in third person) having limited ability to assist students by breaking down the skills enough for them when teaching the weaker unit: “On your weaker unit, I’m not sure you would know quite how to help them as best.” The use of third person may indicate on Kayla's discomfort with weaker content.

Repeated teaching. Kayla discussed repeated teaching as influencing on her PCK. The more she repeats the lessons, the better they become: “Now I have taught it, I don’t know how many times, I can’t even count. But you figure six times every day for three weeks…” Kayla continued: “Well I think the lessons got better.” She talked about perfection that forms gradually as she gains more experiences and trials in teaching the particular instructional unit. The refinement of Kayla’s lessons is related to reflection for the purpose of improving the lesson: “I go back and I analyze what went wrong, did I
lose time here, was it as organized as it should have been, was there something I should have left out, and I try to improve it every time.”

*Depth of content.* Kayla indicated that the information she provides in each instructional unit is different. The information she presents to the class during her weaker unit is less detailed and less developed than the information she presents in the stronger instructional unit. Kayla described her content presentation of a weaker unit: “If it was my weaker sport, I would probably tend not to give as much detailed information about not necessarily the sport but technique. I wouldn’t go too deep if I wasn’t sure.” When teaching her stronger content, however, Kayla provides the students with more tasks and also makes connections between the activity learned in class to the sport and its culture. Kayla summarized her instruction of stronger content: “I would probably get more involved and more in depth with the information and expand it.”

2. *Error Detection and Correction*

Kayla noted she may not exactly know how to assist struggling students in her weaker unit. Nevertheless, she asserted that repeated teaching improved her ability to anticipate students’ errors.

*Anticipating performance and common errors.* Repeated teaching of the golf lessons enhanced Kayla’s ability to anticipate student errors: “I understand where the kids are messing up.” In most cases, Kayla reported she “would know that there is something wrong” in a student’s performance. The limitation is more in her ability to correct the error than to discriminate the error.
**Correcting errors.** Kayla’s ability to correct errors was lacking in her weaker unit of instruction: "In lacrosse [i.e., which is a weaker unit], you might not have the knowledge or the ability to know how to re-correct it [an error]." Lack of content compromised Kayla’s ability to correct errors: “Now if I was teaching maybe at a high school and they were doing something that was way above my knowledge, then I might not be able to really help them out.”

3. **Varied Teaching Methods**

Kayla reported using more varied teaching approaches in her stronger unit of instruction. When Kayla was more confident about the content she was teaching, she asked the students many questions about their learning. She did not utilize such practice in her weaker unit, as a result of two concerns: (a) desire to be in complete control over the lesson, and (b) fear that she would not be able to answer students' questions. Kayla described her teaching in her stronger unit of instruction: “I ask more questions, and I really didn’t ask a whole lot of questions before.” With reference to her weaker unit Kayla observed: “I want to be in control of the lesson so much. That if a kid would say, you know, well, whatever their response would be and I would have to go on a tangent.”

4. **The Guilt Factor**

Kayla noted that she strives to do her job the best she can, for the benefit of the learners. She commented that had she not participated in a golf workshop for example, and still attempted to teach the students golf, she would be doing an injustice to them. Kayla made the following comment with reference to the golf workshop: “I would have
done injustice to the kids if I would have taught them before this…because I don’t think I would have done a very good job. I really don’t.”

Taylor

Taylor’s answers were grouped into the following four categories:

1. *Appropriate Teaching Practices.* In this category Taylor mainly discussed repeated teaching, reflection, and ability to modify instruction.

   *Repeated teaching.* As previously discussed, Taylor acquired extensive and repeated experience in teaching gymnastics for children. Consequently, Taylor’s ability to teach gymnastics improved from lesson to lesson and from one year to another.

   My lessons change and improve throughout the week because of the number of times I repeat the lesson. For example, new lesson on Monday, I teach three times. By Thursday, I have taught the lesson nine times with some variations grades 3-5.

   Repeated teaching allowed Taylor to determine if the activities would work for the students. She could evaluate the activity in all of the instructional units, yet more so in her stronger units. For example: “I think in gymnastics I already know. Like, I feel like I already know if it’s going to work or not.” In other weaker units, however, Taylor expressed concern regarding her limited ability to meet the needs of her diverse learners. Consequently, she spends time preparing and selecting activities for her weaker unit: “I spend lot of time thinking about it before I actually put it on paper.” Taylor also noted that repeated teaching improved her transitions, as she already knows how to set up the equipment.
Reflection. Taylor regularly reflects on her teaching. She is a reflective type of person. Reflection was well emphasized in her undergraduate teacher education program, and she regularly collaborates with a physical education colleague. Taylor noted: “Reflection was pretty big at the [PETE] program. But I am also a very reflective person, but this is just how I am. I also think that is because I have worked with other people, specifically Brenda.” Taylor continued to describe the reflection process with her colleague:

She and I, kind of my reflection log, we’ll say, taught this lesson today, this didn’t work quite right, or I changed this and this really worked well, I should use this cue. So she and I are constantly emailing back and forth, because we normally teach the same unit. So that’s a huge, or we talk on the phone. That is a huge reflection piece for us.

The reflection process affects Taylor’s teaching: “I am constantly teaching things different to try and make it better for the kids so that they understand it better.”

Ability to modify instruction. Taylor attributed her ability to modify instruction to the experience she has in teaching content: “I would say probably the exposure [to teaching the content in the past]. And once I am going to teach a lesson I would be able to say, ok, need to modify, need to change the rules, and that type of thing.” Taylor described diverse methods for modifying instruction:

If they don’t get it then I’ll stop their group, maybe do like a freeze game. Act it out, or if it is a specific individual that is having trouble with the skill I might pull them out, pick somebody else. And or try to work with them individually or try
and play with them, depending on what it is. Demonstrate it again or you know or maybe they have a friend that they like and will demonstrate it to them.

Taylor tries to anticipate which students may struggle in a particular content by recalling their performance in previous units (e.g., how they moved to the ball in the invasion games unit), and by examining their grades. Her ability to observe and discriminate performance is better in her stronger unit (i.e., gymnastics) than in her weaker unit (i.e., invasion games). Taylor stated: “I am going to be more comfortable seeing a kid doing a roll than being conscientious and trying to watch three games going on.” Taylor also has more confidence modifying instructions in gymnastics as a result of the extensive time spent on creating progressions and modifications of gymnastics activities in her PETE program.

2. Error Detection and Correction

Selection of critical elements. Taylor prefers to teach three or four critical elements so the students are able to understand and remember those critical elements. She observed: “I like them to be able to repeat it. Or to be able to say it to their partner you are not stepping with opposition.”

Anticipating performance and common errors. Taylor’s ability to identify errors varies. She can identify when an activity does not work when teaching her stronger unit, and she needs more time for discriminating errors in her weaker unit. Referring to her stronger (i.e. gymnastics) and weaker (i.e., invasion games) units, Taylor asserted that errors are more easily identified in individual sports than in team sports: “It is much more
obvious in gymnastics if they are not getting it.” Therefore, it may take Taylor more time to discriminate an error while teaching her weaker unit.

Correcting errors. Taylor noted that in some cases, when teaching a weaker unit, she does not know how to detect or correct an error: “I don’t know always what is wrong.” In other cases, Taylor may be able to discriminate and correct an error, yet it would take her more time than her response time in her stronger unit. She said: “It may take me a while to get it.” Taylor observed that she does not immediately know which remedial activity should be prescribed for the student: “If it is someone who is not getting the tactics, I am going to really have to think about how I am going to make them to get it.” Taylor asserted she could always provide a modified activity, yet occasionally, it may not be the most appropriate activity for the students: “I mean I will definitely be on my feet and will come up with something, but there might be a better way to do it.” She further elaborated on her lack of content in her weaker unit (i.e., invasion games’ tactics): “Like, I would like to have more exposure to teaching tactics. I would like to see the way other people do it.”

3. Teaching Methods

Taylor discussed the teaching methods she used with her classes. For example, she uses more station work for the lower grades (i.e., first and second), and more teacher-led instruction in gymnastics. Taylor also mentioned more indirect approaches such as peer teaching. Taylor explained:
I will probably ask their team or their buddy, their partner, to be giving them peer feedback. Whether they are doing it right, whether they are doing it wrong, or they are not stepping or whatever, helping their teammates, or their team out.

4. Assessment

Finally, Taylor identified assessment as having "huge impact" on her teaching. Taylor explained “there is much more emphasis on assessment” in her district and she needs to follow the assessment requirements. The assessment requirements enhanced Taylor's delivery of instruction: “So in my teaching, I am trying to be really specific in saying you are getting assessed on this.” The assessment also enhanced her knowledge of the students and thus improved her teaching: “So definitely, I think its better, I think I know the kids better…In some ways I think it made me a better teacher.”

*How do Teachers Ensure the Content Delivered is Appropriate to the Students’ Developmental Level?*

*Kayla*

For Kayla it was important to select feasible activities that can be executed by the students. Kayla explained:

I would be able to do it [i.e., the skill], but would the kid be able to do it? So then I had to make sure I was at the level that they could understand it and that they could do it. That is wasn’t asking too much.

Kayla further elaborated on the quick scanning process she uses to discriminate whether or not the activity was appropriate. She observes the students motor behaviors, yet does not require perfect performance from them. Kayla described:
Well, you just kind of assess. As you introduce it to them and then you can just do a quick scan of the classroom and you say they understand, they understand, they understand. Now they might not be doing the skill perfectly, but they understand the concept that you are teaching them.

Taylor

Taylor reported utilizing two practices for identifying whether the content delivered is appropriate for the students. First, she observes the students’ behaviors to see if they are performing the activity successfully:

I might stand back and watch, to say is this working, you know, I would work with my little check book, is this working, are all teams being successful, are they showing the outcome that I would like them to.

Second, Taylor reported using two forms of questioning to evaluate whether the students understand the content: (a) She asks questions during the lesson: “I use questions. ‘Do you understand what I have said’?”; and (b) she presents “the question of the day” at the conclusion of each lesson, and the students provide their answer on their individual physical education daily report. Taylor reads the students’ answers after school and determines whether the students understood the subject matter she taught. Taylor explained:

I review the question of the day and I try and check every night so that lets me know, ‘oh, they did not get that concept’. So then I may write something like see more, I make a note in my planner to talk with them so that I can see if it is just on paper that they are not getting it or if its not getting it, like applying it.
Summary of Phase 2

Similar to the focus group teachers, Kayla and Taylor also reported on practices that may have increased their CK and PCK. For example, they participated in sports when they were young, they accumulated instructing experiences, and were able to self-instruct when required to teach new content. Kayla and Taylor reported on utilizing appropriate teaching practices, detecting and correcting errors, and implementing various teaching methods as possible indicators for their PCK. Finally, Kayla and Taylor ensured the instruction was appropriate for the students by observing their performance and asking them questions. With some understanding of Kayla and Taylor's past histories and knowledge of possible behaviors they may display in their teaching, the investigator continued to phase 3 of the study.

Phase 3

This phase of the study involved a descriptive investigation conducted through systematic observations on specific teaching behaviors of Kayla and Taylor. The report of the data in this section is presented in the following manner. First, interobserver agreement (IOA) is reported for the data collected in this phase, for both teachers. Subsequent to the IOA section, the data for each teacher are reported separately, first Kayla and then Taylor, in the following order. Academic Learning Time in Physical Education (ALT-PE) data are shared as an indication of the teachers’ effectiveness, followed by the results of the eight research sub-questions.
Interobserver Agreement

This section depicts the IOA collected for both teachers on the different research questions.

Interobserver Agreement on ALT-PE

The ALT-PE data were collected only on one lesson per unit for both teachers. The IOA was collected on 100% of the lesson of both teachers, for three target students of different skill levels (i.e., high, medium, low). Table 4.3 summarizes the mean and range of the IOA obtained for the three students in each unit of each teacher. Overall, the mean IOA obtained for the high, medium, and low-skilled students exceeded 91% (range 91-99%) in the Kayla and Taylor's stronger and weaker instructional units.

<table>
<thead>
<tr>
<th>Teacher and instructional unit</th>
<th>Mean and range IOA for all three students in the lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kayla: Stronger instructional unit (volleyball)</td>
<td>91% (87-96%)</td>
</tr>
<tr>
<td>Kayla: Weaker instructional unit (golf)</td>
<td>97% (96-99%)</td>
</tr>
<tr>
<td>Taylor: Stronger instructional unit (floor tennis)</td>
<td>92% (90-94%)</td>
</tr>
<tr>
<td>Taylor: Weaker instructional unit (invasion games)</td>
<td>94% (92-95%)</td>
</tr>
</tbody>
</table>

Note: IOA = Interobserver Agreement

Table 4.3 Percentage of Interobserver Agreement for Kayla and Taylor’s lessons
Interobserver Agreement on the Dependent Variables of Phase 3

As the unit of analysis in this research was the tasks provided to the students, IOA was obtained according to the delivered tasks, and is reported in this section in three categories: (a) Interobserver Agreement for the general PCK components represented in research sub-questions 1-4; (b) IOA for research sub-question 7, which denote the independent variable of appropriateness of whole class tasks; and (c) IOA for the adaptation PCK variables represented in research sub-questions 5, 6, and 8. The researcher strived to obtain IOA for 33% or more of the tasks in each instructional unit. The percentage of IOA obtained was dependent on the availability of the additional observers, yet in most cases IOA was conducted on more than 33% of the data.

Interobserver Agreement on general PCK components. Table 4.4 summarizes the percentage of tasks that IOA was collected on for the variables of research sub-questions 1-4.

<table>
<thead>
<tr>
<th>Instructional unit/Dependent variable</th>
<th>Type of task</th>
<th>Instructional form</th>
<th>Number of times cues used</th>
<th>Recipient of tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kayla: Stronger instructional unit (volleyball)</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>Kayla: Weaker instructional unit (golf)</td>
<td>44%</td>
<td>44%</td>
<td>44%</td>
<td>44%</td>
</tr>
<tr>
<td>Taylor: Stronger instructional unit (floor tennis)</td>
<td>83%</td>
<td>83%</td>
<td>83%</td>
<td>83%</td>
</tr>
<tr>
<td>Taylor: Weaker instructional unit (invasion games)</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
</tr>
</tbody>
</table>

Table 4.4 Percentage tasks assessed for Interobserver Agreement for Kayla and Taylor’s instructional units on research sub-questions 1-4
Overall, IOA was collected on more than 44% of the tasks for all four variables. More IOA was obtained for Taylor's stronger unit (i.e., 83%) because the observers were more available for coding on times when Taylor's lessons were scheduled to be analyzed.

Table 4.5 summarizes the IOA obtained for each of the variables of research sub-questions 1-4. A mean IOA of 100% was obtained for the variables type of task, instructional forms and recipients of tasks, for both Kayla and Taylor in their stronger and weaker instructional units. For the variable number of times cues used, the mean IOA obtained in Kayla and Taylor's stronger and weaker units exceeded 87% (range 50-100%).

<table>
<thead>
<tr>
<th>Instructional unit/Dependent variable</th>
<th>Type of task</th>
<th>Instructional form</th>
<th>Number of times cues used</th>
<th>Recipient of tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kayla: Stronger instructional unit (volleyball)</td>
<td>100%</td>
<td>100%</td>
<td>87% (71-100%)</td>
<td>100%</td>
</tr>
<tr>
<td>Kayla: Weaker instructional unit (golf)</td>
<td>100%</td>
<td>100%</td>
<td>91% (62.5-100%)</td>
<td>100%</td>
</tr>
<tr>
<td>Taylor: Stronger instructional unit (floor tennis)</td>
<td>100%</td>
<td>100%</td>
<td>98% (50-100%)</td>
<td>100%</td>
</tr>
<tr>
<td>Taylor: Weaker instructional unit (invasion games)</td>
<td>100%</td>
<td>100%</td>
<td>93% (79-100%)</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 4.5 Mean and range percentage of tasks’ Interobserver Agreement for Kayla and Taylor’s instructional units on research sub-questions 1-4

*Interobserver Agreement on appropriateness of whole class tasks.* Table 4.6 refers to IOA collected on appropriateness of whole class tasks (research sub-question 7).
Overall, the IOA of appropriateness of whole class tasks was collected on more than 33% of the tasks for the instructional units of both teachers. An exception was the IOA that was collected on only 13% of the tasks in Taylor's stronger unit. The data for this variable were collected live on site, and the IOA person could join the researcher on site less than 33% of the times Taylor was delivering her stronger unit. Overall, the mean IOA obtained for this appropriateness variable exceeded 91% (range 61-100%) in Kayla and Taylor's stronger and weaker instructional units.

<table>
<thead>
<tr>
<th>Instructional unit/Dependent variable</th>
<th>Percentage of tasks IOA was collected on</th>
<th>Mean and range of IOA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kayla: Stronger instructional unit (volleyball)</td>
<td>50%</td>
<td>91% (77-100%)</td>
</tr>
<tr>
<td>Kayla: Weaker instructional unit (golf)</td>
<td>33%</td>
<td>92% (87-97%)</td>
</tr>
<tr>
<td>Taylor: Stronger instructional unit (floor tennis)</td>
<td>13%</td>
<td>92% (90-95%)</td>
</tr>
<tr>
<td>Taylor: Weaker instructional unit (invasion games)</td>
<td>55%</td>
<td>86% (61-100%)</td>
</tr>
</tbody>
</table>

Note: IOA = Interobserver Agreement

Table 4.6 Interobserver Agreement for Kayla and Taylor's instructional units on appropriateness of whole class tasks (research sub-question 7)

*Interobserver Agreement on adaptation PCK variables.* Table 4.7 summarizes the percentage of tasks that IOA was collected on for the variables of research sub-questions 5, 6, and 8. Overall, IOA was collected on more than 38% of the tasks for all three variables in teachers' instructional units.
Table 4.7 Percentage of adaptation tasks assessed for Interobserver Agreement for Kayla and Taylor’s instructional units on research sub-questions 5-6, and 8

<table>
<thead>
<tr>
<th>Instructional unit/Dependent variable</th>
<th>Antecedents</th>
<th>Type of adaptation</th>
<th>Appropriateness of adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kayla: Stronger instructional unit (volleyball)</td>
<td>48%</td>
<td>48%</td>
<td>48%</td>
</tr>
<tr>
<td>Kayla: Weaker instructional unit (golf)</td>
<td>38%</td>
<td>38%</td>
<td>38%</td>
</tr>
<tr>
<td>Taylor: Stronger instructional unit (floor tennis)</td>
<td>79%</td>
<td>79%</td>
<td>79%</td>
</tr>
<tr>
<td>Taylor: Weaker instructional unit (invasion games)</td>
<td>89%</td>
<td>89%</td>
<td>89%</td>
</tr>
</tbody>
</table>

Table 4.8 summarizes the IOA obtained for each of the variables of research sub-questions 5, 6, and 8. Overall, the mean IOA obtained for the antecedents variable for the stronger and the weaker instructional units of both teachers exceeded 92% (range 50-100%). The mean IOA for the type of adaptation exceeded 94% (50-100%), and the IOA for the appropriateness of the adaptation exceeded 96% (75-100%).

In Kayla’s stronger instructional unit, a mean IOA of 92% (range 50-100%) was obtained for antecedents, 95% (range 50-100%) for type of adaptation, and a mean of 98% (range 83-100%) was obtained for the appropriateness of the adaptation. In Kayla’s weaker instructional unit, a mean IOA of 96% (range 75-100%) was obtained for antecedents, and for appropriateness of the adaptation, and a mean of 100% was obtained for type of adaptation. A mean IOA of 100% was obtained in Taylor’s stronger instructional unit, for all three variables. In Taylor's weaker unit, a mean IOA of 100%
was obtained for antecedents and appropriateness, while a mean of 94% (range 50-100%) was obtained for the type of adaptation.

<table>
<thead>
<tr>
<th>Instructional unit/Dependent variable</th>
<th>Antecedents</th>
<th>Type of adaptation</th>
<th>Appropriateness of adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kayla: Stronger instructional unit (volleyball)</td>
<td>92% (50-100%)</td>
<td>95% (50-100%)</td>
<td>98% (83-100%)</td>
</tr>
<tr>
<td>Kayla: Weaker instructional unit (golf)</td>
<td>96% (75-100%)</td>
<td>100% (75-100%)</td>
<td>96% (75-100%)</td>
</tr>
<tr>
<td>Taylor: Stronger instructional unit (floor tennis)</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Taylor: Weaker instructional unit (invasion games)</td>
<td>100% (50-100%)</td>
<td>94% (50-100%)</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 4.8 Mean and range percentage of adaptation tasks’ Interobserver Agreement for Kayla and Taylor’s instructional units on research sub-questions 5-6, and 8

**Determining the Effectiveness of the Teachers**

In order to support the selection of the teachers for this study as effective, ALT-PE was used. Data were collected on three students of different skill level (i.e., high, medium, and low skilled), according to the following categories: activity, transition, knowledge, management, off task, waiting, and not codable category for all instances in which the students’ behavior was not captured on tape during an interval. The ALT-PE data are presented as percentage measure of response.

**Kayla**

Kayla’s weaker instructional unit was golf. The golf unit was taught for five lessons. Kayla’s stronger instructional unit was volleyball. The volleyball unit was taught
for four lessons, followed by two badminton lessons. The ALT-PE data were collected during the fourth lesson of both units.

*ALT-PE in the stronger instructional unit.* The three students spent an average of 45% (range 41-53%) of the lesson time in activity, and 28% (range 27-30%) of the lesson time in waiting (See Figure 4.1). The students' behaviors could not be coded on 13% (range 6-18%) of the time. Transitions, management, and off-task behaviors occurred on less than 10% of the lesson time.

![Figure 4.1: Academic Learning Time in Physical Education (ALT-PE) data as percentage of time for three students in Kayla’s stronger instructional unit](image)

*ALT-PE in the weaker instructional unit.* In the first three lessons of the golf unit, the students were paired and rotated from one station to another according to Kayla’s instructions. Only one partner was practicing at a time, while the other was waiting. In
the fourth and fifth lessons, the students were in groups of three. Again, only one partner was practicing at a time, while the other two were waiting. The ALT-PE data reported in this section were collected in lesson four (See Figure 4.2). The three students spent an average of 41% (range 39-41%) of the lesson time in waiting, and 17% (range 16-20%) of the lesson time in activity. They were involved in management for 11% (range 10-11%) of the time, and their behaviors could not be coded on 11% (range 9-16%) of the time. Transitions and off-task behaviors occurred on less than 10% of the lesson time.

![Alt-PE Category Percentage of lesson time](image)

**Figure 4.2 Academic Learning Time in Physical Education (ALT-PE) data as percentage of time for three students in Kayla’s weaker instructional unit**

_Taylor_

Taylor’s weaker instructional unit was invasion games. The invasion games unit was delivered over six lessons and included three ultimate Frisbee lessons, two team
handball lessons, and one soccer lesson. The ALT-PE data were collected on the third lesson of this unit (i.e., Frisbee lesson). Taylor’s stronger instructional unit was floor tennis. The floor tennis unit was delivered over five lessons, and ALT-PE data were collected on the third lesson on this unit as well.

*ALT-PE in the stronger instructional unit.* The three students spent an average of 44% (range 40-49%) of the lesson time in activity, and 19% (range 17-21%) of the lesson time in waiting (See Figure 4.3). They spent 15% (range 11-17%) of the time in receiving knowledge, and their behaviors could not be coded on 11% (range 7-14%) of the time. Transitions, management, and off-task behaviors occurred on less than 10% of the lesson time.

![Figure 4.3 Academic Learning Time in Physical Education (ALT-PE) data as percentage of time for three students in Taylor’s stronger instructional unit](image_url)
*ALT-PE in the weaker instructional unit.* The three students spent an average of 46% (range 38-53%) of the lesson time in activity, and 14% (range 14-15%) of the lesson time in receiving knowledge (See Figure 4.4). Their behaviors could not be coded on 18% (range 15-22%) of the time. Waiting, transitions, management, and off-task behaviors occurred on less than 10% of the lesson time.

![Figure 4.4](image)

Figure 4.4 Academic Learning Time in Physical Education (ALT-PE) data as percentage of time for three students in Taylor’s weaker instructional unit

**Summary**

According to the ALT-PE data, the high, medium, and low skilled students were predominantly engaged in activity more than in any other ALT-PE category. An exception was Kayla's weak instructional unit, in which the students were mostly waiting.
The next section reviews the data obtained for each dependent variable collected in phase 3 of the study.

**Research Sub-Question 1: What was the Percentage of Each Type of Content Task Used in the Teacher’s Stronger and Weaker Unit of Instruction?**

In this research question, data were collected on the types of tasks that were used by the teacher during the instructional unit. Tasks were classified into the following types: informing, extension, refinement, and application. Tasks that were delivered to the class more than once, were classified as review tasks of the same type and therefore were denoted by the letter “R” (e.g., RE represent review extension task). The data are reported as percentage of occurrences of each type of task in each instructional unit.

**Kayla**

Kayla utilized all four types of tasks in the stronger unit (See Figure 4.5). Informing tasks were the predominant type and represented 44% of all tasks in the stronger unit, followed by application tasks which represented 31% of the tasks. Informing tasks were also the most prevalent type in Kayla's weaker unit and represented 86% of all tasks. Extension tasks represented 14% of all tasks in the weaker unit, while refinement and application tasks were not delivered at all.

**Taylor**

Taylor utilized all four types of tasks in both instructional units to a varied extent (See Figure 4.6). Extension tasks were the predominant type and represented 41% of all tasks in the stronger unit. Application and informing tasks were equally used in the stronger unit (i.e., 27%), and refinement tasks were used the least.
In Taylor's weaker unit, application tasks were the most prevalent (i.e., 41%), followed by refinement tasks (i.e., 29%) and informing tasks (i.e., 24%). Extension tasks were used the least in the weaker unit.

Question 1a was: In what order were the types of tasks presented in the stronger and weaker instructional units? The tasks were transcribed and defined by their types, and plotted into a table in a chronological manner by the lessons in which the tasks were introduced to the class. The data for the stronger and for the weaker instructional units are presented separately.
Figure 4.6 Percent of type of tasks used in Taylor’s stronger and weaker instructional units

Kayla

*Stronger instructional unit.* Kayla introduced mostly informing and extension tasks early in her stronger instructional unit (See Table 4.9). As the unit progressed to its mid and end lessons, review tasks and application (i.e., game play) tasks were presented more. A sequential presentation of the tasks also appears on Figure 4.15.
<table>
<thead>
<tr>
<th>Tasks/Lesson</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underhand pass to a partner</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underhand pass with movement to the ball</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underhand pass back and forth in groups of 2-3 students</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serve, underhand return the ball, and catch</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serve, underhand return, underhand pass, and catch</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underhand passing in a circle</td>
<td>I</td>
<td>RI</td>
<td>RI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serve, after a bounce hit a underhand pass back, and catch the ball</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modified volleyball game - start with a serve, ball over by the 3rd hit</td>
<td>A</td>
<td>RA</td>
<td>RA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hitting a birdie back and forth with a partner using an underhand or overhead hit</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modified Badminton game - serve underhand, birdie should go over by the 3'r</td>
<td>A</td>
<td>RA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allow the birdie to get to hitting distance and hit underhand during game play</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: I=Informing, E=Extension, R=Refinement, A=Application, RI=Review informing, RA=Review application

Table 4.9 Chronological presentations of types of tasks during Kayla’s stronger instructional unit

**Weak instructional unit.** In this unit, Kayla mostly remained at the informing level and tasks were only slightly different one from another every lesson (See Table 4.10). The second lesson was more different as it included extension tasks. A sequential presentation of the tasks also appears on graph line in Figure 4.16.
Table 4.10 Chronological presentations of types of tasks during Kayla’s weaker instructional unit

<table>
<thead>
<tr>
<th>Tasks/Lesson</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chipping to a target a/b</td>
<td>I</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Putting to a target a/b</td>
<td>I</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chipping from a short distance (5 steps)</td>
<td></td>
<td></td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chipping from a longer distance (8 steps)</td>
<td></td>
<td></td>
<td></td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>Chip and hit the target with least amount of hits (1 ball)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Chip and hit each ball once to the target (total of 2 balls)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>E</td>
</tr>
<tr>
<td>Chip 2 balls from short and long distance to target</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Putting - choose the target and the distance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Full swing to a target</td>
<td></td>
<td></td>
<td></td>
<td>I</td>
<td>RI</td>
</tr>
</tbody>
</table>

Note: I=Informing, E=Extension, RI=Review informing

Table 4.10 Chronological presentations of types of tasks during Kayla’s weaker instructional unit

Taylor

*Stronger instructional unit.* In this unit Taylor used an assignment sheet that included eight tasks (See Table 4.11): two informing, four extensions, an application task, an informing task, and another application task. Students were required to perform all of these tasks each lesson from day one to day four. Occasionally, Taylor added extension, refinement (mostly of rules), or application tasks to the ones listed on the assignment sheet. A sequential presentation of the tasks also appears on graph line on Figure 4.17.
Table 4.11 Chronological presentations of types of tasks during Taylor’s stronger instructional unit

<table>
<thead>
<tr>
<th>Tasks/Lesson</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bounce and hit on floor (forehand)</td>
<td>I</td>
<td>RI</td>
<td>RI</td>
<td>RI</td>
<td></td>
</tr>
<tr>
<td>Do each task on the assignment sheet twice, write the best score, and progress to the next task</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bounce and hit on floor (backhand)</td>
<td>I</td>
<td>RI</td>
<td>RI</td>
<td>RI</td>
<td></td>
</tr>
<tr>
<td>Bounce and hit on floor (alternate)</td>
<td>E</td>
<td>RE</td>
<td>RE</td>
<td>RE</td>
<td></td>
</tr>
<tr>
<td>Forehand (palm up)</td>
<td>E</td>
<td>RE</td>
<td>RE</td>
<td>RE</td>
<td></td>
</tr>
<tr>
<td>Backhand (palm down)</td>
<td>E</td>
<td>RE</td>
<td>RE</td>
<td>RE</td>
<td></td>
</tr>
<tr>
<td>Alternate (palm up/down hits)</td>
<td>E</td>
<td>RE</td>
<td>RE</td>
<td>RE</td>
<td></td>
</tr>
<tr>
<td>Partner rally: hits back and forth</td>
<td>A</td>
<td>RA</td>
<td>RA</td>
<td>RA</td>
<td>RA</td>
</tr>
<tr>
<td>Hit five serves cross court from each side</td>
<td>I</td>
<td>RI</td>
<td>RI</td>
<td>RI</td>
<td></td>
</tr>
<tr>
<td>Game play</td>
<td>A</td>
<td>RA</td>
<td>RA</td>
<td>RA</td>
<td>RA</td>
</tr>
<tr>
<td>Serve from outside of the court and aim your racket to where you want the ball to go</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serve cross court, alternate sides, maintain side to target</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refinement of the rules of the serve</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Game play 1V1 and 2V2</td>
<td>A</td>
<td>RA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2V2 tournament</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: I=Informing, E=Extension, R=Refinement, A=Application, RI=Review informing, RE=Review extension, RA=Review application

Table 4.11 Chronological presentations of types of tasks during Taylor’s stronger instructional unit

*Weaker instructional unit.* Taylor delivered informing task at the beginning of each sport she taught in this invasion games unit (See Table 4.12). She typically progressed to application tasks, and occasionally provided refinement tasks, within the context of the game. The refinement tasks primarily focused on the rules of the game. A sequential presentation of the tasks also appears on graph line on Figure 4.18.
<table>
<thead>
<tr>
<th>Tasks/Lesson</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frisbee: passes in a team in L shape with cold defense</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frisbee: passes in a team in L shape, pivot on spot, warm defense</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frisbee: 2V2 keep away game, warm defense</td>
<td>A RA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frisbee: 2V2 keep away game, count 1 point for each pass completed</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frisbee: 4V4 full court game play with 3 passes before scoring</td>
<td>A RA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frisbee: in a game play, defense should count loud 5 seconds possession</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frisbee: in a game play, maintain arms length away distance</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handball: 2V2 keep away game with 3 passes before shooting, no goalie</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handball: play game with a jump off and a goalie</td>
<td>A RA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handball: game play, 3 passes before you score, with 5 seconds for ball possession</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handball: in a game play, shoot with one hand aiming at the corners and lead your partner in a pass forward</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soccer: 2V2 game, no goalie, 2 passes before scoring, and use a soccer throw in</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soccer: 4V4 full court game with 2 players backwards and 2 forwards</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soccer: during a game play you can throw the ball in to the goalie from the sideline</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: I=Informing, E=Extension, R=Refinement, A=Application, RA=Review application

Table 4.12 chronological presentations of types of tasks during Taylor’s weaker instructional unit
Summary

According to the types of tasks' data, the teachers made differential use of types of tasks in their stronger and weaker units of instruction. Kayla used all types of tasks in the stronger unit, and functioned mostly at the informing level in the weaker unit. Taylor primarily extended the tasks in her stronger unit, yet did not refine the tasks. She mostly provided application tasks in the weaker unit, yet did not extend the tasks.

Research Sub-Question 2: Which Instructional Forms Were Used by the Teachers to Represent the Content to the Students?

In this research question, data were collected on the instructional forms the teachers utilized while teaching. The three instructional forms were: verbal instructions, demonstrations, and metaphors. The data are reported by percentage of occurrences of each type of instructional form in each instructional unit.

Kayla

Verbal instructions were the most prevalent instructional form Kayla used in both the stronger and the weaker units (72% and 47% of the instruction, respectively). Kayla used demonstrations almost to the same extent in both units (See Figure 4.7). Kayla used more metaphors in the weaker unit than in the stronger one (27% versus 2%, respectively), because the metaphors were suggested in the instructional manual she was using for teaching golf.

Taylor

Verbal instructions and written assignment (each) represented approximately 45% of Taylor's instructions in the stronger unit. In the weaker unit of instruction Taylor
primarily used verbal instructions (i.e., 87%). Demonstrations and metaphors were scarcely used in both instructional units (See Figure 4.8).

![Bar chart showing instructional forms' data]

**Figure 4.7** Percent instructional forms used in Kayla’s stronger and weaker instructional units

**Summary**

Based on the instructional forms' data, both teachers mostly used verbal instructions in their teaching of the stronger and weaker units. They used demonstrations and metaphors to a lesser extent. Kayla also incorporated written instructions into her stronger unit.
Research Sub-Question 3: How Many Tasks Were Provided to the Class, to a Small Group, and to the Individual Student?

This research question explored the percentage of tasks in the instructional units that were delivered to the class, to a small group, and to individual students. The data are reported by percentage of occurrences of tasks classified according to its recipients.

Figure 4.8 Percent instructional forms used in Taylor’s stronger and weaker instructional units

Kayla

Most of the tasks were prescribed to individual students in the stronger and weaker instructional units (75% and 80% of all tasks, respectively). Kayla provided few
tasks to the whole class (18% and 20%, respectively), and even less number of tasks to small groups (See Figure 4.9).

![Bar chart showing percent of tasks delivered to different recipients in Kayla’s stronger and weaker instructional units.]

Figure 4.9 Percent of tasks delivered to different recipients in Kayla’s stronger and weaker instructional units

**Taylor**

Most of the tasks were prescribed to the whole class in the stronger and weaker instructional units (57% and 49% of all tasks, respectively; See Figure 4.10). Taylor occasionally provided tasks to individuals (32% and 23%, respectively), and to small groups (11% and 29%, respectively).

**Summary**

The recipients of tasks data indicate similar trends in the stronger and weaker instructional units for each teacher. Kayla prescribed few tasks to the whole class but
mainly provided tasks to individual tasks. Taylor primarily prescribed tasks to the whole class and occasionally provided tasks to individuals and small groups.

Figure 4.10 Percent of tasks delivered to different recipients in Taylor's stronger and weaker instructional units

Research Sub-Question 4: What Types of Cues Were Used by the Teachers to Represent the Content?

This research question involved collection of data on technical, visual, and metaphorical cues. Specifically, data were collected on the number of different types of cues the teachers used in their stronger and weaker instructional units. For example, "follow through," "arm straight," and "let it bounce," are three different technical cues. "Brush tic tock" and "Y chip Y" are two different metaphorical cues. Data were collected using frequency count of the different cues the teachers used.
**Kayla**

Most types of cues Kayla introduced in both instructional units were technical (See Table 4.13). Nonetheless, types of technical cues were introduced two times more in the stronger unit than in the weaker one (27 versus 13, respectively). Visual cues were used less and almost equally in the two instructional units. Very few metaphorical cues were utilized in the two units, and were more frequent in the weaker than in the stronger one.

<table>
<thead>
<tr>
<th>Average number of types of cues used per lesson/ Instructional unit</th>
<th>Stronger unit – Average (range)</th>
<th>Weaker unit – Average (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical</td>
<td>27 (20-34)</td>
<td>13 (10-17)</td>
</tr>
<tr>
<td>Visual</td>
<td>8 (5-11)</td>
<td>6 (5-8)</td>
</tr>
<tr>
<td>Metaphorical</td>
<td>1 (0-2)</td>
<td>4 (1-6)</td>
</tr>
<tr>
<td>Average total number of cues per lesson</td>
<td>35 (30-43)</td>
<td>23 (20-31)</td>
</tr>
</tbody>
</table>

Table 4.13 Average number of different types of cues used per lesson in Kayla’s instructional units

**Taylor**

Most types of cues Taylor introduced in both instructional units were technical (See Table 4.14). Nonetheless, types of technical cues were introduced three times more in the weaker unit than in the stronger one (18 versus 5, respectively). Visual cues were
used more in the weaker unit than in the stronger one (6 versus 1, respectively). Taylor did not use metaphorical cues at all.

<table>
<thead>
<tr>
<th>Average number of types of cues used per lesson/ Instructional unit</th>
<th>Stronger unit – Average (range)</th>
<th>Weaker unit – Average (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical</td>
<td>5 (4-7)</td>
<td>18 (9-24)</td>
</tr>
<tr>
<td>Visual</td>
<td>1 (0-2)</td>
<td>6 (0-20)</td>
</tr>
<tr>
<td>Metaphorical</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average total number of cues per lesson</td>
<td>9 (6-12)</td>
<td>24 (12-36)</td>
</tr>
</tbody>
</table>

Table 4.14 Average number of different types of cues used per lesson in Taylor’s instructional units

Question 4a was: How many times were the types of cues used during the unit? These data were collected as a frequency measure of response, and reported as an average per lesson. In other words, the data represent the number of times the teacher used technical, visual, or metaphorical cues.

Kayla

Technical cues were the most frequently used in Kayla's stronger instructional unit (See Table 4.15). The average number of technical cues used in the stronger unit was over three times larger than the average number of those cues used in the weaker instructional unit (77 versus 24, respectively). Visual cues were noted fewer times than technical ones and were used almost two times more in the stronger unit than in the
weaker one (15 versus 8, respectively). Metaphorical cues were scarcely used in either unit.

<table>
<thead>
<tr>
<th>Average number of types of cues used per lesson</th>
<th>Stronger unit – Average (range)</th>
<th>Weaker unit – Average (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical</td>
<td>77 (41-121)</td>
<td>24 (18-33)</td>
</tr>
<tr>
<td>Visual</td>
<td>15 (8-26)</td>
<td>8 (5-16)</td>
</tr>
<tr>
<td>Metaphorical</td>
<td>1 (0-3)</td>
<td>8 (1-11)</td>
</tr>
<tr>
<td>Average number of all three cues per lesson</td>
<td>92 (67-135)</td>
<td>40 (26-59)</td>
</tr>
</tbody>
</table>

Table 4.15 Average number of types of cues used per lesson in Kayla’s units

*Taylor*

Technical cues were the most frequently used in Taylor's weaker instructional unit (See Table 4.16). The average number of technical cues used in the weaker unit was four times more than the average number of those cues used in the stronger instructional unit (32 versus 8, respectively). Visual cues were noted fewer times in both units, and metaphorical cues were not noted.

*Summary*

Based on the cues' data, both teachers used more technical cues and fewer visual cues. Kayla made scarce use of metaphorical cues. Overall, Kayla demonstrated more types of cues and used the cues more frequently in the stronger unit than in the weaker
Taylor demonstrated more types of cues and used the cues more frequently in the weaker unit than in the stronger one.

<table>
<thead>
<tr>
<th>Average number of types of cues used per lesson</th>
<th>Stronger unit – Average (range)</th>
<th>Weaker unit – Average (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical</td>
<td>8 (5-10)</td>
<td>32 (14-45)</td>
</tr>
<tr>
<td>Visual</td>
<td>1 (0-3)</td>
<td>4 (0-8)</td>
</tr>
<tr>
<td>Metaphorical</td>
<td>0 (0-1)</td>
<td></td>
</tr>
<tr>
<td>Average number of all three cues per lesson</td>
<td>9 (5-14)</td>
<td>36 (17-53)</td>
</tr>
</tbody>
</table>

Table 4.16 Average number of types of cues used per lesson in Taylor’s units

*Research Sub-Question 5: Which Antecedents Preceded the Teacher’s Presentation of the Task to an Individual Student?*

In this research question, data were collected on the antecedents that preceded Kayla’s instruction to individual students. The antecedent categories were: incorrect performance, correct performance, off task, and other. Not codable was recorded when the antecedents were not captured on the videotape. The data were collected as percentage measure of response, and are reported separately for the stronger and the weaker instructional units.
Kayla

Antecedents in the stronger instructional unit. In 85% of the individual adaptations, Kayla approached individual students when they displayed incorrect performance (See Figure 4.11). The antecedents were not codable in 16% of the episodes. Only rarely did Kayla approach individuals when they were correct, off-task, or other behaviors.

Figure 4.11 Percent of antecedents, type of adaptations and appropriateness of individual tasks in Kayla’s stronger unit of instruction

Antecedents in the weaker instructional unit. In 65% of the individual adaptations, Kayla approached individual students when they displayed incorrect performance (See
Figure 4.12). The antecedents were not codable in 18% of the episodes. In 13% of the individual adaptations, Kayla intervened following other antecedents that did not occur regularly enough to be categorized (e.g., the student recruited assistance from the teacher). Only rarely did Kayla approach individuals when they were correct or off-task.

![Antecedents, type of adaptation, appropriateness](image)

**Figure 4.12** Percent of antecedents, type of adaptations and appropriateness of individual tasks in Kayla’s weaker unit of instruction

*Taylor*

*Antecedents in the stronger instructional unit.* In 69% of the individual adaptations, Taylor approached individual students when they displayed incorrect performance (See Figure 4.13). In 12% of the individual adaptation episodes, Taylor attended to individual following other antecedents that did not occur regularly enough to
be categorized (e.g., the student recruited assistance from the teacher). Only rarely did Taylor approach individuals when they were correct or off-task.

Figure 4.13 Percent of antecedents, type of adaptations and appropriateness of individual tasks in Taylor’s stronger unit of instruction

_Antecedents in the weaker instructional unit._ Incorrect and correct performances were the only antecedents for teacher's adaptation in this unit. In 88% of the individual adaptations, Taylor approached individual students when they displayed incorrect performance (See Figure 4.14). In 12% of the individual adaptations, she approached individual students when they displayed correct performance.
Summary

According to the antecedents' data, both teachers modified tasks for individual students primarily following students' incorrect performance. Antecedents in the form of incorrect performance were detected more in the stronger unit than in the weaker one for both teachers.

Research Sub-Question 6: What Types of Adaptations (From the Initial Tasks Provided) Were Made by the Teachers to Enhance Student’s Performance?

In this research question, data were collected on the types of adaptations the teachers prescribed to make the task more appropriate for the individual. The types of
adaptations were: modifying complexity, assigning a different skill, extending up, changing competition conditions, breaking/refining the task, change of position, and restating the task. The data were reported as percentage measure of response and are presented separately for the stronger and for the weaker units of instructional units.

Kayla

In the stronger instructional unit (See Figure 4.11), Kayla typically broke down or refined the task in 59% of the episodes. Occasionally she asked the student to change position (32% of the episodes), and rarely did she restated the task. Kayla also refined the tasks in 50% of the adaptation episodes in her weaker unit (See Figure 4.12). She changed the students’ position in 26% of the episodes, and restated the task in 17% of the individual adaptation episodes in this unit. In both units Kayla rarely adapted the task by modifying its complexity. She also did not prescribe a different task, extend the task up, or change competition conditions in any of the units.

Taylor

In the stronger instructional unit (See Figure 4.13), Taylor typically broke down or refined the task in 46% of the episodes. Occasionally she asked the student to change position (31% of the episodes), or restated the task (15% of the episodes), and only rarely did she assign a different task. In the weaker unit (See Figure 4.14) Taylor primarily refined the tasks (88% of the episodes) and occasionally restated the tasks (12% of the episodes). In the weaker unit, Taylor did not adapt tasks for individuals by assigning a different task, changing the student's position, extending up, modifying complexity, or by
changing competition conditions. She also did not use the three latter modifications in her stronger unit.

Summary

Both Kayla and Taylor adapted the tasks primarily by refining the tasks for individuals. Kayla used the same types of modifications in her stronger and weaker units of instruction. Taylor used more types of modified tasks in her stronger unit than in her weaker unit of instruction.

Research Sub-Question 7: What Percentage of the Students Performed the Teacher’s Task Correctly?

The focus of this research question was how students responded to tasks that were provided to the entire class. The students’ responses to the teacher’s tasks were recorded and categorized into correct or incorrect. Not codable was recorded when the observers were not able to observe the student prior to the end of the task. The data were reported as percentage measure of response and are presented separately for the stronger and for the weaker units of instructional units. Tasks that were performed correctly by more than 80% of the students were considered to be appropriate.

Kayla

Stronger instructional unit. Most of the tasks (i.e., 80% of all tasks) were performed correctly by less than 80% of the students in the class (See Figure 4.15). The data demonstrate a slight upward, yet variable trend. Five tasks in the unit (i.e., 31%) were performed correctly by 77%-79% of the students. Overall, the average percentage of students successfully performing the tasks in the stronger unit was 75% (range 62-94%).
The students were the most successful in refinement tasks that were delivered in the last two (badminton) lessons in the unit. The students were the least successful in application tasks.

![Graph showing the percentage of students' correct performance across different lessons.](image)

Note: E=Extension, I=Informing, A=Application, R=Refinement. RI=Review informing, RA=Review application.

Figure 4.15 Percent of students’ correct in the whole class tasks during Kayla’s stronger instructional unit

**Weaker instructional unit.** Seven (i.e., 50%) tasks were performed correctly by 80% or more of the students in the class (See Figure 4.16). The data demonstrated a non-functional variable trend. The seven tasks were delivered across all lessons in the weaker unit, except in lesson three. Five of those tasks were informing tasks, and two were extension tasks. All seven remaining tasks that were performed successfully by less than
80% of the students were informing tasks. Overall, the average percentage of students successfully performing the tasks in the weaker unit was also 75% (range 57-88%). The average success level of the students in the stronger and weaker instructional unit was equal (i.e., 75%).

![Graph showing student performance](image)

Note: I=Informing, E=Extending, RI=Review informing.

Figure 4.16 Percent of students’ correct in the whole class tasks during Kayla’s weaker instructional unit

**Taylor**

*Stronger instructional unit.* The nature of the first four lessons in this unit was students’ independent practice of their assignment sheet as soon as they entered the gymnasium. Typically, Taylor prompted the students to begin practicing, and provided
the next verbal and formal instruction several minutes later. During those minutes students progressed along the tasks on the assignment sheet. The data on students’ success in the task were recorded immediately at the end of Taylor’s official instruction. Therefore, the line graph on Figure 4.17 represents some of the tasks that were provided formally by Taylor. Yet the graph may not represent all of the tasks that appear in Table 4.11, as some of those were not prompted by Taylor.

Note: A=Application, I=Informing, R=Refinement, RI=Review informing, RA=Review application.

Figure 4.17 Percent of students’ correct in the whole class tasks during Taylor’s stronger instructional unit

Ten tasks (i.e., 55% of all tasks) were performed correctly by 80% or more of the students in the class (See Figure 4.17). Six tasks were application, three were informing
and one was a refinement task. The data demonstrate a variable trend for this unit. The students were the most successful in review informing tasks and in application task. The students were also the least successful application tasks. Overall, the average percentage of students successfully performing the tasks in the stronger unit was 78% (range 57-95%).

*Weaker instructional unit.* Nine tasks (i.e., 53%) were performed correctly by 80% or more of the students in the class (See Figure 4.18).

![Graph](image)

Note: I=Informing, E=Extension, R=Refinement, A=Application, RA=Review application.

Figure 4.18 Percent of students’ correct in the whole class tasks during Taylor’s weaker instructional unit
Three were informing tasks, three were refinement tasks, one was extension and one was a refinement task. Overall the data formed an upward yet variable trend for this unit and a descending trend for the two latter lessons in the unit. All students were successful in the first task delivered in this unit, an informing task. The students were the least successful in a review application task. Overall, the average percentage of students successfully performing the tasks in the stronger unit was 80% (range 59-100%). The average success level of the students in each instructional unit was similar (78% in the stronger unit and 80% in the weaker one).

Summary

The data on success level in whole class tasks were variable and mostly non-functional for both teachers in their two instructional units. Overall, the average percentage of students successfully performing the tasks Kayla's stronger and weaker units was equal (i.e., 75%). The average success level of the students in Taylor's stronger and weaker instructional units was similar (78% and 80%, respectively).

Research Sub-Question 8: To What Extent Were the Adaptations Made for Individual Students Appropriate?

In this research question, data were collected on the consequences of the tasks the teachers prescribed to make the content more appropriate for the individual. The categories coded were: appropriate, inappropriate, and no opportunity to respond (i.e., NOTR). When the students executed the adaptation task correctly or incorrectly based on the teacher's stated criteria, the task was considered to be appropriate or inappropriate, respectively. When the students’ behavior immediately following the teacher’s adaptation...
was not captured on the videotape, the consequence was coded as not codable (i.e., N/C). The data were collected as percentage measure of response and are reported separately for the stronger and the weaker instructional units.

Kayla

In the stronger unit, 45% of the individual adaptations were classified as appropriate, and only 14% were inappropriate (See Figure 4.11). The students did not have an opportunity to respond to the teacher’s adaptation in 39% of the episodes. In the weaker unit of instruction however, adaptations were appropriate in 33% of the episodes, and inappropriate in 35% of the episodes (See Figure 4.12). The students did not have an opportunity to respond to the teacher’s adaptation in 30% of the episodes.

Taylor

In the stronger unit, 58% of the individual adaptations were classified as appropriate, and only 27% were inappropriate (See Figure 4.13). The students' behavior could not be observed in 12% of the episodes. In the weaker unit of instruction however, adaptations were appropriate in 25% of the episodes, and inappropriate in 38% of the episodes (See Figure 4.14). The students did not have an opportunity to respond to the teacher’s adaptation in 37% of the episodes.

Summary

The appropriate adaptations episodes in Kayla’s stronger unit were three times more prevalent (i.e., 45%) than the inappropriate ones (i.e., 14%). These data were in contrast to the weaker unit in which the inappropriate adaptations episodes occurred more (i.e., 35%) than the appropriate ones (i.e., 33%). The appropriate adaptations episodes in
Taylor’s stronger unit were two times more prevalent (i.e. 58%) than the inappropriate ones (i.e., 27%). Again, in the weaker unit, the inappropriate adaptations episodes occurred more (i.e., 38%) than the appropriate one (i.e., 25%).
CHAPTER 5

DISCUSSION

Chapter 5 is organized in the following manner. Section one presents the conclusions made for each of the research questions in phases 1 and 2 of the study. Section two presents the conclusions for the research questions of phase 3 of the study. Section three discusses conceptual considerations, and section four discusses the methodological considerations. Section five suggests implications for PETE programs.

Conclusions of the Research Questions of Phase 1 and 2

Phase 1 of the study involved a focus group interview, and phase 2 involved individual interviews with Kayla and Taylor. Conclusions in this section were based on (a) all teachers (referenced as “teachers”), (b) only the focus group teachers (referenced as “focus group teachers”), or (c) only some of the teachers (in that case specific names will be mentioned).
How Do Teachers Describe How They Acquired Their CK and PCK Relative to Their Stronger and Weaker Units?

Four findings are drawn from teachers’ discussions about the practices that assisted them in acquiring their CK and PCK. The teachers: (a) were engaged in sports, (b) participated in PETE programs and professional workshops, (c) were involved in instructional settings other than the teaching setting, and (d) demonstrated ability to learn content they had not been directly taught.

Engagement in Sports

All teachers in this study reported positive and pleasurable engagement in sports prior to becoming teachers. Some were introduced to sports by their parents, some played sports in their neighborhoods, and others were frequently involved in sports in school. They grew up in environments that exposed them to sports, and that sport was part of the culture. This type of learning history indicates the teachers’ approach tendencies towards sports that may have influenced their decision to become physical education teachers. Nevertheless, there is no literature that supports the relation between (a) approach tendencies towards sports resulting from specific learning histories, and (b) effective teaching.

Participation in PETE Programs and Professional Workshops

All teachers in this study noted that they improved their CK and PCK as a result of learning from other teachers and attending professional workshops. Taylor and Kayla, for instance, indicated that after participating in professional workshops, they incorporated what they learned in the workshop into their instructional units.
Participation in workshops was also reported in previous studies such as Barrett and Collie (1996) and Graham et al. (1993).

Most teachers in this study described their PETE program as a vehicle for exposure to CK (e.g., games), PCK (e.g., progressions), and pedagogy (i.e., providing feedback). Studies in the PCK literature illustrate the contribution of PETE programs to preservice teachers. Some findings supported that teachers’ CK (Chen, 2004; Sebren; 1995), PCK (Chen, 2004; Jenkins, Garn, & Jenkins, 2005; Jenkins & Veal, 2002; McCaughrty & Rovegno, 2003; Rovegno, 1992) and knowledge of the learners (Chen, 2004) grew during field experience method courses, field teaching experiences, and peer coaching strategies. These findings are in line with the teachers’ reports in this study about the contribution of their PETE program. Thus, according to participants in this study, PETE programs and professional workshops can assist teachers in developing their CK and PCK base and therefore is valuable.

Involvement in Instructional Settings Other Than the Teaching Setting

All the teachers (except one) accumulated coaching or instructing experience prior to their official teaching experience. Marks (1990) referred to such experiences as previous PCK experiences. And indeed the teachers classified these experiences as important for the development of CK and PCK. In contrast to this finding, studies in physical education typically did not describe their participants’ previous involvement in instructional settings other than their formal teaching. A single relevant finding was noted by Graham et al. (1993), who argued that previous teaching experience is extremely important for the development of PCK. The findings from teachers’ reports in this study
indicate that experiences in teaching and instructing children in settings that share common characteristics as K-12 settings can add and contribute to the development of PCK.

*Ability to Learn Content that Teachers Were Not Directly Taught*

All teachers in this study reported on their willingness to learn new professional content independently in various ways (e.g., search websites and read text books). The teachers specifically mentioned their ability to teach themselves about new content they had not been directly taught. The ability to independently learn CK was also prevalent among other teachers in previous studies (e.g., Barrett & Collie, 1995; Doutis, 1997; Graham et al., 1993; Kutame, 2002; Schempp et al., 1998). For example, in Barrett and Collie (1995), elementary physical education teachers participated in a lacrosse workshop because they were unfamiliar with lacrosse content.

*What Teaching Practices do Teachers Identify as Their PCK?*

Analysis of the interviews suggests two primary factors that assisted teachers in this study in delivering the content appropriately to their students: (a) depth of CK and PCK, and (b) experience.

*Depth of CK and PCK*

The teachers in this study spoke of three practices in which their depth of CK and PCK was demonstrated: (a) planning, (b) teaching, and (c) reflecting.

*Planning.* Graham et al. (1993) found that experienced teachers planned mostly when they were novice, expressed their concerns when teaching content they were less comfortable with, and searched for assisting resources. Graham’s et al. (1993) findings
were similar and supported the findings of this study. The teachers in this study reported that they planned lessons in depth at the beginning of their career, or when they felt uncomfortable with the content they needed to teach. In those cases, they planned until they reached a level of comfort with the content, and then planning ceased. Once feeling comfortable teaching the CK, teachers were mostly driven by their previous experience teaching the CK and by knowledge of the students. Teacher's planning is possibly related more to the experience of the teacher with the content, and comfort level of teaching particular CK, than to the years of teaching.

Teaching. The focus group teachers reported they have more depth in teaching their stronger units of instruction and less depth (in which case they often "skim the surface," in their words) in their weaker units of instruction. Similar indications were found in the literature. Rovegno (1992) noticed a shift of preservice teachers’ content from general levels to more specific and detailed levels. The shift represented more developed CK and knowledge of the learners (Rovegno, 1992) which fostered more mature PCK as well. Kutame (2002) also found specific descriptions of content and defined it as “content rich” (p. 24). The depth of CK is present when the teacher assigns appropriate activities, games and practices, modifies equipment and space appropriately, and paces the lesson appropriately. The teachers reported an ability to use a variety of practices at the appropriate time when teaching their stronger units. Those skills were less developed in their weaker units. Skills and practices such as modifying instruction at the appropriate level were typically low among the preservice teachers (Rovegno, 1992),
which is an indication of lack of PCK according to Grossman, Schoenfeld, and Lee (2005).

The focus group teachers attributed the appropriateness of their practices to the knowledge they have about their students and their ability to discriminate and to correct common errors. In the strong content areas, the focus group teachers reported they could anticipate errors and prepare for these errors in advance. This finding is consistent with Grossman et al. (2005) who asserted that PCK is, among other things, the teacher’s ability to anticipate students misunderstanding of the subject matter (e.g., physical education).

Differences in teaching stronger and weaker content are related to rich CK in the stronger unit, and lack thereof in the weaker unit. Furthermore, the richness of CK is an indication of more mature PCK, as also argued by Rovegno (1992), while lack of CK is related to less mature PCK (Chen, 2004; Rovegno, 1992). These findings support Sebren’s (1995) hypothesis that CK precedes the acquisition of PCK. It is also highly likely that rich CK (Kutame, 2002) is a prerequisite for developed PCK, yet developed PCK is not a prerequisite for rich CK.

Time was also an important indicator for PCK. In their stronger content, the focus group teachers can most likely identify errors and respond to students’ performance faster (if they respond at all) in their weaker units. Preservice teachers, again, were not capable of quickly discriminating students’ performance (Rovegno, 1992). The inquiry of the duration of time it takes teachers to respond to students’ performance is completely missing from the PCK literature, despite Hurwitz’s call in 1978 (as cited in Metzler,
1989) to investigate time as an indication for the appropriateness or inappropriateness of teachers’ practices in the gymnasium.

Reflection. The teachers in this study also mentioned reflection as a practice that provides evidence of their PCK. Their discussion about reflection validated the micro and the macro level reflection as part of the modified definition of PCK that was suggested in chapter 2. The teachers are engaged in two forms of reflection. First, they consider modifying instruction for the students’ characteristics as a reflective practice, as was also included in Shulman’s (1987) definition of PCK. This is reflection at the micro level. Second, teachers reflect on whether the lesson objectives have been met. Those reflections occur during or after the lesson, or at the end of the school day. For these teachers, reflection affected how they taught the next lesson or the next time the unit was taught. These changes are macro level reflections. Although the literature does not examine reflection particularly concerning PCK, one study reported the positive impact of reflection on the development of CK and PCK of preservice teachers (Sebren, 1995). Reflection assisted the preservice teachers to plan their next lesson based on the previous one, to consider their learners in future planning, and to improve their teaching (Sebren, 1995). Interestingly, when the teachers were disappointed with a lesson they taught, feelings of guilt were part of their reflection. They felt guilty for not having taught the lesson more effectively. The feelings of guilt may be part of an avoidance contingency (Cooper, Heron, and Heward, 2007). In other words, the teachers possibly strive to deliver high quality teaching to avoid feelings of guilt that rise when they fail to do so.
The teachers’ comments in this study validated the reflection piece as part of the modified PCK definition. Nonetheless, the impact of reflection on teachers’ PCK and the guilt control are yet to be examined in the PCK literature.

Experience

The influence of experience on CK and PCK acquisition was reported by teachers in two forms: (a) experience playing the sport/activity, and (b) experience in teaching content related to sport and physical activity.

Experience playing the sport. Based on the focus group teachers’ reports, prior participation in a sport was not a prerequisite but certainly helped for teaching. Sometimes even participation in similar sports assisted in teaching specific content. The focus group teachers reported they could transfer characteristics from one sport to another when the two sports had similar primary and secondary rules (e.g., soccer and handball). There are no findings in the PCK literature concerning prior participation in sports. Previous studies ranged from skimpy information, that did not include elaborated details (e.g., Kutame, 2002; Schempp et al., 1998), to extensive description (e.g., Rovegno et al., 2003) of the teachers’ prior teaching and coaching experiences, yet they have seldom reported on the teachers’ experience with the content as participants. The PCK literature focused primarily, and almost exclusively, on prior teaching and coaching experience, without attending to teachers’ experience as participants in sports. Based on the findings of the current study, prior participation in sport may contribute to the development of PCK.
Experience teaching the content. Despite teachers’ comments that playing the sport contributes to subsequently teaching that sport, some of the teachers argued that their stronger unit of instruction was different than the sport they played. For these teachers, a unit of instruction was stronger because they had taught it repeatedly, numerous times. They also refined their teaching to make it more appropriate for students’ learning after each lesson and unit taught which is different than teaching the same lesson repeatedly with no improvement demonstrated. Shulman (1986) and Marks (1990) have supported the importance of repetitive teaching as a component of PCK (Marks, 1990; Shulman, 1986). The teachers’ reports in this study support Schincariol’s (2002) argument that repeated teaching may result in the development of PCK.

Specifically, repeated teaching allowed observation of numerous performances of many learners. Consequently, teachers (a) developed a critical eye for students’ performance, (b) improved their ability to anticipate errors, (c) discriminated successful activities for the students, and (d) were able to tailor the instruction appropriately. These four characteristics were discussed by Grossman et al. (2005) as characteristics of PCK. In physical education Graham et al. (1993, p. 209) reported a study of expert teachers who knew “which tasks would work” with their learners. Hence, repeated teaching has been proposed as an important component of PCK, and this finding was supported by the teachers’ reports in this study.
How do Teachers Ensure the Content Delivered is Appropriate to the Students’ Developmental Level?

Ward (2005) conceptualized observation and discrimination skills as a component of CK, and indeed, the teachers in this study reported observation as a primary vehicle for ensuring the content delivered is appropriate to the students’ developmental level. All the teachers explained that they typically scan the class to see if “students got it.” Rovegno (1992) also concluded that the development of PCK is related to enhanced ability to observe students performing. Further, all teachers argued it is success that they are looking for when they are scanning the class, rather than scanning for monitoring purposes or to see if students are on-task. This finding provides some validation for the use of scanning as the independent variable of appropriateness (i.e., research questions 7 and 8) in phase 3, and as a direct measurement of student learning as argued by Silverman (1985). Like the teachers, the researchers determined the appropriateness of the task by scanning all students and discriminating their performance.

Ward’s (2005) discussion of the components of CK and Silverman’s (1985) discussion of direct measurement of students’ learning situates observation and discrimination of performance as highly important skills. As such, skill analysis courses are imperative for developing those teaching competencies. Further, the immediate success of the whole class in responding to the teacher’s task was found to be a critical and acceptable indication for the appropriateness of the task.
Conclusions of the Research Questions of Phase 3

This section provides conclusions about the teachers’ effectiveness. Then the eight research questions of phase 3 are discussed by their numerical number.

Determining the Teachers’ Effectiveness

The teachers’ effectiveness was based on ALT-PE, which were examined in reference to Metzler’s (1989) review on how students spend their time in physical education. Students typically spend between 20-50% of the physical education lesson time in skill learning, and a third of the lesson time (i.e., 33%) in waiting, transition, and management behaviors (Metzler, 1989).

Kayla’s Effectiveness

In the stronger instructional unit, Kayla’s students spent on average 45% of the lesson time in activity, and 36% of the time in waiting and transitions (management time was less than 1%). These data indicate Kayla's effectiveness in fostering activity time. Management and transition time were slightly over 33% of the lesson time, which suggests lack of effectiveness. In the weaker unit, Kayla demonstrated lack of effectiveness, as the students spent only 18% of the time in activity, and 58% of the time in waiting, transition, and management. In other words, Kayla demonstrated differential effectiveness: She was less efficient and less effective in teaching her weaker unit than her stronger one. There are two possible reasons for the differential effectiveness: context and lack of CK and PCK. Relative to context, ALT-PE is context dependent (Metzler, 1989). For example, students would typically be more active in field hockey than in golf or gymnastics, due to the nature of the activity. Relative to lack of CK and PCK, the
ALT-PE data may be a result of her lack of CK in golf, as opposed to more CK and experience teaching volleyball. Lack of PCK is apparent in the organization of the class structure. Kayla organized the golf unit chiefly around practice in pairs. Only one student practiced at a time, while the other partner was waiting. Consequently, activity time decreased, and waiting time increased.

Taylor’s Effectiveness

In the stronger instructional unit, Taylor’s students spent 47% of the lesson time in activity, and 28% of the time in waiting, transitions, and management. In the weaker unit, students spent 49% of the lesson in activity, and 30% of the time in waiting, transition, and management. Based on Metzler (1989), all ALT-PE data support that Taylor's was effective in teaching both instructional units. The lack of differences between Taylor’s two units, in contrast to Kayla’s data, raise the possibility that there are no major differences in the level Taylor delivers in the two units of instruction. Thus it may be that the units Taylor selected were more similar than different with regard to her ability to teach those, rather than representing stronger and weaker units.

Conclusions about the Teachers’ Effectiveness

The ALT-PE data, in reference to Metzler’s (1989) review, suggests that the teachers mostly demonstrated higher than average effectiveness with the exception of Kayla’s weaker unit of instruction in which waiting, transition, and management time was considerably high, while activity time was considerably low. Further, Kayla and Taylor's management time was less than 5% (with the exception of the golf lesson in which it was 11%) of the lesson time. Off-task behaviors were no more than 5% of the
lesson time. These ALT-PE data suggest Kayla and Taylor were effective managers of their physical education classroom. Nevertheless, the ALT-PE data do not provide an indication about the teachers’ effectiveness when PCK is the focus of effectiveness. Therefore, based on ALT-PE, it is not possible to determine how effective Kayla and Taylor were in the selection and delivery of the content to their students.

Research Sub-Question 1: What was the Percentage of Each Type of Content Task Used in the Teacher’s Stronger and Weaker Unit of Instruction?

In the weaker unit, Kayla remained primarily at the informing level, with less extension tasks, and absence of refinement of the golf techniques or applications to the game. This finding was supported by Hastie and Vlaisavljevic (1999) who found that teachers chiefly relied on informing tasks when teaching content in which they were not experts. The limited use of tasks, specifically refinement and application tasks, is consistent with the teachers’ reports in the focus group, Kayla’s interview, and findings by Schempp et al. (1998) that experienced teachers, despite their expertise, still have somewhat limited ability to remediate students’ errors when teaching their weaker content.

Kayla demonstrated better ability to diversify the types of tasks in her stronger unit of instruction, as she utilized all four types of tasks. Such ability was limited in Kayla’s weaker unit as Kayla was less able to attend to the quality of performance or to apply the golf skills into a broader context. These data suggest there was more depth of CK and PCK in the stronger unit versus the weaker one.
Although utilizing all types of tasks in her stronger unit of instruction, Kayla still defaulted mostly to informing and application tasks, and infrequently used extension and refinement tasks. The use of extension tasks allows the teacher to sequence the learning tasks and to create learning progressions. Refinement tasks address the quality of performance, which is another characteristic of fine content development (Rink, 2006). The infrequent use of extension and refinement tasks suggests that Kayla deliver the volleyball unit using insufficient learning progressions, and insufficient emphasis on the quality of students’ performance. Thus, Kayla’s PCK and CK in volleyball was less advanced and developed as one may have expected from a teacher who played, coached, and taught volleyball, and identified it as her strong CK.

Jones (1992) found lack of refining tasks among other experienced elementary physical education teachers. In contrast, Hastie and Vlaisavljevic (1999) showed that expert teachers utilized extension, refinement and application tasks when they taught their subject matter expertise. These contradicting findings may be due to inconsistencies using Rink’s (2006) task system classification, as it is based to a certain extent on subjective judgment in a specific context. For example, when a teacher presents a new skill within a game setting, one observer may code the task as informing, while the other codes it as application. The observers’ judgment regarding a task is also influenced by the extent to which they were exposed to the teacher’s teaching. The primary observer is not only exposed to content of a particular set of tasks, but also to the teacher’s style of teaching, the pattern of the lesson, the flow, and the trend of progression of the content along the instructional unit. A secondary observer, who may be exposed to only selected
lessons for IOA purposes, does not have the same exposure history to that teacher’s teaching. Observer’s training may control for assessment of each episode, yet cannot control for pattern, flow, and trend of the progressions across an entire instructional unit. Consequently, the primary observer may have a more accurate (and different) judgment call about the type of task than a secondary observer who had less exposure to the teacher’s teaching. In other words, tasks may be classified differently by different observers, based on the extent to which they were exposed to the teacher's teaching.

In Taylor’s stronger unit of instruction, extension tasks were most prevalent, followed by informing and application tasks. Refinement tasks were scarcely delivered. Based on Rink (2006), the data suggest that Taylor presented the content in her stronger unit gradually. In the weaker unit, Taylor’s primarily delivered application tasks, followed by refinement and informing tasks. In this unit (i.e., invasion games), Taylor aimed to teach tactics within the game, which may explain the prevalence of application tasks. Nevertheless, based on Rink (2006), the infrequent use of extension tasks suggests that Taylor did not teach the content (i.e., tactics) in this unit gradually. The researchers’ anecdotal observations and the teachers’ task statements in the weaker unit support the argument that students were mostly engaged in game play rather than in gradually learning tactics. A gradual delivery of the content was demonstrated better in Taylor’s stronger unit than in her weaker unit of instruction. The lack of extension tasks in her weaker unit suggests her PCK in this unit was limited. The PCK in the stronger unit was more developed than the PCK displayed in the weaker unit.
Taylor delivered only few refinement tasks in her stronger unit, which typically centered on the rules of the game more often than on tactics or techniques of the sport. Both teachers held students accountable for knowing the rules of the game (e.g., from which position to hit), but typically did not hold students accountable for correctly performing the technique or the tactic. Lack of accountability for actual performance in physical education was also found by Tousignant and Siedentop (1983), and by Tinning and Siedentop (1985), studies which provide further support to the findings in this dissertation. Jones (1992) specifically concluded that physical education elementary teachers seldom held students accountable for skill acquisition, as prevalent in the current study.

Selection of the Content to be Included in the Instructional Unit

Kayla and Taylor verbally identified particular CK as stronger (e.g., volleyball) because of their previous experience in teaching, coaching, and/or participating in that content. All tasks, activities, and progressions included in their instructional unit provide a complete representation of the content that was selected for teaching. Kayla and Taylor’s selection of the activities within their stronger CK (which is different that the topic selected for teaching) warrants discussion. Three considerations could have possibly affected the selection of the content within each instructional unit. The first consideration is convenience. Based on her reports, Kayla included volleyball, badminton, and tennis in the same unit partly because all three sports involve the set up of a net. Second consideration is the teachers’ conceptions about the purpose of teaching
(Grossman, 1990). Kayla did not teach more than two skills in volleyball because she believed students would not be able to perform more than these skills.

Third consideration is the possibility of a lack of CK and PCK in particular content. Three examples support this assumption. The first example is as follows. Kayla taught two volleyball skills (i.e., underhand pass and underhand serve) over four lessons. Kayla taught the volleyball skills using 12 tasks (an average of three tasks per lesson). The two latter lessons included review tasks in the form of game play, while no new content was introduced. Both the content of the tasks and the small number of tasks per lesson suggest that the volleyball skills lacked a gradual presentation from a modified and small scale performance to a full scale performance of the complete skill. Had the skills been broken down and presented more gradually, it is suggested that the data would probably show more tasks per lesson per skill. This is not to argue that the more tasks delivered, the better the skill is taught. It is to suggest however, that more than three tasks per lesson may be required for progressing to the full form of a pass in a fifth grade volleyball unit. Overall, the types and number of tasks Kayla used in her volleyball unit suggest that she did not display rich CK or PCK in volleyball. A similar trend was detected in her weaker unit. Kayla delivered 14 tasks over a five-lesson unit, for teaching two golf skills. Nevertheless, determining which number of tasks is more appropriate to use is impossible without considering the actual content of the tasks, their sequence, and how students respond to the tasks.

The second example is derived from Taylor’s weaker unit. Taylor planned to teach tactical concepts across three sports (i.e., Frisbee, team handball, and soccer) in a
six-lesson unit. Taylor delivered approximately four tasks per lesson, and spent approximately two lessons on each sport. An expert person in these sports should determine whether the combination of the sports, as initiated by Taylor, was conducive for teaching tactics. Another possibility is that the grouping of sports and the structure of the unit was the result of lack of CK and PCK, and allowed Taylor to sustain a longer unit of instruction. Taylor’s task descriptions, the content of the invasion game unit, and the tasks’ data do not provide any indication for task progressions for teaching tactics.

The third example is from Taylor’s stronger unit. Taylor delivered her stronger instructional unit (i.e., floor tennis) using a task sheet that included eight tasks. The task sheet was organized with progressions from informing to application tasks. Nonetheless, Taylor used the same tasks sheet for four consecutive lessons. The use of the same tasks for such a prolonged time is probably not beneficial for learning. The tasks on the task sheet were well sequenced, such that if delivered for a day or two could have been conducive for learning. Using the task sheet for four days implies a lack of CK and PCK of the teacher.

Use of Ambiguous Tasks

Based on Tousignant and Siedentop’s (1983) classification of tasks, Kayla and Taylor frequently delivered implicit tasks. Students were required to know how to perform the task from previous tasks/lessons. For example, Taylor provided the following task in her stronger unit of instruction: “Shake hands and switch teams.” Occasionally both teachers delivered generally explicit tasks (Tousignant & Siedentop, 1983). Those tasks included some general description of the expected response. For example, Kayla
mentioned: “Serve, return the serve and catch the ball. Keep arms straight and bend knees” in her volleyball unit. None of the teachers delivered specifically explicit tasks that include precise criteria for success, as echoed previously by other researchers (e.g., Jones, 1992; Siedentop et al., 1994; Tousignant & Siedentop, 1983). The mostly implicit or generally explicit tasks had sufficiently broad boundaries that each response could be considered suitable, appropriate, or correct, as argued by Siedentop et al. (1994). The observations and findings of this study portray a similar picture of physical education lessons as the one that was described almost two decades ago in a series of studies at The Ohio State University (e.g., Jones, 1992; Siedentop et al., 1994; Tousignant & Siedentop, 1983). Teachers use implicit and partially explicit tasks, but formal accountability in physical education is lacking.

*Sub-Question 1a: In What Order Were the Types of Tasks Presented in the Stronger and Weaker Instructional Units?*

Kayla introduced mostly informing and extension tasks early in her stronger instructional unit. As the unit progressed to its mid and end lessons, Kayla presented more frequently review for tasks that had already been introduced and application (i.e., game play) tasks. However, in her weaker unit, Kayla remained at the informing level and tasks were only slightly different in every lesson. The second lesson was exceptional in that it included extension tasks. Based on Rink (2006), Kayla delivered more progressions in her stronger unit of instruction in contrast to her weaker unit which almost completely lacked extension tasks. Her PCK in her stronger unit was more developed than the PCK she demonstrated in her weaker unit.
A similar trend was found in Taylor’s units. In her stronger unit, she delivered adequate progressions that were well sequenced, with the reservation of the prolonged use of the task sheet. Nevertheless, the last two lessons in the unit were devoted only to game play. The lack of extension tasks and the increased use of application tasks in Taylor's weaker unit leads to the assertion that Taylor’s PCK in the stronger unit was more developed than the PCK in her weaker unit.

Overall, both teachers made extensive use of application tasks in both their stronger and weaker units (with the exception of Kayla’s golf unit). The application tasks were not necessarily preceded by gradual progressions in the form of extension and refinement tasks, and as elucidated by Rink (2006). Both teachers taught lessons in which the students were engaged in only one task for the entire duration of the lesson, which further illustrates the lack of progressions and the limited PCK exhibited by Kayla and Taylor in their stronger and weaker units of instruction.

The assertions regarding lack of adequate progressions demonstrated in this study are in contrast to inservice teachers who demonstrated rich progressions of skills and concepts (Schempp et al., 1998) and to elementary teachers who demonstrated volleyball progressions utilizing different types of tasks (Doutis, 1997). These studies utilized Rink's task system (2006) as well. It is quite possible, as discussed before, that the contradiction was derived from inadequate utilization of Rink’s task system (2006). It is also possible, however, that the contradiction stems from differences in the depth of CK and PCK the teachers possessed in the different studies.
Research Sub-Question 2: Which Instructional Forms Were Used by the Teachers to Represent the Content to the Students?

One of the substantial functions of task presentation is “to give students a picture of the correct way to perform a task or skill” (Metzler, 2005, p. 226). Despite the importance of demonstration, the teachers in this study mostly relied on verbal instructions as a means of presenting the task, and made little use of demonstrations. This finding was in contrast with Doutis (1997) who reported on frequent use of demonstrations by two experienced elementary physical education. Metaphors were seldom used in Taylor’s PCK instruction or in Kayla’s PCK for teaching volleyball.

Shulman (1986) initially defined PCK as the ways that teachers use to transmit the content to students, such as examples, metaphors, and demonstrations. The more ways of delivering the content, the more options the teacher has to select an appropriate method to convey the content to an individual student. Based on the PCK conceptualization suggested in chapter 2, various ways of delivering the content appropriately, is considered an indication of more developed PCK. If one accepts this argument, then relying chiefly on verbal instructions for conveying the content to the students somewhat limits PCK. The absence of metaphors, and the infrequent use of other forms of content representation, decreases the ways in which teachers convey the content to the students, and is therefore suggestive of less developed PCK. This is not to imply, however, that the instructional forms the teachers use are not effective. These data suggest that more varied pedagogies could better attend to the needs of diverse learners in the classroom. Such richness of practices is considered to be an indication of more
developed PCK. This assertion supports the development of PCK as a variable on a continuum as suggested in the second chapter of this dissertation.

Research Sub-Question 3: How Many Tasks Were Provided to the Class, to a Small Group, and to the Individual Student?

No major differences were found between Kayla’s stronger and weaker unit of instruction as related to the recipients of her tasks. She provided tasks to the entire class and then frequently interacted with individuals as they were performing those tasks. Taylor, however, delivered the most tasks to the whole class, and fewer to individual students. She delivered individual tasks more often in the stronger unit (i.e., floor tennis) than in the weaker unit (i.e., invasion games), possibly because: (a) the invasion games unit included team sports and the data indeed showed delivery of more tasks to small groups in this unit. Floor tennis is an individual activity, which at least partially accounts for and explains the occurrence of more individual interactions in this unit; (b) the existence of individual tasks represents the teacher’s attempts to tailor to students’ characteristics (Shulman, 1987). Those tasks were more prevalent in Taylor’s stronger unit than the weaker one. Shulman (1987) argued that adaptations are a component of PCK. Based on Shulman’s (1987) argument, Taylor displayed more mature PCK in her stronger unit.

No studies have used the recipients of tasks as an indication of PCK. Further, based on the findings of this study, identifying the recipients of tasks, whether class or individual, is not a fine primary indicator for PCK for the following reasons. First, the “recipients of tasks” variable is closely related to the teachers’ teaching style. The
teachers in this study displayed substantially different teaching styles regardless of how strong they were with CK. Taylor delivered tasks mostly to the whole class, Kayla mostly delivered individual adaptations. Second, it is quite possible (although not apparent in the current study) that an expert teacher with mature PCK is capable of remaining at high success level of whole class tasks, with no need to frequently modify tasks for individual students. In this case, lack of individual adaptations would be irrelevant, and unneeded.

Research Sub-Question 4: What Types of Cues Were Used by the Teachers to Represent the Content?

Both teachers made primary use of technical cues, moderate use of visual cues, and very little use of metaphorical cues. Similar finding was by Kutame (2002), who also found a prevalence of technical cues, and no use of metaphorical cues. Kayla used different types of technical cues in her stronger unit two times more than the types of cues she used in her weaker unit. Her CK and PCK in the form of cues were richer and more developed in the stronger unit of instruction. Taylor used more types of technical and visual cues in the weaker unit than in the strong one. She displayed more mature PCK in the form of cues in her weaker unit of instruction. Therefore it is possible that Taylor’s selection of invasion games as her weaker unit was inaccurate, at least when compared to her floor tennis unit.

The teachers’ CK and PCK, as indicated by cues, were more developed in the units in which they displayed a wider variety of cues. For Kayla this occurred in her stronger unit, and for Taylor, surprisingly, in her weaker unit. The display of more types of cues signifies richer CK and more mature PCK as the teacher has ample ways of
representing the content to the students and tailoring to their characteristics (Shulman, 1986, 1987). For instance, master physical education teachers mentioned 83 different types of cues when teaching volleyball (Chen & Ennis, 1995). By using cues, the teachers increased the teachability of the CK, as also supported by methods text books (e.g., Rink, 2006; Siedentop & Tannehill, 2000).

In the context of Shulman’s discussion (1986) of PCK, one may argue that “more is better” as far as using cues, yet this assertion is not completely accurate for the following reasons. Rink (2006) actually recommended that learning cues should be only few in number, and Fronske (2001) added cues should be delivered only one at a time; and indeed Rovegno et al. (2003) found that experienced teachers of basketball did not use an ample array of cues, as “they followed the principle: less is more” (p. 435). The “more is better” cues’ approach was found in this study and by Chen and Ennis (1995). The “less is more” cues’ approach was discussed by Rovegno et al. (2003) and recommended by Fronske (2001) and Rink (2006). The functionality of the cues for students’ learning should be examined for determining which approach is more valuable.

Finally, the teachers selected which cues to use in their teaching, and therefore by definition, cues are a legitimate indicator for PCK. The numerous cues the teachers delivered in one unit, and the fewer cues delivered in the other, further supports the development of PCK as a variable on a continuum. As such, Kayla displayed more mature PCK in her stronger unit and less developed PCK in her weaker unit. Taylor, on the other hand, displayed more developed PCK in the unit she identified as weaker than
in her stronger one. It is possible, then, that invasion games were not a weaker unit of Taylor's when compared to floor tennis.

*Sub-Question 4a: How Many Times Were Those Types of Cues Used During the Unit?*

Similar data patterns were detected for the variable "number of times cues were used." For both teachers, technical cues were the most frequently used during both instructional units. Kayla used technical and visual cues considerably more than in the weaker unit. Taylor stated cues in her weaker unit four times more often than the corresponding cues in her stronger unit. The cues’ data collectively indicate that the teachers’ CK and PCK were more developed in one unit over the other. For Kayla there is strong evidence that she has more depth of CK and ample ways of conveying the content to her students (i.e., PCK) in the stronger unit than in her weaker unit. The data suggest an opposite trend in Taylor’s teaching, as she consistently displayed more types of cues, and stated those more times, in the weaker unit. Thus the PCK Taylor displayed in her weaker unit was more mature than the PCK displayed in her stronger unit of instruction. It could be that Taylor’s reports on stronger and weaker units of instruction were inaccurate. The literature did not examine the type and number of cues delivered in relation to the teachers’ stronger or weaker CK and PCK. Therefore, these data cannot be evaluated in comparison to other findings.

*Research Sub-Question 5: Which Antecedents Preceded the Teacher’s Presentation of the Task to an Individual Student?*

Both teachers in their instructional units approached individual students to modify the task for them, mostly when those students exhibited incorrect performance. Hence
both teachers made appropriate decisions for intervening with individual students to improve their performance.

With regard to antecedents, Kayla responded to incorrect performance more frequently in the stronger unit. She intervened following students' correct performance more often in the weaker unit. Taylor demonstrated a different trend. She responded to students’ correct and incorrect performance more often in her weaker unit than in her stronger one. Overall, both teachers provided modified tasks to individuals when they were incorrect. The teachers displayed better ability to discriminate incorrect performance in one unit rather than the other. Hence their CK in the form of skill discrimination (Ward, 2005), was richer in one unit over another. For Kayla, CK was better in the stronger unit. For Taylor, CK was richer in her weaker unit. These data also validated the teachers’ observations in phase 1 and 2 of this study, that regardless of their level of expertise in the subject matter, they would be able to identify that “something in the performance is wrong.”

It is important to remember that these data only represent episodes in which antecedents (i.e., incorrect performance) were detected by the teacher, and which prompted the teacher’s intervention. Based on the researcher's anecdotal observations, occasionally, there were additional events of students’ incorrect performances that did not prompt the teacher’s intervention. Those events occurred possibly because the teacher: (a) did not observe the performance, (b) observed the performance yet did not detect the error, or (c) detected the error, yet chose not to intervene. The instances in which the teacher detected incorrect performance yet did not act on it suggest limited CK (i.e.,
limited error detection) and limited PCK (i.e., no selection of content to overcome the learning difficulty).

*Research Sub-Question 6: What Types of Adaptations (From the Initial Tasks Provided) were made by the Teachers to Enhance Student’s Performance?*

Seven types of adaptations were tracked in phase 3 of this study. Shulman (1986) asserted that adaptations of tasks are an indication of PCK. Kayla utilized the same four types of task adaptations in her instructional units (by order of prevalence): refining the task, change of position, restating tasks and modifying complexity. Refinement tasks were also frequently used by other experienced teachers (Hastie & Vlaisavljevic, 1999). Taylor used four types of adaptation in her stronger unit (in order of prevalence): refining the task, change of position, restating the task, and assigning a different task. She refined the task or restated it only in her weaker unit. The predominance of refinement tasks as adaptations suggests that: (a) the whole class task were frequently taught at a higher level than that which students could achieve, and that (b) such tasks were later scaled down for better comprehension.

Similarly to the previous discussion in the cues section, Taylor displayed varied ability to modify tasks in each unit. The variety of adaptations suggests greater ability to tailor to students’ characteristics (Shulman, 1987), and more mature PCK. Taylor displayed more developed PCK in her stronger unit as opposed to her weaker one. No such difference was found in Kayla’s stronger and weaker units. These data contrast Taylor's cues and antecedents’ data in which PCK was more developed in her weaker unit than in her stronger one. These data suggest that even though Taylor reported on the
two instructional units as stronger and weaker, her two units were more alike than
different, with regard to PCK.

The complete absence of modifications in the form of extension of skills up is
concerning as it suggests one of two possibilities. First, the initial whole class tasks were
too difficult and needed to be broken down for individual students. If this is the case, then
it is possible that the content was not presented in a gradual manner that allows initial
high level of success for the students. Second, extension tasks represent an increase in
level of difficulty (Rink, 2006). Extension tasks should then be delivered to students who
have already met the teacher’s criteria for successful and correct performance. The
advanced students in a class may need extension tasks as their progress through the
content is more rapid than average or less skilled students. The lack of extension tasks as
a form of individual adaptation suggests that the teachers simply did not attend to skilled
students who performed the task successfully and may have been ready for an extension
task. Those skilled students were possibly deprived of appropriate instruction that could
allow them to progress based on their individual skill level. The lack of adaptations in the
form of extension up suggests that students who were less advanced may have been more
likely to receive individualized instruction (i.e., refinement tasks) in contrast to advanced
skill students who did not.

*Research Sub-Question 7: What Percentages of the Students Performed the Teacher’s Task Correctly?*

In this research question, each student’s response was coded to measure the
success level of the entire class in the provided task. Students’ success in Kayla’s both
stronger and weaker units was 75%. Students’ success in Taylor’s stronger unit was 78% and in her weaker unit 80%. The success data for both classes were variable and did not indicate any particular trend.

Two findings are made based on the data. First, the appropriateness of the task variable as measured by the students’ success level resulted in variable data that do not hold any functional significance. The researchers rigorously held the students accountable for criteria that were briefly stated by the teacher, which accounts for some of the lower than 80% success level data. The students were typically not held accountable for those criteria by the teacher. Nevertheless, this variable of “observing the students for determining appropriateness” was considered by all teachers in the current study to be a good indication of the appropriateness of the task they selected to teach.

Second, the variability of success level should partially be attributed to the extent tasks were explicit, how wide the tasks’ boundaries were, and the existence of accountability (Siedentop et al., 1994; Tousignant & Siedentop, 1983). For instance, in wide boundary task such as "switch courts and start another game," a wide range of responses would be considered as correct. Students can cease from demonstrating "side to the target" as asked at the beginning of the lesson, but still be correct as they engage in game play.

Research Sub-Question 8: To What Extent Were the Adaptations Made for Individual Students Appropriate?

The consideration of appropriate or inappropriate task in this question was based on students' correct or incorrect performance. In addition, the researcher coded frequent situations in which students had no opportunity to respond (NOTR) to the teacher's
modified task. For example, in game play situations the teachers typically provided a modified task yet rarely set up the game play environment in a way that would be conducive for imitation of the required response (e.g., freeze-replay situations). The NOTR episodes overall represented more than 30% of the consequences of the teachers' adaptations. These data are cause for concern, as valuable teaching time is wasted when teachers modify tasks yet do not immediately follow up to ensure learning is occurring.

The appropriate/inappropriate data suggest that Kayla displayed substantially differing ability to assign appropriate instruction for individual students in the two units she taught. She exhibited adequate and better ability to modify instruction in her stronger unit than in her weaker unit. This is another indication, in addition to the ALT-PE data discussed earlier, for Kayla’s differentiated effectiveness. Her PCK in the stronger unit is more mature than the PCK in her weaker unit. As PCK is derived also from the teacher’s CK, it is apparent that Kayla’s CK was more developed in her stronger unit of instruction. The same trend was found in Taylor’s teaching. Substantial differences were found between Taylor’s stronger and weaker instructional units. She exhibited better ability to modify instruction appropriately to her students in the stronger unit than in the weaker one. Taylor’s PCK was more mature in her stronger unit and less mature in her weaker unit. Her CK was also more developed in her stronger unit of instruction.

The same patterns of data for both teachers validate the argument that there are differences in the PCK of teachers in their stronger and weaker units of instruction. Kayla and Taylor were less capable of providing appropriate modifications for individual students in their weaker units. This finding is consistent with Rovegno (1995) and
Whipple (2003), who found limited ability of teachers to provide appropriate feedback, and with Schempp et al. (1998) who noted teachers reported limited ability to overcome learning difficulties as those occurred. The higher prevalence of inappropriate adaptation episodes in teachers’ weaker unit also serves as an indicator for their less developed ability to specifically discriminate errors in their weaker subject matter, as found by Rovegno (1992), and by McCaughtry and Rovegno (2003). These data also further validate the teachers’ reports in this study regarding their ability to detect, anticipate, and correct errors in their weaker CK.

Conceptual Considerations

This section reexamines the assumptions made in chapter 2. The review of literature in chapter 2 concluded that PCK lacks an operational definition that allows for measurement. Rovegno (1994) argued that Shulman’s early (1986, 1987) definitions and explanations for PCK were inconsistent and were not research based. The absence of an operational definition influenced how PCK has been investigated so far. The vast majority of studies on PCK entailed qualitative methodologies for investigating the teachers’ PCK. Although previous data added important knowledge to the inquiry of PCK, seldom have studies attempted to utilize quantifiable measurements of PCK rather a qualitative descriptions. An operational definition is a prerequisite to valid observation, measurement, and experimentations that may result in a better understanding of PCK. As noted in chapter 2, researchers agree that PCK is an important dimension of teaching, which increases the need for an operational PCK definition. Furthermore, the lack of an operational definition resulted in inconsistencies as to what PCK is and how it should be
investigated and also influenced the outcomes of PCK investigations and the recommendations that were made based on research. Investigators occasionally concluded that PCK was more or less developed, advanced or problematic, yet their explanations essentially described CK and its variations, or increased knowledge of the learners, rather than pure and uncontaminated PCK (e.g., Chen, 2004; McCaughtry, 2003; Rovegno, 1992).

Consequently, the following operational definition of PCK was discussed in chapter 2: Pedagogical Content Knowledge is the act of selecting content from one’s knowledge base for the purpose of teaching in a specific context. This operational definition assisted in selecting variables for observation that served as indicators of the existence of PCK in the teacher’s repertoire. The definition was found to be: (a) inclusive and non-limiting. It allowed for various variables to be considered as indication for PCK and extended Marks’ (1990) argument that PCK cannot be investigated in isolation.; (b) operational, as other researcher could read the definition and determine whether behaviors (i.e., teaching practices) should or should not be included in the definition (Cooper et al., 2007); and (c) functional, as the distinct variables that fall under the definition are observable and measurable. As such, the modified definition of PCK was found to be valuable for both the educational and the research community.

The literature suggests that PCK is an integration of several knowledge bases such as curricular knowledge, CK, knowledge of the learners, knowledge of instructional strategies, and knowledge of the purposes and values of teaching (Grossman, 1990; Grossman et al., 2005; Gudmundsdottir & Shulman, 1987; Marks, 1990; Shulman, 1986,
Prior to the formulation of an operational definition for PCK, it was challenging to determine the components of PCK, which variables demonstrate PCK, how can they be measured, and in what way they impact PCK. The operational definition suggested in the current study attends to these concerns and therefore is functional for the investigation of PCK.

Researchers have varied in their assertions regarding the components of PCK. Despite this diversity of definitions, they all include CK as an important component of PCK (Grossman, 1990; Gudmundsdottir & Shulman, 1987; Marks, 1990; Shulman, 1986, 1987), yet they do not specifically explain how CK and PCK are related. The operational definition provides a clear distinction between CK and PCK, and elucidates the specific relation between CK and PCK. The methods implemented in this study allowed partial examination of the relation between CK and PCK, as they provided a thorough examination of the participating teachers’ PCK base, yet only limited evaluations of their CK base. The teachers’ CK was only described rather than assessed in terms of their: (a) experience participating in the sport, (b) engagement in professional workshops, and (c) experience in teaching a particular content. For instance, stronger conclusions about the relation between CK and PCK could have been drawn had the teachers’ CK was more thoroughly assessed by a CK assessment exam.

The definition and the distinction drawn between CK and PCK assist in interpreting previous findings about CK and PCK. In light of the definition and the findings of the current investigation, it is suggested that the depth of CK and its level of development is related to the level of PCK. Graber (1995) noted the temporal relations by
asserting that CK acquisition precedes PCK acquisition. Rovegno (1992) argued more specifically that an increase in PCK is related to improvement in the observation of children’s performance, which is essentially an increase in CK. Jenkins and Veal (2002) found that preservice teachers increased their learning cues during a methods course. The increase in cues usage influenced the preservice teachers’ PCK (Jenkins & Veal, 2002). Thus less developed levels of PCK may likely be derived from less developed CK. Chen (2004) argued that weak CK results in weak or immature PCK. Chen’s argument was based on his finding that preservice teachers had inadequate levels of understanding of the nature and structure of creative dance, which is, essentially, deficiency of dance CK.

Grossman (1990) argued that one of the components of PCK is the knowledge and conceptions about the purpose of teaching at the different grade levels. This assertion was evident in the teaching displayed by both teachers in this study. There are various examples from both teachers that shed light on their perceptions about the purpose of teaching physical education in elementary school. Kayla for instance, decided to introduce three net games in the same instructional unit, and to introduce only two fundamental volleyball skills in the volleyball unit. Kayla clearly stated she would not introduce more skills because she suspected that the students cannot learn more than two volleyball skills in fifth grade. Therefore, she remained with the two skills, and never introduced volleyball tactics. This is evidence for Kayla’s perceptions about her purpose of teaching. Kayla’s perceptions were consistent with other teachers who taught basic skills and excluded other content they believed the students will not be able to
comprehend (Chen & Ennis, 1995), and with inservice teachers who mostly valued the acquisition of skills as the primary goal of physical education (Schempp et al., 1998).

The preceding discussion illustrates that teachers have certain conceptions about the purpose of teaching that influence their decisions of what to teach, how to teach it, and for how long. These conceptions about the purpose of teaching influence the teachers’ PCK as previously argued by Grossman (1990). Teachers’ conceptions about teaching should be a key variable to explore when investigating teachers’ PCK.

The dependent variables measured in this study collectively show the variability of PCK between teachers’ stronger and weaker units of instruction. Overall, the PCK displayed in the teachers’ stronger units was more mature than the one displayed in the weaker units. This argument is supported by: (a) more variety of cues in one unit more than the other, which indicates richer CK as well as more developed PCK; (b) more diversified use of tasks in the teachers' stronger unit of instruction; and (c) more appropriate modifications for individual students in the stronger unit than in the weaker one. All of the above examples illustrate major differences between mature to immature forms of PCK as found in this study. This finding is consistent with Schempp et al. (1998) who provided a practical example for PCK: “The same teacher who may be proficient at teaching fitness activities may be woefully lacking when it comes to teacher racket sports” (p. 353).

These data also validate the development of PCK on a continuum from less mature to more mature forms. The teachers in this study utilized various teaching practices, selected content to teach, and made choices as to how to deliver that content.
The teachers have displayed PCK that varied from one unit to another. In one unit they exhibited PCK that was more mature than the PCK they exhibited in the other unit, which supported the variability of PCK’s maturity. McCaughtry and Rovegno (2003) described the PCK development as a shift from “immature and problematic PCK to more advanced” (p. 364).

Researchers who investigate PCK bring to the analysis their beliefs about the content that ought to be taught in PE and the appropriate ways of delivering it. Therefore, the authors’ evaluation of the content selected (i.e., CK) by the teachers, and the ways it was taught (i.e., PCK), does reflect her own bias, based on her previous experiences with teaching this content in physical education. A way for controlling personal bias and for increasing a more objective judgment call on the appropriateness and maturity of PCK is by receiving another expert’s opinion on the content selected and the practices selected for teaching it. Therefore, one should acknowledge that assertions made by Chen (2004) and Graber (1995) for example, that inadequate PCK is related to weak CK, may include their own bias in particular content. While this argument and others may be true, they are invalid until validated by: (a) a group of professionals who have expertise in the CK in similar context, (b) examination of published sport specific method text book (e.g., Ward, 1996) that explain how to teach the CK for particular grade levels.

Methodological Considerations and Recommendations for Future Research

This section discusses the methodological considerations and suggests recommendations for future research. Most of the recommendations are related to the
methodological considerations. The other recommendations are more general in referring to the investigation of PCK in physical education.

**Methodological Considerations**

The current investigation began with a focus group and individual interviews with effective teachers. The purpose of the focus group and the interviews was to: (a) begin to understand the teacher’s learning history relative to PCK; (b) examine the possible contingencies the teachers’ behavior is operating under, that cannot be found by observing the immediate teaching context; and (c) discover additional variables related to PCK that can be tracked when observing the teachers’ practices. The first two objectives of the focus group and interviews were accomplished. The investigator learned about the teachers’ past experiences relative to PCK and other events that may have guided their present behaviors. As related to the third objective, the investigator validated the variables that were already predetermined to be collected in this investigation. In addition, some of the teachers also discussed another variable, pacing, that may differ when they teach one content rather than another, presumably due to differences in CK and PCK. Pacing was not measured in this study.

Most of the studies that investigated PCK as the primary variable adopted data collection methods such as interviews, field observations, and field notes. The data collected were reported via qualitative methods, and added valuable information about PCK. Yet, methodologically, the investigation of PCK has not been diversified, to explore more aspects of this phenomenon in different ways. Only four of 25 investigations incorporated specific indicators for PCK that can be measured and
quantified: Kutame (2002) collected data on time distribution in the class, frequency and duration of practice tasks, types of task communication, selection and organization of cues, and students’ response trials (i.e., opportunities to respond); Doutis (1997) also measured practice time, time distribution, and content development; Chen and Ennis (1995) used mapping approach for assessing PCK and Rovegno (1995) assessed the types of tasks used.

Unlike previous studies, this investigation was based on collecting a set of observable dependent variables that can be objectively measured, and that serve as indicators for the existence of PCK. No prior study has examined the particular eclectic set of variables, as was suggested and pursued in the current investigation. As an exploratory study, the following challenges arose during the data collection, coding, and analysis: (a) task classification, (b) task delivery, (c) whole-class tasks’ appropriateness data, (d) individual adaptations’ appropriateness data, and (e) use of cues.

Task Classification

Determining and classifying the type of task delivered was difficult, as previously reported by Rovegno (1995). For example, an informing task is delivered when it introduces a new skill for the first time. Yet, how should the same task be classified when presented within the game play situation? Is it to be classified as an informing task, or as an application task? A second challenge occurred when teachers delivered long tasks that included several components, as well as elements of two types of tasks (e.g., informing and extending, or informing and refinement). The third struggle with task classification arose when the students practiced in stations and rotated from one station to another. In
these cases, it was unfeasible to situate the tasks in an appropriate sequence, as there was no such sequence. Different students got to experience the task in a different order based on their starting station.

The preceding discussion results in two assertions. First, Rink’s (2006) classification of tasks contributed greatly to the terminology used by instructors in PETE programs, yet tasks may not be prescribed as stated in physical education method text books. Therefore it is difficult to classify them into the task categories. Possibly a more specific explanation of what each of the type of tasks constitutes, along with some examples and non-examples, would improve scholars’ ability to use the task system more accurately for research purposes. In this study, the researchers encountered a challenge when tasks could have been considered as informing and application, or extension and application. To overcome this challenge, the researchers revisited all tasks in the sequence they were delivered in the lesson and in previous lessons. Finally they made a judgment call regarding the type of task, based on the overall context of the lesson and the particular way the teachers were delivering the instructional unit.

There are two additional methods for overcoming the task classification challenge. Those methods hold merit primarily for research purposes, and less for practical teaching purposes. First, researchers can add a context classification to Rink’s (2006) task classification. The context classification can be application (i.e., game play setting) or practice. Hence, each task will be denoted by a type as suggested by Rink (2006) and by the context in which it was delivered (i.e., game play or practice). Second, when tasks can be classified into more than one type of task, researchers can rank the task
classification into the primary type of the task and its secondary type based on the task focus, as presented by the teacher. For instance, a teacher introduces the tactic move to get open for the first time, during a 4V4 game play in soccer. Based on the first extension method for task classification as suggested above, this task should be classified as an informing task in an application context. Based on the second extension method, if the teacher emphasizes more the tactic of moving to get open, and momentarily disregards previous task components such as scoring the game, this task would be classified primarily as informing, and secondary as application task.

The second assertion that emerged from this study is that Rink’s (2006) notion of task sequencing, derived from the types of tasks, is impractical when the teacher facilitates the practice in circular stations. With circular stations, teachers typically provide instruction prior to the beginning of the practice. Each station represents a task. The stations can be, but are not always, sequenced in a progressed manner. Nevertheless, if at the beginning of the practice time, all stations are occupied by students who then rotate from one station to another, then different students experience a different sequence of tasks, based on their first practice station. For example, one student may progress from station 1 to 6, which represents adequate progression of tasks. Another student, however, may begin in station 6 and then experience a considerable drop in level of difficulty as she moves to station 1. This example illustrates that judgment regarding the sequencing of tasks is impractical when stations are implemented, as not all students go through the same sequence of tasks. This distinction is of added importance if practice in stations is the prevalent form in elementary school physical education.
Task Delivery

The ways in which tasks were delivered, posed challenges in coding and in analyzing the data. As previously mentioned, tasks were often ambiguous, had wide boundaries, and were free from risk due to the absence of accountability. These findings were consistent with other studies in the literature (Siedentop et al., 1994; Tinning & Siedentop, 1985; Tousignant & Siedentop, 1983). The difficulty arose because the task was the unit of analysis in this study. Students’ performance was evaluated based on the prescribed task. Appropriateness of the task was determined based on students’ performance. Yet the wide task boundaries, which allowed a wide array of responses to be correct, and the absence of accountability made it difficult to evaluate students’ performance, and to determine the task’s appropriateness. Nevertheless, teachers in their interviews validated that observation practice as an acceptable for determining correct or incorrect performance, and based on that, appropriate or inappropriate task.

A task is important as it represents the content that the teacher considers to be important for students to learn. Therefore, addressing the challenges of task delivery warrants serious consideration. First, the findings of the current investigation regarding the delivery of implicit tasks and lack of accountability in physical education represent a continuation of a teaching profile that had already been noticed in the mid 80’s and 90’s (e.g., Siedentop et al., 1994; Tinning & Siedentop, 1985; Tousignant & Siedentop, 1983). If one accepts the argument that tasks are the vehicle to represent the content to the learner, then based on the findings, the teachers in this study inadequately represented physical education content to their learners. Representation of tasks can possibly change
via teacher training programs, which ought to devote more attention to matters such as how to represent content to students, and how to deliver tasks. Furthermore, delivering tasks properly, in a manner that would enhance students’ learning, warrants experimentation.

*Whole Class Tasks Appropriateness Data*

Appropriate PCK, based on Shulman’s (1986) definition, should result in students’ understanding. Students’ understanding in physical education pertains to their correct and successful physical performance, as well as their cognitive understanding. Thus, determining whether a particular teaching practice, as indication for PCK, was appropriate or not, requires observation and discrimination of the students’ response to the teachers’ instruction. This study measured the students’ responses to the teacher’s instructions to discriminate students’ performance and appropriateness of instructions. The appropriateness variable was never used before in the PCK literature, and was investigated in this study for the first time.

Collecting data on the appropriateness of tasks that were delivered to the whole class was challenging when the students progressed independently from one task to another, as demonstrated in Taylor's stronger unit of instruction. Taylor utilized an assignment sheet in this unit. Students were required to independently progress through the tasks on the sheet. The data on appropriateness were collected immediately following the teacher’s cue to begin practicing and therefore reflected the students' success level on the first and perhaps the second tasks only (i.e., temporal proximity to the teacher’s cue to begin practicing). If a task sheet is a strategy the teacher typically uses during the unit,
time sampling within the independent practice time may be a better strategy for collecting data on appropriateness.

In addition, as soon as 30 seconds elapsed from the teacher’s cue to begin practice, the class was scanned from one side to the other in a moderate to rapid pace. While scanning all students, occasionally, the students who were observed at a particular moment were not activity-on-task. For example, some were waiting, retrieving the ball, or being off the ball during a game play. In all of those observed situations, the students were not necessarily incompliant with the teacher’s task, yet, they were not technically (or tactically) on-task. The success level data reflect those situations as well. As noted before, this variable was agreed by the panel of teachers to be acceptable for evaluating the task and should be further pursued, using a different method for collecting the data.

Data would be more accurate if reporting only on behaviors that meet or do not meet the teacher’s instructions. Thus, the observation method on this type of variable can be refined by videotaping these data instead of collecting them live. It is recommended to videotape the whole class performing, while ensuring all students are captured on the tape. All students can then be observed in a particular time frame. The tape would need to be rewound constantly, to stay within the designated time frame of observation. During the interval, all students in the class should be observed in a random order, until the behavior of each one of them is coded. This process should be repeated for each task. The designated and constant time frame for observation will enable the observers to code students’ behaviors when required, and not when they are engaged in other behaviors that do not provide an indication on the appropriateness of the task.
Individual Adaptations’ Appropriateness Data

This study investigated the teacher-student interactions, examining variables such as the antecedents, task adaptations, and the consequences. This is the first attempt of conducting a functional analysis of the teacher’s behaviors. More research involving functional analysis of teachers’ behaviors is required for validating (a) the findings of this study, and (b) the acceptability of functional analysis as a measurement tool.

Measuring the appropriateness of individual modification was challenging. At times, students did not initiate a response to the teacher’s adaptation within a 10-second interval. The 10-second interval was too short for the initiation of a response. When a response was initiated, students, in most cases, did not perform more than one trial within the 10-second interval, which was a limitation in this study. These particular data are initial, and represent the first attempt to collect data on the appropriateness of the teacher’s modification to a student. Albeit a limitation, those data were demonstrated to be valuable for understanding the teacher’s PCK.

The observation of this variable must be refined for future research. Possible options for refinement are: (a) extending the time interval for observation on an individual student; and (b) if the student is required to perform discrete trials, the observation can continue until the student completes five trials of the modified task. Alan Launder, a national pole vault coach, asserted that when he provides a correction to an individual (i.e., adaptation), he would allow some room for error in the initial trials (personal communication, February 15, 2007). Nevertheless, if after five trials the individual still cannot accomplish the task, the coach would immediately modify the task.
The investigator, who has been coaching tennis for different ages and levels for 13 years, agreed that five trials are acceptable, and after which, if a correct response was not demonstrated, she would modify the task again.

The Use of Cues

Two previous studies (i.e., Chen & Ennis, 1995; Kutame, 2002), in addition to the present investigation, included data on the cues teachers used during the instructional units. The use of different types of cues, and the number of times those cues were stated by the teacher, demonstrated coherent differences between the two units of instruction. The interpretation of those differences is significant. Two possibilities exist: (a) the more cues used, the better (e.g., Chen & Ennis, 1995), or (b) the less is more approach (e.g., Landin, 1994; Rovegno et al., 2003). Occasionally, a teacher may not need more than few (Fronske, 2001; Landin, 1994) yet really effective cues to convey the message in a comprehensible manner. This study concluded in support of "the more the better," yet none of the studies, including the current investigation, empirically investigated or demonstrated the value of one approach over another. Overall the data illustrate that cues, as an independent variable, were important for this investigation. Based on research findings and method text books, it is agreed that cues are important for learning (e.g., Chen & Ennis, 1995; Fronske, 2001; Kutame, 2002; Rink, 2006). Examining the effects of the cues’ delivery approach (i.e., more is better, or less is more) on students’ learning warrants investigation.
General Recommendations for the Investigation of PCK

The participants in this study were selected as effective teachers based on PETE program faculty recommendations and their service as cooperating teachers for teacher candidates. The teachers’ effectiveness was evident in their classroom management, and less so in the CK and PCK they displayed. To learn more about PCK, studies should employ teachers who can actually display mature forms of PCK. The selection of teachers as participants then becomes critical. The selection of participants can be based on recommendations of professional in the field but should also be based on pre-observations on the designated teachers to gain some initial knowledge regarding their display of PCK. Rovegno et al. (2003) for instance conducted rigorous selection of participants that included the participants’ involvement in public presentations of professional work, recommendations, observations, observation of their students’ learning as compared to other classes, and years of experience in teaching.

The teachers who were selected for this study reported confidence teaching CK as a result of the multiple times they already taught the particular content to students in the various grade levels. Shulman (1986) referred to repeated teaching as a component that contributes to the development of PCK, and Schincariol (2002) supported the same argument. Nevertheless, the investigation of how CK and PCK develop as a consequence of repeated teaching is non-existent and requires more attention in the PE literature.

The CK teachers emphasized in this study was mostly about the primary and secondary rules of how to play the game. Much less emphasis was on the quality of performance, while tactical emphasis was completely neglected. It is the investigator’s
anecdotal observation that students came to know the rules of the game, and were able to retain the knowledge when prompted by the teachers. This was a form of informal accountability for that particular knowledge (Tinning & Siedentop, 1985; Tousignant & Siedentop, 1983). If CK of physical education is of primary focus, it may be valuable to ask the students, at the conclusion of the unit, what they came to know about physical education and the content they were taught, and how they came to know about it. Students are clients of physical education. The students’ perceptions of the CK they were taught in physical education may give us information on how and what it is that we actually teach our clients.

Finally, future research should continue investigating the differences between stronger and weaker unit of effective teachers in different sports to (a) validate the findings of this initial research and to (b) gain more knowledge on the PCK of effective teachers. This investigation should be extended to inservice secondary school teachers, and to other subject matters in physical education. These extensions would result in a broad body of literature of PCK in physical education and may assist in creating profiles of a typical delivery of specific CK by effective teachers. Furthermore, a stronger and wider body of literature on PCK would assist in promoting the experimentation with PCK as recommended by Rovegno early in 1992.

Implications for Physical Education Teacher Education Programs

The recommendations made in this section are based on the focus group, the interviews data, and the dependent variables that were measured in this investigation. The recommendations are also influenced by the author’s previous engagement in the
exploration of PCK via several projects in a large PETE program prior to the execution of the current study. Therefore, these recommendations warrant assessment. However, they are consistent with the findings of this study and with the author’s current understanding and conceptualization of how PCK develops.

The PETE programs should:

1. *Initiate specific practices for improving the acquisition of PCK of their teacher candidates.* The PETE programs cannot continue to train for CK and hope that PCK would develop, as previously argued by Kutame (2002) and Schincariol (2002). Specific practices pertain to explicit contact with students of age group and with content that teacher candidates are more likely to encounter as they exit the PETE program.

2. *Make efforts to establish relations with cooperating teachers who share the same values the PETE program conveys to its candidates and who display behaviors and practices that are being taught in the PETE program.* Placing teacher candidates with such cooperating teachers for field experiences would foster a continuation of their learning experiences, and may have positive impact on their teaching. This recommendation reiterates Siedentop and Locke’s (1997) argument that in order to prepare good physical education teachers that could craft and sustain good physical education in schools, PETE programs need to expose the teacher candidates to good physical education programs.

3. *Provide future teachers with more depth of CK, and wealth of progressions for delivering the CK to the students.* Such depth of CK and PCK truly well would better prepare the teacher candidates to present the content gradually, to sustain longer in
quality instructional units, and to refrain from defaulting to game play situations early in
the unit. In other words, thorough knowledge of the content and progressions of a few
subjects' matters would assist future teachers to teach those subjects well. Consequently,
deepth of CK and PCK would better prepare future teachers for creating and sustaining
good physical education programs, as recommended by Siedentop and Locke (1997).

4. **Teach candidates to be independent and to be able to self-instruct.** As
physical education content cannot all be directly taught in PETE programs, efforts should
be made towards developing teacher candidates’ ability to independently create unit
plans, lesson plans, and task progressions. The PETE programs can pursue this goal by
addressing the generalizability between sports that are directly taught in the program, and
those that are not, but which still share common characteristics (e.g., soccer and field
hockey).

5. **Teach skills such as observing, analyzing, and discriminating students’
performance to a proficiency level (as verified by formal assessment).** Hence classes such
as skill analysis are highly valuable for developing those teaching skills, as already
advocated by Kutame (2002).

6. **Teach candidates to provide tasks properly, with clear boundaries, and with a
dimension of accountability to it.** Part of learning how to provide a task should also
include the learning of how to modify a task, and how to provide students' with the
opportunities to execute the modified task.
7. *Should consider requiring teacher candidates to have some initial experience in instructing children.* Such experience should be acquired in sport or physical activity settings prior to the admission into the teacher training program.

Conclusions

This study contributed to the literature in three ways: conceptually, methodologically, and practically. The first conceptual contribution was the modified definition for PCK. This investigation was guided by a modified operational definition for PCK that extended definitions of other researchers in the area of PCK in general education (Shulman, 1986; Grossman, 1990). The modified definition is operational as it allows researchers to clearly determine which behaviors ought to be included or excluded from the PCK definition. The understanding of what PCK is and what it constitutes is exceptionally important for both research and practice.

A second conceptual contribution was the underlying theme in this study, of the conceptualization that PCK develops on a continuum from immature to mature. The selected indicators for PCK were measured in assorted ways in two content areas that the teachers identified as stronger and weaker. Overall, differences were apparent in the level and frequency that the PCK variables were displayed by the teachers in the different units. The display of those variables initially indicated the existence of PCK in the repertoire of teachers, regardless of how highly developed. Some PCK indicators were more mature in one unit than another, yet all PCK indicators could be situated on the continuum. The data also supported the argument that PCK is content specific. For example, a teacher’s PCK can be mature in one content (i.e., volleyball) and less so in the
other (i.e., golf). The developmental continuum facilitates a cohesive understanding of
the specificity of PCK and allows its investigation as such. This dissertation provides the
first the first formal conceptualization of PCK as a variable on a continuum.

Methodologically, this investigation was derived by the behavioral theoretical
framework (Cooper et al., 2007). The primary methods for observing and collecting data
were behavioral in nature, involving observable operational variables and definitions.
This methodology is a significant extension of the methods used in the majority of
previous studies in the field. Previous studies have primarily relied on methods such as
field observations, field notes and interviews, for collecting data on PCK.

In addition, this study provided a collection of operational variables that are
indicators of PCK. These variables were investigated together to gain more knowledge of
the teacher’s PCK. This methodology for investigating PCK is clearly in its earliest stage.
It needs to evolve and this study has set the ground for further operational and functional
exploration of PCK.

Finally, this study contributed to the literature by adding practical suggestions
regarding acquisition and training of PCK within PETE programs. Previous studies of
PCK resulted in high inference conclusions and in general recommendations of what
PETE programs ought to do about PCK. Those recommendations were not necessarily
based on specific findings about the components of PCK and the specific relations
between those components. This study, in contrast, concluded with specific
recommendations of what PETE programs should do to facilitate the acquisition of PCK
of their teacher candidates.
LIST OF REFERENCES


Schincariol, L. M. (2002). The types, sources, and perceived relevance of knowledge acquisition, and the enacted effects when teaching unfamiliar and familiar


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APPENDIX A

INTERVIEW QUESTION FOR PHASE 1 AND 2
Phase 1 and 2 Interview Questions

Research Sub-Questions

1. How do teachers describe how they acquired their CK and PCK relative to their stronger and weaker units? (Interview questions 1-4)

2. What teaching practices do teachers identify as their PCK? (Interview questions 4-7)

3. How do teachers ensure the content delivered is appropriate to the students’ developmental level? (Interview questions 8-10)

Interview Questions

The lettered interview questions are the prompting questions to follow a teacher’s answer, if they had not already addressed the topic.

1. Could you please describe your sporting or physical activity history? For example, what sports did you play? Did you compete?

2. What would you say are your stronger unit/s of instruction in terms of your ability to teach children how to perform?
   a. Why is it your stronger unit of instruction?
   b. To what extent did you experience the content of the unit as an athlete/participant?
   c. How did you learn to teach your stronger unit of instruction?

3. What would you say are your weakest unit/s of instruction in terms of your ability to teach children how to perform?
   a. Why is it your weaker unit of instruction?
b. To what extent did you experience the content of the unit as an athlete/participant?

c. How did you learn to teach your weaker unit of instruction?

4. If I were to watch you teach your stronger unit of instruction and your weaker unit of instruction what differences might I see?

5. What are some of the teaching practices you use to deliver the content to your students?
   a. What are the reasons for using these specific teaching practices?
   b. Can an outside observer see those practices in action? If so, how would I be able to identify those practices if I was observing your class?
   c. Do those practices differ between your weaker and stronger instructional units?
   d. Where did you learn those practices, or how did you come about knowing and using them?

6. How do you get ready to teach your instructional units each year?
   a. Are there any differences between getting ready for your stronger and for your weaker instructional units? If so, what are those differences?
   b. What role does planning play in your teaching of your stronger and weaker units?

7. Has the development and delivery of the content to the students changed over the years? If so, could you please describe why and how?

8. Does knowledge about student’s understanding and ability to perform influence your teaching of the subject matter? If so, how?

9. How do you make the content you teach appropriate to the students’ level and needs?
a. Does it differ between your stronger and weaker units of instruction? If so, how?

10. Are there specific ways you ascertain student understanding or confusion around the subject matter you teach? If so, what are those ways?
APPENDIX B

TEACHER CONSENT FORM
TEACHER CONSENT FOR PARTICIPATION IN SOCIAL AND BEHAVIORAL RESEARCH

Protocol title: Exploring Pedagogical Content Knowledge of Experienced Teachers in Physical Education

Protocol #: 2006E0550

Principal Investigator: Phillip Ward

Dear Teacher,

Shiri Ayvazo and I are interested in exploring how experienced teachers teach physical education in elementary school. Our focus is primarily on the teacher’s behaviors during the lesson, and thus involves videotaping of the teacher’s behaviors. In this process, it is also possible that your students will be videotaped. As we try to learn more about how experienced teachers teach elementary physical education, we will be observing the teacher for the duration of 2-3 instructional units taught. All of the data collected will remain confidential.

If this is acceptable to you, we would like to invite you to participate in this study, by signing the following consent form.

I consent my participation in research being conducted by Phillip Ward of The Ohio State University and his assistants.

The investigator has explained in this letter the purpose of the study, the procedures that will be followed, and the amount of time it will take. I understand the possible benefits, if any, of my participation. I know I can choose not to participate without penalty. If I agree to participate, I can withdraw from the study at any time, and there will be no penalty.

I consent the use of videotapes, I understand how the videotapes will be used for this study.

I have had a chance to ask questions and to obtain answers to my questions. I can contact the investigator at (614) 846-1570. If I have questions about my rights as a research participant, I can call the Office of Research Risks Protection at (614) 688-4792.

I have read this form or I have had it read to me. I sign in freely and voluntarily. A copy has been given to me.

Please print the name of the participant: ________________________________

Date: _________________________________ Signed: ________________________________

(Participant)

Signed: ________________________________

(Principal Investigator or his/her authorized representative)

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APPENDIX C

PARENTAL CONSENT FORM
PARENTAL INFORMED CONSENT FOR PARTICIPATION IN SOCIAL AND BEHAVIORAL RESEARCH

Protocol title: Exploring Pedagogical Content Knowledge of Experienced Teachers in Physical Education

Protocol #: 2006E0550

Principal Investigator: Phillip Ward

Dear Parent,

I and my assistants are interested in exploring how experienced teachers teach physical education in elementary school. Your physical education teacher is considered to be an expert. We are interested in how the teacher determines what to teach in physical education and therefore we will be observing and videotaping the teacher’s teaching practices for the duration of 2-3 instructional units. In the process of videotaping, it is also possible that your child will be videotaped as they go about their regular activity in the physical education class. All videotapes will remain confidential.

Due to the potential that your child will be videotaped, we ask your permission for the participation of your child in this study, if this is acceptable to you, by signing the following consent form.

I consent to my child’s participation in research being conducted by Phillip Ward of The Ohio State University and his assistants.

The investigator has explained in this letter the purpose of the study, the procedures that will be followed, and the amount of time it will take. I understand the possible benefits, if any, of my child’s participation. I know that I or my child can choose not to participate without penalty. If I agree to my child’s participation, I understand that participation is voluntary and that I or my child can stop participating in the study at any time, and there will be no penalty.

I consent the use of videotapes, I understand how the videotapes will be used for this study.

I have had a chance to ask questions and to obtain answers to my questions. I can contact the investigator at (614) 846-1570. If I have questions about my rights as a research participant, I can call the Office of Research Risks Protection at (614) 688-4792.

I have read this form or I have had it read to me. I sign in freely and voluntarily. A copy has been given to me.

Please print the name of the participant: ________________________________

Date: _____________________________________ Signed: _____________________________________ (Participant)

Signed: ___________________________________ (Principal Investigator or his/her authorized representative)

Signed: ___________________________________ (Person authorized to consent for participant, if required)
CHILD ASSENT FOR PARTICIPATION IN SOCIAL AND BEHAVIORAL RESEARCH

Protocol title: Exploring Pedagogical Content Knowledge of Experienced Teachers in Physical Education

Protocol #: 2006E0550

Principal Investigator: Phillip Ward

Dear Student,

A professor from The Ohio State University is interested in how I teach you physical education and therefore will be videotaping me teaching two sports/activities. In the process of videotaping me, there is a possibility that you will be videotaped as well, as you go about your regular activity during our lesson. Because of that, we need your permission to participate in this project, and we will also ask your parent’s permission.

If there is a student who is not interested in participating in this study, please come to talk with me at the end of this class, and I will assure you will not be videotaped. If you have any questions about this project, please come to talk to me as well.

I agree to participate in the research being conducted by Phillip Ward of The Ohio State University and his assistants.

The investigator has explained in this letter the purpose of the study, the procedures that will be followed, and the amount of time it will take. I understand the possible benefits, if any, of my participation. I know that I can choose not to participate without penalty. If I agree to participate, I understand that my participation is voluntary and that I can stop participating in the study at any time, and there will be no penalty. I understand it is OK to say no and not participate in the study, or to say yes and then change my mind without getting into trouble.

I assent the use of videotapes, I understand how the videotapes will be used for this study.

I have had a chance to ask questions and to obtain answers to my questions. I can contact my teacher, or the investigator at school or at (614) 846-1570. If I have questions about my rights as a research participant, I can talk with my teacher, the investigator, or the Office of Research Risks Protection at (614) 688-4792.

I have read this form or I have had it read to me. I agree freely and voluntarily.
APPENDIX E

ACADEMIC LEARNING TIME PHYSICAL EDUCATION-WRITTEN TEST (taken from Siedentop et al., 1982 and Parker, 1989)
Academic Learning Time Physical Education - Written Test

Transition. Time the student spend in managerial and organizational activities that are related to instruction (Parker, 1989).

Management. Time spend in business activities that are not related to instruction (Parker, 1989).

Knowledge. Time the student spend in receiving knowledge about physical education content (e.g., rules, how to execute technique or tactic, guideline for appropriate and inappropriate behaviors, and the subject’s history; Parker, 1989).

Activity. Time that is devoted to motor engagement in physical education activities (e.g., skill practice, scrimmages, games, fitness, warm up; Parker, 1989).

Waiting. Time when the student has already completed a task, and has a period of no activity and no movement between activities.

Off task. Time the students are engaged in the activity that was not prescribed by the teacher.

Please mark one of the following letters next to each statement (Siedentop et al., 1982): “T” for transition, “M” for management, ”K” for knowledge, “A” for activity, “W” for waiting, and “O” for off task.

1. Students are moving from one gymnastics station to another. The target student is among those moving ____ (T)

2. The teacher is demonstrating the drive in a field hockey lesson. The target student is watching the demonstration _____ (K)
3. The class is doing tumbling skills. The target student is spotting for a classmate (A)

4. The class is playing a soccer game. The target student is standing on the sideline, waiting to get into the game (W)

5. The class is numbering off for teams. The target student had just called his number and is watching his classmates calling theirs (M)

6. The teacher asked the students to balance their body on three body parts. The target student is balancing on one leg and one arm only (A)

7. The class is instructed to run around the court 3 times. The target student continues to dribble the basketball during that time (O)

8. The entire class is doing the Hora dance. The target student is performing the dance correctly (A)

9. The class is observe the learning cues the teacher had placed on the wall, and listen to the teacher’s comments (K)

10. In a strength development lesson, the target student is standing next to one station while his friend does leg curls at that station (W)

11. The class is in a jump rope unit, practicing the Double Dutch at the moment. The target student is turning ropes (A)

12. The class is doing pushups. Yet, instead of doing pushups, the target student merely “goes through the motion” (O)

13. The target student is waiting for the ball to be tossed to him (W)
14. The teacher is reading the names of the students. The target student is sitting and listening to the teacher ____ (M)

15. The class is instructed to take a 2 minutes break. The target student is walking to the water fountain ____ (M)

16. The teacher lectures about the history of basketball. The target student talks to his friend and points to the door of the gym ___ (O)

17. The class is doing lay ups. The target student goes to retrieve the ball ____ (T)

18. The teacher is explaining net violations in volleyball. The target student seem to be listening ____ (K)

19. The teacher explains about the fitness test the students are about to take. The target student listens to the teacher ____ (K)

20. The teacher explains how the fitness test will be facilitated, and assigns the target student, as well as other students, with roles _____ (M)
APPENDIX F

TYPES OF CONTENT TASKS - WRITTEN TEST
Type of Content Tasks - Written Test

*Informing.* “The initial task in the progression of a skill” (Rink, 2006, p. 115). For example, mimic the motion of throwing, without a ball (Rink, 2006).

*Extension.* A task that increases the level of difficulty of a previous task. For example, progressing from motion of throwing without a ball to the same motion with a ball (Rink, 2006).

*Refinement.* A task that expresses additional focus on the quality of performance. For example, focusing on moving the elbow back prior to moving the arm forward (Rink, 2006).

*Application.* A task that centers on assessment of form or on how to use the movement, rather than just how to do the movement (Rink, 2006). For example, using the skill of throwing within a team handball game.

Tasks are coded only when the teacher pause the activity and provides instructions (either new instructions or refinement of the previous ones). The following situations are not coded as tasks: (a) when the teacher makes a statement that resembles a task (e.g., “Toni move to the spot to get open), but is provided *during* an activity, or (b) when the teacher pause the activity, reinforces the group, check for matching (e.g., who guards who) but never actually provides refinements or a new task. Short and concise comments such as “lets try to catch the disc” during activity time will not be considered as tasks.

Please mark one of the following letters next to each statement: “I” for informing task, “E” for extension, “R” for refinement, and “A” for application.
21. “Now, let’s try to land with both feet as soft as possible” _____ (R)
22. “Today we will introduce kicking. Please contact the ball with your foot” _____ (I)
23. “Make sure you transfer weight forward after you make contact”_____ (R)
24. This task is, for example, when students practice first without a ball, and then with a ball _____ (E)
25. “First, let’s practice the dance steps each child individually” ____ (I)
26. The teacher moves the students from a close distance to a far distance ____ (E)
27. The teacher says: “Try to do it again, this time higher” _____ (R)
28. “First task for today’s session is passing the ball beyond the net. We did not experience that before. Do you think you could get 10 successful?” _____ (I)
29. The children now practice hitting the ball after they practice the motion without a ball _____ (E)
30. “Try to move more quickly toward the ball” ______ (R)
31. The teacher said “let’s see if you can do it 5 times in 2 minutes” _____ (A)
32. “We first play volleyball without a net, and then with a net, and then we score the game” _____ (I, E, A)
33. “Good. Now lift your elbow higher than your shoulder” ____ (R)
34. “Make sure you step with the left foot” ______ (R)
35. “You have 30 seconds to shoot to the basket. How many baskets can you score?” _____ (A)
36. “Move further away from each other, and still try to maintain consecutive work” ____ (E)
37. “This is how you position your hands for the cartwheel. Let’s see if you can do that”  

38. “Ok now let’s put this skill into the game, we’ll play 3v3”  

39. “Check your performance: You get 3 points for doing it correctly, and 2 points for partially correct”  

40. First task was hitting the ball that is tossed right at the player. The second one is similar with one difference: The ball is now tossed to the side and the player has to move to it.
APPENDIX G

INSTRUCTIONAL FORMS - WRITTEN TEST
Instructional Forms - Written Test

*Verbal instructions.* Occurs when the teacher uses a word or several words to tell, explain, or prompt to occasion students’ response (Cooper et al., 2007). Typically, verbal instructions are sufficient when the students already have experience with the skill and its terminology. If not, teachers need to aid instructions with demonstrations (Rink, 2006).

*Demonstrations.* A visual communication, when the teacher nonverbally models how to perform or how not to perform the task (Cooper et al., 2007; Rink, 2006).

*Metaphors.* Occur when the teacher transfers name or attributes of one subject to the other (Newman, 2001; White, 1996). For example, when a teacher says “use a rainbow toss”, she attributes the arched characteristic of the rainbow to the toss she would like her students to use.

Please mark one of the following letters next to each statement: “V” for verbal instruction, “D” for demonstration, and “M” for metaphors. In real situations, the teacher integrates several instructional forms together. For example, verbal instruction and metaphor, or verbal instruction and demonstration.

1. “This is how you would do the forward roll (performs the task). Please try it…” ____ (D)
2. “Dribble the ball from one line to the other 10 times” ____ (V)
3. “Eyes on me, I would like to show you how to do skipping” (and then she shows what do to) ____ (D)
4. “Let’s roll forward like a ball, from the beginning of the mattress, until its end” ____ (M)
5. “Jump like a frog 10 times” _____ (M)
6. “Pancake catch” _____ (M)
7. “Please run 4 laps around the gym” _____ (V)
8. The teacher says: “Try to do it again, this time higher” _____ (V)
9. The teacher shows the student how to swing the arm, although he does not contact the ball _____ (D)
10. A teacher says: "Do like me" and performs a set ____ (D)
11. The teacher shows how to extend the arms _____ (V)
12. “From one line to the other, please run fast like superman” _____ (M)
13. The teacher located her feet on the ground as a correct example for the performance _____ (D)
14. The teacher says: “Please perform this task 15 times in a roll” ____ (V)
15. “Move in the gym like a snake until the music stops” ____ (M)
16. “Twist your trunk before you throw the ball” ____ (V)
17. “Twist like a sponge before you throw the ball” __ (M)
18. "Square your shoulders” said the teacher, and modeled the movement” ____ (V+D)
19. “Lets do 10 Bunny hops, and then one lap around the court” ____ (M+V)
20. The teacher said "look at me" and served the ball to the other side____ (D)
APPENDIX H

TYPES OF CUES - WRITTEN TEST
Types of Cues - Written Test

**Technical cue.** Key word or a phrase that emphasizes a technical characteristic of the skill to be performed. For example, “elbow up” in a basketball shot, or “hand-hand-foot-foot” for a cartwheel performance (Kutame, 1997).

**Metaphorical cue.** Key word or a phrase that communicates the critical elements to the students using characteristics of another subject (Kutame, 1997). The cue does not include all elements of a task (e.g., situation of players, criteria to achieve).

**Visual cue.** Objects or other aids the teacher uses to occasion a correct response. For example, hand foot cues or taped line on the ground to occasion correct hand foot placement during a cartwheel performance (Kutame, 1997).

Cues are different than feedback as they do not describe an evaluation of performance. For example, nice catch, way to throw, or try to kick the ball, would be feedback and prompts for the students. Cues are short and concise comments (Fronske, 2001) such as nice and flat, move to it, arms straight, would be considered as learning cues. Hustle and motivation comments such as “hustle” and “come on” are not considered as learning cues. Comments that include two clauses such as “try to catch the Frisbee (i.e., part 1) because if not this would be a turn over (i.e., part 2)” are not a learning cue and therefore should not be coded.

Please mark one of the following letters next to each statement: “T” for technical cue, “M” for metaphorical cue, and “V” for visual cue. Put an X if the statement provided is not a cue. X statements will not be coded during this study.

1. “Kick with your shoe laces” ____ (M)
2. (Run on the) “red line” _____ (V)

3. “Show me Mickey Mouse hands” _____ (M)

4. “Like a snake” _____ (M)

5. “Way to throw that ball” ______ (X)

6. “Elbow up” _____ (T)

7. When teaching the cartwheel, the teacher always repeats the phrase “hand-hand-foot-foot” _____ (T)

8. In the tennis practice, the coach always reminds the students how the backswing loop looks by doing the motion with his arm _____ (V)

9. “Hustle” _____ (X)

10. “Like a frog” _____ (M)

11. “Get set” _____ (T)

12. “Point and shift” _____ (T)

13. “Swing up and forward” _____ (T)

14. “Move that way or that way” _____ (T)

15. The teacher wrote some cues and publicly posted them on the wall _____ (V)

16. “nice catch” _____ (X)

17. “Pancake catch” _____ (M)

18. “Reach to the cookie jar” _____ (M)

19. “Do not run close to the disc as you might get hit” _____ (X)

20. The teacher says “here” and shows where the racket should be located _____ (T+V)
APPENDIX I

TYPES OF TASK ADAPTATIONS - WRITTEN TEST
Types of Task Adaptations - Written Test

*Modifying task complexity.* Modifications only to the following factors of the task (Siedentop & Tannehill, 2000): (a) Modifications to the space (e.g., changing the dimensions of the playing area); (b) Equipment (e.g., using beach balls in volleyball); (c) Participants, and number of participants (e.g., 1v1 versus 5v5); (d) Rules (e.g., catching the ball before passing it).

*Different task.* The teacher assigns the student a completely different task that is not performed by the entire class. For example, changing the striking task (practiced by the entire class) to a kicking task (performed only by a single student; Rink, 2006).

*Extending/Breaking the skill down.* (a) Asking the student to perform only some elements of the task; or (b) adding elements to the skill that is being practiced (e.g., one practice running and dribbling, while the entire class practices dribbling and walking).

*Competition conditions.* Moving the students from competitive to non-competitive situations and vice versa (Rink, 2006; e.g., set shots followed by set shots against the clock).

Please mark one of the following letters next to each statement: “MC” for modifying complexity, “DT” for assigning a different task, and “E/B” for extending or breaking the skill down, and “CC” for changing competition conditions.

1. The teacher allowed the student to play a bigger distance from the net in comparison to the other students _____ (MC)

2. When practicing control drills, the teacher gave Tami a ball that was bigger than the others _____ (MC)
3. “I want you to stay under the water, and kick with your feet. Sam, I just want you to stay under the water and do bubbles” (E/B)

4. While the class was practicing overhand throwing, Paul was asked to practice dribbling (DT)

5. “Joni, they stay under the water for 20 seconds, but I want you to try and stay for 30 seconds” (E/B)

6. The teacher comes to Tom and whispers in his ear “Although they just practice the skill, I want you to count how many baskets you make before I end this task” (CC)

7. While the class practiced with a volleyball, Sheila practiced with a beach ball according to the teacher’s instructions (MC)

8. “I want you to sprint from one line to the other. Mark, for you I am going to measure how fast you can do it” (CC)

9. Although the entire class practices the forward roll, one student was practicing the backward roll (DT).

10. The teacher instructs: “I want you to get to 10 consecutive shots”. Then she walks to Beth and says: “I want you to get to just get 20 shots” (E/B).

11. The class practices in teams of 4. The teacher wants David to practice in twos (MC).

12. Meredith was practicing the lay up from the left hand side, while all other students practiced it from the right hand side (E/B)
13. “Everyone lets see if you can get from line A to B in 10 jumps. Gerry, I just want you to jump from one line to the other, without counting the number of jumps” (CC)

14. “The class will practice kicking, but since you are injured, I would like to you do practice overhand throwing” (DT)

15. The entire class was practicing the long jump, but Ann needed further practice on the high jump (DT)

16. When practicing the high jump, the teacher lowered the poll for Dominic, and elevated it for the rest of the class (MC)

17. The class is practicing throwing the ball at the target and needs to get to 10 hits. The teacher pauses Frankie and asks him to throw the ball to her back and forth (E/B)

18. All teams participate in a team handball scrimmage. Suddenly, the teacher pulls Bob to the side, and practices with him on his overhand throwing (CC- cc precedes change of task)

19. After observing his performance, the teacher gave Andrew a smaller target to practice to, as compared with the class (MC)

20. After observing Danny’s performance, the teacher asked him to get 3 steps closer to target and continue practice throwing (MC)