The Effects of a Content Knowledge Workshop on Teachers' Pedagogical Content Knowledge and Student Learning in a Soccer Unit in Middle School Physical Education

Dissertation

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By:
Yun Soo Lee, M.A.
College of Education and Human Ecology

The Ohio State University
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Dissertation Committee:
Professor: Phillip Ward, Advisor
Professor: Sue Sutherland
Professor: Weidong Li
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ABSTRACT

There is an assumption that pedagogical content knowledge (PCK) is observable and measurable. Yet, in many studies referencing PCK, the construct of PCK remains both undefined operationally and poorly described. In physical education, although one study has measured teachers’ PCK using teachers’ weak and strong units of instruction (Ayvazo, 2007), there are no studies that directly examine the relationship among content knowledge (CK), PCK, and student learning. The purpose of this study was: (a) to examine the effects of a CK workshop on the improvement of teachers’ PCK, and (b) to examine the effects of changes in teachers’ PCK on student learning in a middle school soccer unit. A descriptive design was used to investigate teachers’ teaching behaviors using a behavior analytic theoretical framework. Two middle school physical education teachers’ soccer units were examined using direct observation in the comparison and the experimental groups. The following variables were measured: task maturity and appropriateness, verbal (e.g., instructions, descriptions, analogies and metaphors, cues, and specific congruent feedback) and visual (e.g., demonstrations, gestures, task cards, pictures, and diagrams, video clips, and physical assistance) representations, task adaptations for teachers, together with three student variables, correct, incorrect, and off-task performance. Results showed differences between the comparison group and the experimental group in all variables. These differences demonstrated that teachers showed
more mature PCK following the CK workshop than before the workshop. Conceptually, the findings in this study provide a validation for the variables of task maturity and appropriateness. The findings also (a) validate the assumption that PCK is exists on a continuum from immature to mature and (b) provide descriptive evidence that improving CK can improve PCK. Methodologically, a momentary-time sampling strategy was used to assess student performance and this strategy has not been used in physical education. This strategy was accurate in recording student performance. The use of new variables such as task maturity and appropriateness provides a new set of variables to examine PCK.
Dedicated to my beloved wife and son:

Ji Hye Kim and Jooho Lee
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December 19, 1976 .......................... Born – Seoul, Korea
1999 ................................. Bachelor of Sport Science
Seoul National University
Seoul, Korea
1999-2001 ............................. Teaching Assistant
Seoul National University
Seoul, Korea
2001 ................................. Master of Arts in Education
Seoul National University
Seoul, Korea
2006-2008 ............................. Graduate Administrate Associate
The Ohio State University
Columbus, Ohio
2008-2010 ............................. Graduate Teaching Associate
The Ohio State University
Columbus, Ohio

FIELDS OF STUDY

Major Field: Education

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CHAPTER 1

INTRODUCTION

In 1986, Shulman, in a paper describing knowledge for teaching, argued that research on subject matter was virtually nonexistent, calling it the “missing paradigm” (Shulman, 1986, p. 7). Shulman’s (1986) initial discourse about the teacher knowledge base set a new milestone in the educational community. He categorized teacher knowledge into three domains: (a) subject matter content knowledge (CK), (b) pedagogical content knowledge (PCK), and (c) curricular knowledge. In his view, CK is the foundation of knowledge for teaching (Shulman, 1986).

In 1987, Shulman expanded his view of the knowledge base for teaching, including four additional categories: general pedagogical knowledge, knowledge of learners and characteristics, knowledge of educational contexts, and knowledge of educational ends. He defined CK as knowledge and skills that are to be taught in schools (Shulman, 1987). Drawing on Shulman’s (1986, 1987) initial work, Grossman (1990) categorized professional knowledge for teaching into four components: (a) general pedagogical knowledge, (b) subject matter knowledge (i.e., CK), (c) PCK, and (d) knowledge of context. Grossman’s (1990) view differed from Shulman’s view suggesting that professional knowledge was interactive with other knowledge and not isolated.
In physical education, Siedentop (2002) defined CK as a range of movement skills. He also argued that the competence of the specific activity is needed for physical education teachers to be able to teach that activity. He compared CK courses in physical education with dance education. In dance education at Ohio State, they teach many courses devoted to performing dance, focusing on technique and performance. In contrast, he noted that Physical Education Teacher Education (PETE) programs have few content courses devoted to performance (Siedentop, 2002). Siedentop (2002) argued that PETE programs should provide more CK courses. He also argued that discipline courses are not CK courses even though some people consider the discipline courses as CK courses (Siedentop, 2002). His rationale for excluding discipline courses as CK is because this content is not taught in schools (Siedentop, 2002). Siedentop (2002) observed that “You can’t have pedagogical content knowledge without content knowledge, and all of our advances in pedagogy in physical education can’t change that simple truth” (p. 368). The problem as he defined it is that, “we have arrived at a point where we can now prepare teachers who are pedagogically more skillful than ever, but who, in many cases, are so unprepared in the content area that they would be described as “ignorant” if the content area were a purely cognitive knowledge field” (Siedentop, 2002, p. 369).

Siedentop’s argument for increased CK courses is grounded in the assumption that if one can perform the content one gains the knowledge to teach the content. However, Ward (2009a) has suggested that merely acquiring CK from participation is not sufficient CK for teaching. In mathematics education, Ball, Thames, and Phelps (2008) have made a distinction between common content knowledge (CCK) and specialized
content knowledge (SCK). According to Ball et al. (2008), CCK is defined as knowledge and skills needed to perform an activity, in math this would be being able to calculate a mathematical problem (e.g., \(3 + 4 = 7\)). In contrast, SCK is defined as content knowledge and skills needed to teach the content (e.g., how to teach the calculation of \(3 + 4 = 7\)). SCK includes CCK, but CCK is only a small part of the knowledge to teach the calculation (i.e., SCK).

In physical education, CCK includes the knowledge and skills needed to perform a particular activity whereas SCK is the knowledge and skills needed to teach a particular activity. The relationship between CCK and SCK becomes clearer if we begin with the assumption that one must know the content in order to teach it. Ward (2009a) has suggested that CK includes four domains: (a) rules and etiquette, (b) technique and tactics, (c) error detecting, and (d) representation of the content and instructional tasks. Rules, technique, and tactics can best be represented as CCK. Common errors and instructional tasks are best represented as SCK.

The problem is that teachers do not have enough CCK or SCK. The reason for this can be found in the ways in which teachers acquire their CK (Ward, 2009a). First, they experience physical education in their schooling (i.e., elementary, middle, and high school) but too often what they experience is neither positive nor developmentally appropriate and they are left with poor CCK and little SCK (Ward, 2009a). Second, teachers, as students and adults, can acquire CK from participating in extracurricular activities in and out of school (Ward, 2009a). Here they may gain CCK in one activity, but little SCK. Third, teachers can acquire CK from their teacher education program
The problem in teacher education programs is that there are too few CK courses (Lee & Kim, 2009) because the programs of study in most PETE programs are dominated by disciplinary courses (Siedentop, 2002; Ward, 2009a). Finally, teachers can improve their CK through participating in professional development programs (Ward, 2009a). However, there are few opportunities to participate in such programs and CK is often not the focus of professional development (Ward, 2009a).

The reality is preservice teachers in physical education leave their program with insufficient CK (Siedentop, 2002). If they leave without enough CK, they cannot teach long instructional units with any depth. The result is a deferment to short instructional units in a multi-activity curriculum, which results in low skill mastery level for students (Siedentop, 2002; Ward, 2009a). The multi-activity curriculum, which is characterized by few progressions and few real outcomes, is used because of the lack of CK (Siedentop, 2002).

CK is important, because it is the base for PCK. Shulman (1986) defined PCK as “the most powerful analogies, illustrations, examples, explanations and demonstrations – in a word, the ways of representing and formulating the subject that make it comprehensible to others” (p. 9). CK is the foundation of PCK (Grossman, Schoenfeld, & Lee, 2005) because CK is necessary for teachers to represent PCK. If teachers do not provide a rich, accurate and effective description then students are not likely to learn. For example, if teachers do not have an understanding of CK in volleyball, they will not be able to use any metaphors or demonstrations, nor will they be able to provide critical elements of, for example, forearm passing in volleyball. Thus, teachers’ CK can be seen
to exist on a continuum from no CK in a topic to a deep understanding. In this manner, mature PCK is defined as the degree to which a task is well represented to the students. However, if teachers’ representation is unsophisticated containing poor or incorrect descriptions, their PCK can be described as immature. Therefore, a deep understanding of CK is the indication of more mature PCK (Rovegno, 1992).

Statement of the Problem

Though it is conceptually understood that CK is related to PCK (Ayvazo, 2007; Siedentop, 2002), there is little research demonstrating this fact. Such a relationship can be best demonstrated by experimental manipulation of the degree of CK and determining its impact on a teacher’s PCK. The purpose of this study was: (a) to examine the effects of a CK workshop on the improvement of teachers’ PCK, and (b) to examine the effects of changes in teachers’ PCK on student learning in a middle school soccer unit.

Research Questions

The main research question in this study was: What are the effects of the implementation of a CK workshop on teachers’ PCK and student learning? The answer to this question was pursued by examination of the following research sub-questions:

1. What level of task maturity and appropriateness occurred in the comparison and the experimental group lessons?

2. What were the difference in the number and types of teachers’ verbal and visual representations between the comparison and the experimental groups?

3. What level of task adaptation occurred in the comparison and the experimental groups?
4. What was the percentage of correct, incorrect, and off task performance by students in the comparison and the experimental groups?

5. What was the percentage of correct performance by students in the comparison and the experimental groups when the data were coded using appropriate and inappropriate task criteria?

Anthropological Assumptions

Siedentop (1983) argued that research should include a brief statement about the view of humanity from which the study’s methodologies come.

*Such a section would not only alert the reader to the basic point of view of the researcher but, more importantly would require the researcher to consider seriously the implications of the questions asked and the assumptions underlying the implications of the questions asked and the methodologies used to answer those questions* (p. 11).

This study was framed within a behavior analytic theoretical framework. The variables of this study are the behaviors of teachers and the students. Both teacher and student behaviors may be explained in terms of the effects of independent variable (i.e., the CK workshop) on their behaviors.

This study holds several important anthropological assumptions.

1. Behavior is a phenomenon that occurs only at the individual level and it is continuous in nature (Cooper, Heron & Heward, 2007).

2. The task of behavior analysis is to explain variability in behavior through the use of functional relationships between environment and behavior. In this study the
teachers were influenced by the CK workshop and the students by changes in the teachers PCK.

3. The evidence of knowledge is shown when a person demonstrates it. Thus PCK is demonstrated when the teacher teaches and the behavior can be observed. Such as when he/she uses different forms of content representations to inform students.

4. Teaching can develop new student behavior and change existing student behaviors. For example, when a teacher provides appropriate tasks to students, the students are more likely to perform correctly.

5. Teaching effectiveness is determined by changes in student behavior.

Limitations

This study is limited by the following:

1. The teachers and schools were purposefully selected for this study. Therefore, the teachers or schools characteristics may have affected the results.

2. The investigator facilitated the CK workshop and thus experimenter effects may have occurred.

Delimitations

This study is delimited to:

1. Two physical education teachers and grade 6-8 students in public middle schools

2. A large Midwestern city within the United States.

3. A specific subject matter (e.g., soccer) taught by the teachers to middle school students.
Definition of Terms

In this section, the operational definitions of the terms are described.

*Analogies and metaphors.* Analogies are the teachers’ use of similar or different examples to explain the skills. Metaphors are teachers’ imaginative ways of describing something using different names with the same characteristics.

*Appropriateness.* The task that the teacher provided was developmentally appropriate, content specific, and context specific.

*Common content knowledge.* Knowledge and skills needed to perform an activity (Ball et al., 2009).

*Content knowledge.* “The amount and organization of knowledge per se in the mind of the teacher” (Shulman, 1986, p. 9)

*Correct trials.* Students met the criteria (i.e., critical elements) that teachers provided for them. If the students met all criteria, it would be coded as a correct trial.

*Cues.* Cues are not full sentences (i.e., clauses), but shortened groups of words (i.e., phrases) that relate to the information about the performance of the movement provided by the teacher (Rink & Werner, 1989; Rink, 2010). Cues can be technical, visual, or metaphoric (Kutame, 1997).

*Demonstrations.* Demonstrations are “modeling desired performance executed by teacher, student(s), and/or visual aids” (Rink, 2010, p. 372).

*Descriptions.* Descriptions are the teacher’s verbal explanation or illustration on what a particular skill (activity) is like.

*Gestures.* Gestures are positive nonverbal behaviors for students’ effort or
success. It includes “a body contact, hand gesture, or facial expression” (Quarterman, 1989, p. 330).

**Immaturity.** The task was presented in an unsophisticated manner with simplistic or poor descriptions or illustrations.

**Inappropriateness.** The task that teacher provided was NOT developmentally appropriate, and/or content specific, and/or context specific.

**Incorrect trials.** Students did NOT meet the criteria that teachers provided for them. If the students did not meet all criteria, it would be coded as an incorrect trial.

**Instructions.** “Teacher is verbally describing to the students how to do a skill, or is using a verbal prompt to direct students in attempting a skill or activity” (Hawkins & Wiegand, 1989, p. 279).

**Maturity.** Refers to the degree to which a task is well represented to the students. It may include cues, descriptions, analogies, metaphors, or demonstrations so that students clearly understand what to do. What distinguishes task representations is the quality and sophistication of the representation to the students.

**Pedagogical content knowledge.** PCK is “the most powerful analogies, illustrations, examples, explanations and demonstrations –in a word, the ways of representing and formulating the subject that make it comprehensible to others” in teachers’ content areas (Shulman, 1986, p. 9).

**Physical assistance.** Physical assistance is “physically moving the player’s (student’s) body to the proper position or through the correct range of motion of a skill” (Lacy & Darst, 1989, p. 371).
Specialized content knowledge. Knowledge and skills needed by teachers to teach the content (Ball et al., 2008).

Specific congruent feedback. Specific congruent feedback is “the degree to which teacher feedback during an activity is congruent with (matched to) the focus of the task” (Rink, 2010, p. 372).

Task cards, pictures, or diagrams. Task cards, pictures, or diagrams are visual equipment to help students understand what to perform and how to perform.

Verbal representation. Teachers’ use of words to explain the tasks.

Video clips. Video clips are used to motivate students or help them understand a particular content or skill (i.e., task).

Visual representation. Teachers’ use of visual aids to help students understand the tasks.
CHAPTER 2

REVIEW OF LITERATURE

The purpose of this chapter is to provide a conceptual analysis of content knowledge (CK) and pedagogical content knowledge (PCK). The chapter is organized into four sections. The first section describes the conceptualization of CK used in this study. The second section describes the conceptualization of PCK. The third section describes research problems related to this study. In the fourth section, the knowledge packet used in this study is described.

Content Knowledge

Shulman (1986) initially categorized teacher knowledge into three domains: (a) CK, (b) PCK, and (c) curricular knowledge. Shulman (1986) defined CK as “the amount and organization of knowledge per se in the mind of the teacher” (p. 9). In other words, CK refers to total knowledge of the teachers. In mathematics, algebra, geometry, and statistics are elements of the CK of that subject matter. In physical education, CK is comprised of movement skills (Siedentop, 2002) including all activity-based movements (e.g., dance, yoga, and martial arts) as well as sports (e.g., basketball, flag football, floor hockey, soccer, team handball, tennis, volleyball, swimming, etc.).

Shulman (1987) argued that the CK needed for teaching was the knowledge and
skills that are to be taught in schools. This draws a distinction between the mathematics learned in a calculus class in an Arts and Science curriculum vs. the math learned in a teacher education curriculum. In physical education, Siedentop (2002) supported Shulman’s position and argued that disciplinary courses (e.g., sport psychology, sport history, sport philosophy, sport sociology, exercise physiology, biomechanics) are not included in the content that is taught in schools and that movement itself was the relevant CK for physical education.

It is clear that CK is one of the foundational bases of knowledge base for teaching (Shulman, 1986). CK is not optional, but rather it is mandatory knowledge for teachers to effectively teach students. In physical education, there is a dominant misconception that if one is able to perform an activity, he or she can teach that activity (Ward, 2009a). Even though some level of performance is needed to teach, this type of knowledge (i.e., how to perform) is not sufficient to teach (Ward, 2009a).

In mathematics education, Ball, Thames, and Phelps (2008) conceptualized CK within two domains: Common Content Knowledge (CCK) and Specialized Content Knowledge (SCK). According to Ball et al., (2008) CCK is defined as the mathematical knowledge and skills needed to do the math; that is, possessing the ability to calculate mathematical problems. However, while CCK is necessary, it is not sufficient for teaching because teachers need more than the ability to perform the calculations. In mathematics education, Ball et al., (2008) defined SCK as the mathematical content knowledge and skills needed to teach the content, including how to teach calculation and algebra. SCK is required for teaching, but teachers also need to know how to demonstrate
the content for students. Ball et al. (2008) provided three examples of SCK: (a) mathematical language use, (b) the selection and use of mathematical representations, and (c) explanation and justification of mathematical ideas. For example, when teachers teach fractions, they need to know how to explain it (e.g., the distinction between fractions in mathematics and in everyday life), what kind of diagrams to use (e.g., rectangles or circles), and why they teach in that way. Most people may not have this knowledge because it is very unique for teaching.

A physical education teacher has CCK in a particular activity, when she knows how to perform that activity in terms of technique and tactics, and what the rules are in that activity. In contrast, if the teacher has SCK in a particular activity, she would know not only how to perform and what the rules are but also what to teach as the activity, what the common errors made by students are and what are appropriate solutions, and a repertoire of instructional tasks (i.e., progressions). The main theme here is that teachers should have knowledge of teaching as well as knowledge of performing.

Ward (2009a) categorized four domains of activity-based CK in physical education: (a) rules and etiquette, (b) technique and tactics, (c) skill discrimination, and (d) instructional tasks. The first domain, rules and etiquette, is fundamental to perform an activity. For example, in soccer, knowing the rule that only goalie can touch the ball with his or her hands must be conveyed to the participants so that they can play the game correctly. Before you start match in taekwondo, etiquette requires that the participants bow to each other. Second, you need to know the skills technique and tactics of game, sport or physical endeavor. To use tennis as an example, you need to know that you
contact the ball in front of your non-dominant knee in forehand groundstroke and then a follow through from low to high. Knowing how to move to open space in order to receive a pass is one example of tactics in soccer. Most adults and teachers may know the rules, etiquette, technique and tactics if they have had experiences in these activities. These two domains can be easily learned by the learning through performing but obtaining a level of skill in these domains is not enough knowledge to be qualified to teach the activity (Ward, 2009a).

The skill discrimination domain refers to recognizing students’ correct and incorrect performances. Teachers need to know possible performance errors, for example, when the students practice using a 4 vs. 1 passing game in soccer. Knowing why the ball is going high after tennis backhand groundstroke would be another example. The fourth domain, instructional tasks, includes different activities and progressions. For example, if the students’ movements and attempts are not successful when they practice in a 4 vs. 2 passing game, the teacher can make the decision to remove one defensive player from the game (i.e., make it 4 vs. 1 game) and this is an example of effective instructional tasks. Most adults may not hold the complete domains of skill discrimination and instructional tasks but the teachers should possess all four domains that Ward (2009a) has identified.

Although it is important to know how to perform an activity using correct rules, technique, and tactics, this alone is not sufficient knowledge to teach that activity properly. A teacher, who performs the activity very well and knows the rules, techniques, and tactics, may be able to teach these components, but may lack the ability or knowledge required to observe, correct, and report on students’ incorrect performance or
may not provide appropriate tasks based on the students’ skill level. Therefore, as a teacher, one needs to know how to analyze students’ performance, recognize their mistakes, and select and provide appropriate, customized instructional tasks to individual students. In this respect, the teacher should know what the common errors are and what kind of tasks he or she needs to provide to the students. In other words, “a reasonable mastery of the sport activities” (Siedentop, 2002, p. 374) or activity-based movement as a part of CK beyond the skill mastery, knowing what to teach and how to teach as the activity. Even though Grossman et al. (2005) argued that effective teachers should possess CK competence, this competence is still not enough to teach well. If teachers know neither what to teach nor how to perform a particular activity, there is no ways to teach it. Both forms of CK should be evident in the teacher’s repertoire and should be combined when teaching.

Ward (2009b) argued that CK courses should be taught to student teachers in new ways within the physical education teacher education (PETE) program. He emphasized that teaching content should be based on the four CK domains (i.e., rules and etiquette, technique and tactics, skill discrimination, and instructional tasks). For example, the CK courses in the PETE program at The Ohio State University are organized based on the four CK domains using a concept called “knowledge packets” that represent bundles of knowledge (Ward, 2009b). Knowledge packets for each content area have been developed and continuously refined through CK courses. These CK courses are composed of two parts: 1) activity-based part, 2) laboratory-based. For the activity-based section, preservice teachers practice teaching with their peers (i.e., peer teaching) using
the provided lesson plans and knowledge packets that include content related to the four CK domains. For example, sequence and scope, critical elements and common errors of the skills (i.e., technique) along with some tactics, and some rules and etiquette of the activity are included in the knowledge packets. For the laboratory-based section, preservice teachers are provided with experience in the performance analysis process using video clips to detect performance errors and subsequently provide appropriate progressions, cues, and feedback. They also take online quizzes related to the content during this time. Through this process, preservice teachers can develop a critical eye to identify students’ performance errors, select instructional tasks based on the students’ performance, and also improve their own skill level to be able to perform well in demonstrations to the students.

To date, there is little evidence to support either Siedentop’s (2002) contention that performance of skills leads to strong CK of the kind needed for teaching or Ward’s (2009a) content that emphasis must be placed on SCK. Recently, Stuhr et al. (2007) used a written CK test to investigate the relationship between undergraduate students’ previous experience and their knowledge of both CK and PCK in soccer, basketball, and track and field. Participants were four groups of undergraduate students who were taking different courses (i.e., two PETE courses in two different universities, one activity course, and one general education course). Based on Ward’s (2009b) four domains of CK, 30 questions on each activity were developed, including questions related to rules and etiquette, and technique and tactics (15 questions) and skill discrimination and instructional tasks (15 questions). A major finding of this study showed that students who had previous sport
experiences had higher scores than students who did not have these experiences. For example, the means of scores for questions regarding rules, etiquette, technique, and tactics were 27% for players and 1% for non-players. For the questions regarding skill discriminations and instructional tasks, the means of soccer scores were 14% for players and 7% for non-players. The results of this study support Ward’s (2009a) argument that students’ previous experience to participate in the activity both in school and out of school were not sufficient enough to influence CK and in particular SCK.

Stuhr et al. (2007) also examined pre-post differences of CK as a function of participation in a major activity course, a basic instruction course, a PETE course designed to teach CCK and a PETE course designed to teach SCK. The results showed that the improvement of basketball CK scores (i.e., 61% to 84%) in pre- to post-written tests was the largest percentage among four groups for one of the PETE courses designed to teach SCK. The improvement of CK in pre- to post-test scores in basketball is shown in Figure 2.1. This study concluded that all CK domains should be taught. However, this raises an important problem. Most PETE curriculums have limited time devoted to CK courses (Lee & Kim, 2009) because the programs of study in most PETE programs are dominated by disciplinary courses (Siedentop, 2002; Ward, 2009a).

The key point here is that teachers do not have enough CK for teaching. Castelli and Williams (2007) further illustrate this point. Castelli and Williams (2007) conducted a study that examined middle school physical education teachers’ health-related fitness CK and self-efficacy. A 3-part cognitive health-related fitness test and a self-efficacy questionnaire were completed by 73 middle school teachers. Results showed that even
though physical education teachers were very confident in their health-related fitness knowledge and their anticipated scores were high, their actual scores did not meet the standard. One of the implications of this study was that teachers should continue to develop their CK through targeted professional development using pragmatic resources (Castelli & Williams, 2007).

Figure 2.1 The Improvement of CK in Pre to Post Test Score in Basketball
Pedagogical Content Knowledge

PCK can be viewed from a number of perspectives.

Definitions of PCK

The concept of PCK has evolved since the mid of 1980s and has been widely used in educational research. In 1986, Shulman originally defined PCK as “the ways of representing and formulating the subject that make it comprehensible to others” (p. 9). He emphasized two components of PCK: 1) how teachers represent the particular content to learners, 2) what students know about the content (e.g., their background, their understanding and misunderstanding of some concepts). For example, teachers need to know how to make a decision on what to teach for 7th grade students in a volleyball unit, design the tasks they should provide based on the students’ skill level, and represent the appropriate content. In this case, there are many ways of representation of the content such as “the most powerful analogies, illustrations, examples, explanations, and demonstrations” (Shulman, 1986, p. 9). For example, in order to represent the content, the teachers can demonstrate the volleyball set with analogies and illustrations such as, “You want to make a diamond when touching the ball with your fingers, and push then follow throw while extending your elbows.”

In 1987, Shulman argued that PCK is a combination of CK and pedagogical knowledge and expanded the knowledge base for teaching. He also included four additional knowledge categories into his three initial knowledge domains. Shulman extended his definition of PCK as “the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented,
and adapted to the diverse interests and abilities of learners, and presented for instruction” (Shulman, 1987, p. 8). According to his definition of PCK, the teachers need to know what kinds of instructional tasks and progressions are organized, what the learners’ abilities and understandings of the content are, and how these things can be combined.

Grossman (1990) restructured the professional knowledge base (i.e., general pedagogical knowledge, subject matter knowledge (e.g., CK), PCK, and knowledge of context). Comparing to Shulman’s (1986) initial view of the knowledge base, Grossman argued that four categories of professional knowledge were interactive with each other (Grossman, 1990; Mark, 1990). She proposed four components of PCK: (a) concepts and purposes for teaching subject matter, (b) knowledge of students’ understanding, (c) curricular knowledge, and (d) knowledge of instructional strategies. In addition, she identified how teacher candidates acquire their PCK: (a) apprenticeship of observation, (b) subject matter knowledge, (c) teacher education, and (d) classroom experience (Grossman, 1990).

Along with Grossman’s (1990) view, Marks (1990) argued that PCK came equally from both subject matter knowledge (e.g., CK) and general pedagogical knowledge. She pointed out that dividing knowledge categories is not easy because there are some ambiguities and overlap in each knowledge category. Grossman (1990) and Marks (1990) also argued that knowing students is very critical in the teaching and learning process. In other words, Marks (1990) defined PCK as the integration of what to teach, how to teach, and how students learn in any particular content and he emphasized
how students learn among them. Similar to Marks, Grossman (1990) argued that knowledge of students’ understanding and misunderstanding is the important component of PCK. According to Grossman and Marks’ view, the most important thing is that teachers need to know what the students’ common errors are in a particular activity. The teachers need to have a critical eye toward detecting students’ incorrect performances.

Grossman et al. (2005) did not emphasize curricular knowledge and instructional strategies that were different from Grossman’s (1990) initial view of professional knowledge for teaching. Grossman et al. (2005) defined PCK as the teacher’s recognition and diagnosis of students’ understandings and misunderstandings with specific content and their ability to deal with diverse students’ misunderstandings. Likewise, they emphasized the students and the content as the primary components of PCK.

In physical education, Ayvazo (2007) investigated the appropriateness of PCK in strong and weak units of instruction by effective physical education teachers. In her study, she defined PCK as “the act of selecting content from one’s knowledge base for the purpose of teaching in a specific context” (p. 77). She promoted our understanding of how to conceptualize PCK and how to measure PCK using functional analysis. Ayvazo (2007) argued that PCK is specific in terms of content and learners’ performance level. For example, one who is expert in teaching soccer may be poor in teaching lacrosse.

Ward (2009b) conceptualized a new way to view the influences on PCK composed of three components: (a) past teaching experience in this content area and a particular grade of students, (b) current context, and (c) professional knowledge. The first component includes teachers’ content and their knowledge about students from their
experience. The second component emphasizes that PCK is informed by the current context and curriculum that the teachers face. The third component is professional knowledge, which may include pedagogical knowledge. Another way to view the influences on PCK is shown in Figure 2.2.

In addition, Ward (2009b) defined PCK as:

A focal point, a locus, defined as such as an event in time (and therefore specific contextually) where teachers make decisions in terms of pedagogy and content based on their understandings of a number of knowledge bases (e.g., of understanding students, of pedagogy, of content, of curriculum) (p. 13)

From his working definition, it is important to note that PCK represents teachers’ abilities to blend content and pedagogy. For students, the learning and teaching act occurs through the teachers’ selection and transformation of the content from different knowledge bases. His definition is grounded in the argument that PCK is informed by CK, context, student, pedagogy, and curriculum (Grossman, 1990; Doutis, 1997; Jenkins, Garn, & Jenkins, 2005; Jenkins & Veal, 2002; Kutame, 2002; Rovegno, Chen, & Todorovich, 2003; Sebren, 1995).

PCK as a Continuum

Shulman (1987) argued that teachers should have strong PCK in order to teach well. Several studies related to PCK in physical education also identified that strong, weak, or immature PCK exist (Chen, 2004; McCaughtry & Rovegno, 2003; Rovegno, 1992; Tsangaridou, 2002). Even though they used different words, their meanings are
similar and there is an agreement that PCK varies among and within teachers. Ayvazo (2007) argued that PCK is situated on a continuum, where the left end is immature and the right end is mature. Similarly, Ward (2009b) argued that the effectiveness of PCK also exists on a continuum. The question becomes what the strong PCK, weak PCK, or immature PCK is. To answer this question, the investigator suggests the existence of PCK on a continuum in terms of maturity, effectiveness, and appropriateness.

![Figure 2.2 Another Way to View the Influences on PCK](image)

**A Continuum of PCK Maturity**

Ward (2009b) emphasized the maturity of PCK. He defined mature PCK as the level of content expertise; in other words, mature PCK refers to the degree to which a task is well represented to the students. It may include cues, descriptions, analogies,
metaphors, or demonstrations so that students clearly understand what to do. What distinguishes maturity in task representations is the quality and sophistication of the representation to the students. For example, if the statement by the teacher was, “You are going to be performing a log roll; logs are long and straight, so in the log roll you need to stay really straight like a log with your arms together and extended with your legs together and straight. Watch Susan’s demonstration of the log roll,” this is a concise and clear statement that students can understand exactly what they are supposed to do. This statement shows that the teacher had some depth of knowledge about the content (i.e., a log roll). In contrast, immaturity refers to the task being presented in an unsophisticated manner with simplistic or poor descriptions or illustrations. For example, if the statement by the teacher was “Now I want you to perform a log roll, ready, go,” it is very simple and unsophisticated instruction. Thus, this statement is immature because students may not understand what “log roll” means because it has been represented poorly.

Ayvazo (2007) argued that the maturity of PCK can be explained with a continuum (Ward, 2009b). For example, the preservice teacher and the experienced teacher may have a different level of maturity of PCK (Ayvazo, 2007). If the teacher has a high level of content expertise, they would probably have had numerous experiences at teaching a particular activity (i.e., experienced teachers) or they are expert teachers of the particular activity. This group of teachers is placed closer to the mature end of the continuum. On the contrary, those who have a low level of content expertise are usually preservice teachers or novice teachers. This group is placed closer to the immature end of the continuum.
According to Ayvazo (2007), teachers have both strong and weak (i.e., less strong) units and they have different quality levels of teaching. One of the results of her study showed that one of the teachers used all types of content tasks (i.e., informing, extension, refinement, and application (Rink, 2010)) in her strong unit, but a dominant number of informing tasks (86%) were used in conjunction with some extension tasks (14%) in her weak unit. This result could explain the PCK continuum. In terms of instructional forms, the results showed that both teachers used mainly verbal instructions and a fewer number of demonstrations and metaphors both in their strong and weak unit. Based on Shulman’s (1986) definition of PCK, Ayvazo (2007) concluded that the teachers’ instructional forms were not effective because they relied heavily on verbal instructions instead of using demonstrations and metaphors. The verbal and visual representations can determine if the teacher’s PCK is mature or immature.

The maturity of PCK determines if the teachers’ selection and transforming of the content is correct or incorrect. Furthermore, this selection and transforming could heavily impact on student learning. However, it is important to note that poor selection and transforming of the content may occur even for experienced teachers because they may not be familiar with the particular activity. Ayvazo’s (2007) data showed that teachers demonstrated more mature PCK in their strong unit and less mature PCK in their weak unit. Therefore, it is important to know that PCK exists on a continuum regardless of the teachers’ years of teaching or expert level, and that all teachers can be placed on the continuum (Ayvazo, 2007).

Ayvazo (2007) and Ward (2009b) also argued that there are three characteristics
for maturity of PCK: (a) developmental, (b) content specificity (Grossman et al., 2005), and (c) context specificity. Teachers have a different degree of PCK based on the developmental status, content, and context. First, it is important to know that teachers have developmentally different levels of PCK depending on what unit they are teaching. All teachers have their strong unit and weak unit. For example, a teacher is very strong in teaching basketball but weak in teaching flag football.

Second, PCK is content specific. For example, a teacher may have mature PCK in teaching soccer to seventh grade students which means perhaps the teacher had already taught soccer to seventh grade students many times. This teacher can be placed closer to the mature end of continuum for soccer. However, the same teacher may be placed closer to immature PCK in teaching track and field to the same grade students because the teacher is not familiar with this content area.

Third, PCK is context specific. For example, a teacher may have mature PCK in teaching team handball to beginners, but the teacher may have immature PCK in teaching the same content to professional players because the learners’ level is much higher and because the teacher has had little experience teaching this content to professional players. Therefore, the ultimate goal is for our teachers to have more mature PCK in a variety of activities (Ward, 2009b).

A Continuum of PCK in Terms of Effectiveness

The effectiveness of PCK can also exist on a continuum (Ayvazo, 2007; Ward, 2009b). The effectiveness of PCK is determined by student performance. If students correctly and successfully perform the task, we can assume that the teacher’s PCK is
effective. In general, if teachers teach their strong unit, the effectiveness of their PCK will be placed closer to the right end (i.e., more effective) of the scale. If they teach their weak unit, their PCK will be placed closer to the left end (i.e., less effective) of the scale. The problem is that in the past it has been assumed that a teachers’ PCK is effective for all students, but the reality is that it may not be the case for some students because PCK is context specific (i.e., the student is context in this case). In other words, even though a teacher provides appropriate progressions to the class, some individuals may not receive any benefit. In this case, the teacher needs to modify and present different tasks to address the needs of individual students. For example, when a teacher explains team handball tactics using soccer tactics, some students, who have had previous experience in playing soccer, may understand what to do, but others may not understand because they do not know the soccer tactics.

** Appropriateness of Tasks as a Continuum of PCK **

If the task that the teacher provided was developmentally appropriate, content specific, and context specific, the teacher’s PCK is appropriate. Developmentally appropriate refers to “activities geared toward a student’s developmental status, previous movement experience, fitness and skill levels, body size, and age” (Siedentop & Tannehill, 2000, p. 119). Content specific refers to using a particular activity, and context specific refers to using appropriate equipment and space. For example, the teacher provided a log rolling activity (content specific) to 3rd graders as a warm up activity (developmentally appropriate) using mats (context specific) to prepare for the gymnastics unit. This task is appropriate because it is age appropriate and equipment is ready to use
for the task. In contrast, inappropriateness occurs when the task that teacher provided was not developmentally appropriate, and/or content specific, and/or context specific. To use the same example of gymnastics, the teacher provided a log rolling activity to 9th graders without any mats for a gymnastics unit. This task is developmentally inappropriate because a log rolling activity is too easy for 9th graders and the equipment (i.e., mats) is not being used for the task.

The teacher needs to have the ability to select different tasks from knowledge bases based on the students’ understandings and misunderstandings, and the context (Ayvazo, 2007). These modifications of the selected instruction based on students’ characteristics are called adaptations (Shulman, 1987), and the adaptations are a part of PCK. The adaptations should be developmentally appropriate. Ayvazo (2007) proposed three forms of knowledge base: “(a) selection of content to be included in the lesson plan, (b) enactment of content in the act of actual teaching, and (c) repeated interactions with the same content” (Ayvazo, 2007, p. 77). Ayvazo’s (2007) definition of PCK emphasized the selection process and adaptation. The adaptations occurred when teacher selected the content from their CK base. With regard to the adaptation, the results of Ayvazo’s (2007) study showed that both teachers responded primarily to students’ incorrect performance and modified tasks for individual students. She concluded that both teachers have richer CK in terms of the domain of skill discrimination (Ward, 2009a).

*Viewing PCK as a Combination of Maturity and Effectiveness*

Ward (2009b) explained the combination of teachers’ maturity and effectiveness. He argued that most teachers are included in the less mature and less effective group and
they usually stay in this group. Few teachers are in the combination of more mature and more effective group, and effective teachers aspire to be in this group. He also indicated that sometimes teachers can be lucky because their PCK in a particular activity was immature but students’ performance was correct and successful. At the same time, the opposite is also true - teachers who have mature PCK in a particular activity can still make errors and students’ performance might not arrive at the standards that the teacher expected. It is important to note that this combining continuum can be also content and context specific. The combined continuum between maturity and effectiveness is shown in Figure 2.3.

![Figure 2.3 A Combined Continuum between Maturity and Effectiveness](image-url)
Viewing PCK as a Combination of Maturity & Appropriateness

Similar to the combination of maturity and effectiveness, Ward (2009b) argued that the combination of maturity and appropriateness provides for richer understanding of PCK. According to this view, PCK can be determined if the task was delivered using mature PCK and in this delivery the task or adaptation was appropriate. If a task delivery is developmentally appropriate, content specific, and context specific using mature PCK, this combination would be considered as the most mature and appropriate PCK. However, if the level of maturity or appropriateness is low in teachers’ PCK, the teachers cannot perform their teaching well. In addition, if teachers have immature and inappropriate PCK, that would be a big problem. Therefore, this combination of maturity and appropriateness is one of fair ways of viewing PCK.

Research Problems Related to Content Knowledge and Pedagogical Content Knowledge in Physical Education

There are at least four main research problems related to CK and three main research problems related to PCK in physical education.

Research Problems Related to CK

Lack of CK Definition

Although CK is a widely used term in the educational community, clear definitions have not been developed well. In physical education, Ward (2009a) observed that there is “a lack of conceptual clarity relative to what is the subject matter knowledge (i.e., CK) that best serves a teacher” (p. 346). Shulman’s (1986) initial definitions of teacher knowledge lead us to come up with an enduring question on knowledge for
teaching, “What do teachers have to know in order to teach students effectively.” In order to answer this question, CK needs to be clearly defined and conceptualized.

*Lack of Research on CK*

The second problem is that empirical research on CK is very rare in physical education (Ward, 2009a). In particular, there has been no research showing a direct relationship between CK and PCK in physical education. Yet CK is obviously related to PCK (Ayvazo, Ward, & Stuhr, 2009; Siedentop, 2002) and there is agreement that PCK is informed by CK (Grossman, 1990; Doutis, 1997; Jenkins et al., 2005; Jenkins & Veal, 2002; Kutame, 2002; Rovegno et al., 2003; Sebren, 1995). In addition, Grossman et al. (2005) argued that the relationship between CK and PCK is significant. The relationship of CK and PCK is related to the assumption that if you do not have strong CK in a particular activity, you do not have strong PCK in that activity. We urgently need data-based evidence showing the relationship between CK and PCK. Such a relationship can be best demonstrated by experimental manipulation of the degree of CK and determining its impact on a teacher’s PCK.

*Lack of Student Learning Related Research*

Research on the relationship between CK, PCK, and student learning has not yet been conducted in physical education. Even though CK is clearly related to PCK (Ayvazo et al., 2009; Siedentop, 2002), there is no direct research on the relationships between CK and PCK and between PCK and student learning. Student learning related research is necessary because teacher effectiveness is determined by student learning. It is important to note that this kind of research can help researchers identify what forms of PCK impact
on student learning and thereby provide teachers with an opportunity to improve their PCK based on the results of the research.

Acquisition of CK

There are problems in the ways that teachers used to acquire CK. Ward (2009a) suggested that teachers’ CK may be acquired in four ways: (a) through schooling, (b) through extracurricular physical activity, (c) through teacher education programs, and (d) through professional development programs. He argued that these ways of learning CK are not effective.

The first way by which teachers acquire CK is through experience as students in elementary, middle, and high school (Ward, 2009a). However, these physical education experiences were mostly negative, developmentally inappropriate, and exclusive. It is reasonable that the students, who had negative experiences, have only insufficient CK when they enter the PETE program. The big problem is that this cycle can continue over time due to the lack of preservice teachers’ CK.

Teachers also acquire CK through extracurricular physical activity in and out of school (Ward, 2009a). These experiences usually consist of long-term practice sessions and provide more opportunities to participate in both games and practice. Many students obtain their knowledge mostly from participating in outside of school activity. However, generally speaking, these activities are limited to one or two different sports (Ward, 2009a) naturally due to lack of time and energy on the part of the individual. In addition, these activities do not provide enough knowledge for teaching because they are only focused on performance (Ward, 2009a).
Third, the PETE program needs to provide opportunities to obtain CK for preservice teachers (Ward, 2009a). Even though most PETE programs have their own required curriculum for general educational courses, disciplinary courses, and some CK courses, there are few CK courses (Lee & Kim, 2009) and the disciplinary courses are dominant in the majority of the PETE programs (Siedentop, 2002; Ward, 2009a). The big problem here is that these disciplinary courses are not taught in schools; namely, preservice teachers may have little opportunity to develop their CK even in their PETE program. The PETE program should provide more time for preservice teachers to improve and gain in-depth CK and to experience interaction with learners and their conceptions (Ayvazo et al., 2009).

Furthermore, preservice teachers in physical education leave their program with insufficient CK (Siedentop, 2002). If they leave without enough CK, they cannot teach long instructional units, which provide students with better opportunities to develop their skills. In this case, these teachers can only implement short instructional units in a multi-activity curriculum, which results in low skill mastery level for students (Siedentop, 2002; Ward, 2009a). When they teach without appropriate and sufficient CK, they cannot provide appropriate tasks for students to learn nor can they respond correctly to student performance errors.

Fourth and finally, teachers can improve their CK through professional development programs. However, there are limited opportunities for these programs and the focus of the professional development programs is not CK (Ward, 2009a). According to Ward (2009a), there are two ways to improve CK through learning from experience:
(a) formally (e.g., participating in a state or national conference, obtaining a degree, attending an endorsement program), (b) informally (e.g., searching the Internet or reading books). However, both these approaches have limitations. For example, professional conferences are usually lectures and, although the teachers may gain ideas and information there is little chance to practice. Many teachers attend professional meetings not because they want to learn but because they want to receive some rewards from the school district or they are required to attend as part of their contract.

In addition, teachers have little or no opportunity to interact with others (e.g., experts) if they choose the informal approach. Working alone, it is not easy to select accurate and systematic information in an informal setting because they do not have any chance for discussion with those who have experience in a particular activity. This setting also does not allow for any structured practice with feedback from a professional.

Thus, it is clear that a specifically organized workshop using knowledge packets would be one of the most effective ways to improve the teachers’ level of CK.

*Research Problems Related to PCK*

*Lack of Definition of PCK*

Even though the term “PCK” has been widely used in educational literature since 1986, it has not been clearly defined and conceptualized (Ayvazo, 2007). Because there is no functional definition of PCK, many studies have used different definitions and conceptualizations of PCK in physical education (Ayvazo, 2007). Marks (1990) emphasized the lack of definition of PCK. Recently, scholars also describe the same issue in different content areas (Ball et al., 2008; Abell, 2008). PCK is the most important
knowledge for teachers (Siedentop, 2002). Methods in how to teach and develop PCK should be identified to help teachers improve their PCK, but first, it must be defined. Without a clear definition, we cannot know how to teach and develop PCK as well as how to use and discuss it in research and practice (Ayvazo, 2007).

*PCK Viewed as Effective When It Might Not Be!*

The effectiveness of PCK is determined by student performance. PCK can vary based on the teachers’ teaching experience, their familiarity with the content, and context. A teacher who has had previous teaching experience in specific content may have effective PCK, but her PCK for other content which she has not taught before may not be effective. In addition, even though a teacher’s PCK may be high for a specific task, the task can sometimes be effective in some groups of students, but not in others. There is an assumption that PCK makes effective student learning but if PCK is placed on a continuum, this assumption would not be true depending on where a teacher’s PCK is placed on the continuum.

*Measuring and Observing PCK*

Measuring and observing PCK is important. Because of the lack of definition of PCK, it is not easy to identify how to measure and how to observe teachers’ PCK. There could be two ways of measuring and observing PCK. One of the ways to measure teachers’ PCK is with a written test (Stuhr et al., 2007). The written test provides a situation or case related to teachers’ misunderstanding and teachers need to answer questions about this situation. The other way is to directly measure and observe teachers’ teaching practices (Ayvazo, 2007). If a researcher uses direct observation to measure
teachers’ PCK, the researcher needs to functionally define PCK first and subsequently
decide which variables can best represent PCK as defined.

Knowledge Packet

Several instructional models have been introduced in physical education. Play
Practice (Launder, 2001) is an alternative and effective instructional model to teach sports
(Zhang, 2008). The essential assumption of Play Practice is that all children could have
opportunities to challenge and participate in sports while having fun (Launder, 2001). The
Play Practice concept places great emphasis on games and challenges through realistic
and enjoyable learning environments (Launder, 2001). Traditional ways of teaching are
totally different from teaching in Play Practice. One of advantages of Play Practice is
many progressions to develop technical and tactical elements. Based on students’ skill
levels, the teacher can provide different progressions.

Another key element in Play Practice is that students can play and participate in
small-sided games and competitions. In other words, it is more realistic and there are
many game-like situations. These characteristics of Play Practice make students improve
their technical and tactical abilities rapidly and efficiently. The other key feature of Play
Practice is the “Freeze Replay” concept (Launder, 2001, p. 57). This concept allows
students to develop quality performance and gives teachers the opportunity for teachable
moments for students to better understand the game (Launder, 2001).

In addition, a knowledge packet consists of several components: (a) the written
form of critical elements, (b) the written form of common errors, (c) different
instructional tasks, and (d) organizing arrangement using diagrams. These components
are based on Ward’s (2009a) four domains of CK in physical education. He defined a knowledge packet as something developed over time by continual teaching and modification, and argued that it should be used to teach content (Ward, 2009b). In order for the teacher to effectively teach one particular sport, she needs to have error detection ability and needs to know some progressions as well as rules, technique, and tactics (Ward, 2009a). It is not enough to know what the rules are and how the activity is performed, that is, the teachers should have some knowledge for teaching the skill. Using a knowledge packet is a different way of teaching content (Ward, 2009b).

Teachers can benefit from knowledge packet in terms of what they need to teach in a particular sport. Even though the teacher knows the critical elements of each skill and how to play the activity, that alone is not enough for them to teach. They should have further knowledge to teach the sport as a whole concept. In other words, they should possess the knowledge of what the common errors are in a particular drill or activity. If they have this ability, they could easily identify students’ performance errors and provide more appropriate feedback, progressions, and cues. In addition, they should have effective organizational and arrangement abilities to increase students’ practice time and trials. Distinct activities need to be organized with differently and teachers need to have an idea of how to organize the class for a particular activity.

Knowledge packets can give teachers new ideas and the focus of a particular activity. Even though teachers know the new drill, they might not use it effectively because they may not know the important points of the drill. With knowledge packets, the new idea and the focus of drills should be provided together to enhance teachers’ PCK.
Knowledge packets are useful tool for teachers to develop their CK in a short time because it is concise, but still includes all important components. In general, it will take much time to develop CK in one sport because we do not know how much CK and what kind of CK the teachers need. However, the knowledge packet includes key components of CK in one sport and it is easy for the teachers to understand because it is developed overtime and modified through repeated teachings.

All in all, using knowledge packet is one of the best ways to manipulate teachers CK. Even though teachers have some ways of developing their CK, there is little opportunity to improve teachers’ CK (Ward, 2009a). If knowledge packet is used, it is easy and effective way to improve teacher’s CK.
CHAPTER 3

METHOD

This chapter consists of six sections. The first section describes the selection of the setting, participants, gaining access to research sites, and the timeline of data collection. The second section defines the independent variable. The third section describes the definition and the measure of the dependant variables. The fourth section describes the observation and recording procedures. The fifth section discusses the research design and treatment integrity. In the last section, a summary of how the data are analyzed and how the research questions are answered is described.

Selection of Setting and Participants, and Gaining Access

In this section, the school setting, the participants, gaining access to the research sites and the timeline of data collection are described.

School Setting

One suburban public middle school and one urban public middle school in a Midwestern city were purposely selected for this study. In school A, students received physical education in 55-minute lessons every day for a 6-week block. School A had three physical education teachers and one of them participated in this study. In school B, students received physical education in 49-minute lessons every day for the entire quarter.
This school had only one physical education teacher and she participated in this study.

The characteristics of each school setting are shown in Table 3.1.

<table>
<thead>
<tr>
<th>School</th>
<th>Location</th>
<th>Student Race</th>
<th>Number of Students</th>
<th>Free or Reduced-Price Lunch</th>
<th>Physical education class per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>School A</td>
<td>Suburban</td>
<td>69% White 16% Black 13% Hispanic 2% Multi Racial</td>
<td>802</td>
<td>57% free/reduced</td>
<td>Every day for a 6-week block</td>
</tr>
<tr>
<td>School B</td>
<td>Urban</td>
<td>5% White 75% Black 18% Hispanic 2% Multi Racial</td>
<td>365</td>
<td>96% Free/reduced</td>
<td>Every day for entire quarter</td>
</tr>
</tbody>
</table>

**Table 3.1 Characteristics of Schools**

*Participants*

Two participants were purposely recruited to participate in this study according to the following criteria. Teachers were included if they met three criteria: (a) teachers who agreed to participate in this study; (b) teachers who were able to teach two 6-day soccer units to four classes (two different classes for comparison group and two different classes for experimental group); and (c) teachers who considered a soccer unit as their weak unit. Both teachers were female and Caucasian. The number of years of teaching ranged from 5-25 with an average of 15 years. Descriptions of the teachers can be found in Table 3.2.
Students in each class selected for the study also served as participants. Table 3.3 shows the number of students in each class.

<table>
<thead>
<tr>
<th></th>
<th>Kathy</th>
<th>Lisa</th>
</tr>
</thead>
<tbody>
<tr>
<td>School location</td>
<td>Suburban</td>
<td>Urban</td>
</tr>
<tr>
<td>Age</td>
<td>31</td>
<td>52</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>Female</td>
</tr>
<tr>
<td>Race</td>
<td>Caucasian</td>
<td>Caucasian</td>
</tr>
<tr>
<td>Number of Years Teaching K-12</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Number of Years Teaching at the current school</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Grade level</td>
<td>7-8</td>
<td>6-8</td>
</tr>
</tbody>
</table>

Table 3.2 Descriptions of the Teachers

**Gaining Entry**

The investigation was approved by the Institutional Review Board (IRB) at the Ohio State University (IRB #2010B0108) (See Appendix A). Permission was previously obtained from the school district. After the teachers agreed to participate in this study, permission was obtained from the school principal. Parent permission forms were sent to the parents and a child assent verbal script was presented by the investigator prior to the first day of the unit (See Appendix B and C). The parents (or guardians) and the students were informed of the investigator’s intention to observe the lessons, investigating procedures, and that the collected data would be kept confidential. Teacher consent forms
were also signed by the teachers (See Appendix D). The teachers were informed of experimental conditions but dependent variables were not provided.

**Timeline of Data Collection**

The data collection timeline is shown in Table 3.4.

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Class</th>
<th>Total number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kathy</td>
<td>C 1</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>C 2</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>E 1</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>E 2</td>
<td>24</td>
</tr>
<tr>
<td>Lisa</td>
<td>C 1</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>C 2</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>E 1</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>E 2</td>
<td>26</td>
</tr>
</tbody>
</table>

*Note C – Comparison group, E- Experimental group

**Table 3.3 Number of the Students in Each Class**

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Comparison group</th>
<th>Experimental group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kathy</td>
<td>May 3 – May 11</td>
<td>May 17 – May 24</td>
</tr>
<tr>
<td>Lisa</td>
<td>May 4 – May 11</td>
<td>May 17 – May 25</td>
</tr>
</tbody>
</table>

**Table 3.4 Data Collection Timeline**
The Independent Variable: A Content Knowledge Workshop

A content knowledge (CK) workshop was conducted in the gymnasium of each middle school. Soccer balls, small goals, and cones as well as the knowledge packet for soccer were used in this workshop (See Appendix L). The workshop occurred three times and the duration of each workshop was one hour (i.e., total three hours per teacher).

The goals of the workshop for the physical education teachers were:

(a) To understand and obtain specific content knowledge regarding a soccer unit that they could use in their lesson to represent the content to students,

(b) To select appropriate and effective progressions, and

(c) To understand and recognize student common errors in each drill (i.e., activity).

The CK workshop included a knowledge packet that consisted of critical elements of activities, common errors, tasks, and organizational arrangements (See Appendix L). Prior to the start of the workshop, the knowledge packet including critical elements, common errors, and progressions of each skill in a soccer unit with diagrams (e.g., organizational arrangement) were provided to each teacher. The teachers were asked to review the soccer knowledge packet independently before the workshop. The workshop was organized into four phases:

1. The first phase provided an overview of the workshop. The basic principles of Play Practice (Launder, 2001) were introduced. The researcher also explained the Play Practice in technical and tactical strategies.
2. The researcher and his assistants (including some students in each school) modeled each task in the knowledge packet with demonstrations during the workshop. He expertly instructed the teachers on how to represent the content to their students. He also explained what the focus was in each activity and what the teachers needed to expect from their students. Different instructional tasks were also discussed with demonstrations.

3. The teachers were asked to practice teaching the researcher and the assistants. During this time, the researcher used “freeze and replay” to correct the teachers’ teaching errors.

4. After watching particular demonstrations of each task in soccer by the researcher and his assistants, the teachers identified what was correct and incorrect, what kinds of feedback and cues needed to be provided to their students, and what kinds of tasks needed to be provided to their students. If the teacher correctly identified seven out of ten questions, the workshop would be finished. However, if the teacher did not meet the criteria (e.g., 7 out of 10), another set of questions was provided and it continued until the teacher met the criteria.

The workshop was presented to the teachers using the following pedagogy. The investigator used clear instructions and descriptions to introduce a task (e.g., 3 vs. 1 passing and possession game) to the teachers. In terms of verbal representations, he used one analogy (e.g., triangle formation), some cues (e.g., move to open space), and specific congruent feedback (e.g., I like the way that you moved to open space) if necessary. He
also had his assistant and some students at the school demonstrate the task. During students’ practice of this task, the investigator used some gestures (e.g., thumps up when students perform correctly) and physical assistant (e.g., having students move to open space by touching them). Then the investigator explained that the teachers might want to use task cards, diagrams, pictures, and video clips. The investigator provided different forms of verbal and visual representations in different tasks. However, he verbally explained with examples that the teachers can also use different forms of representations. Figure 3.1 provides a checklist indicating which elements of the workshop were presented to teachers versus merely described to the teacher.

The teachers discussed with the researcher about their reflections on their own teaching based on the workshop. Along with the workshop, daily feedback was delivered as a reminder right before each lesson for the teachers.

Knowledge Packet

The knowledge packet is one of dimensions of the CK workshop. The knowledge packet was developed by the researcher who is an expert in soccer (See Appendix L). In order to ensure content and face validity for this knowledge packet, two soccer experts were asked to thoroughly read and revise it where appropriate. These two experts were required to check if the sequence of the knowledge packet was appropriate and if the content was developmentally appropriate and accurate. For example, one of the experts suggested that the sequence of the knowledge packet be not appropriate because of the order of learning process. The investigator discussed this with the other expert and revised the sequence properly. Another recommendation from the other expert was that
some tasks were not appropriate for middle school students. The investigator also discussed this issue with another expert and revised it correctly.

<table>
<thead>
<tr>
<th></th>
<th>Verbal Representations</th>
<th>Visual Representations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instructions</td>
<td>Descriptions</td>
</tr>
<tr>
<td>2v2 Dribbling, screening, and passing game</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Pass and possession</td>
<td>3 vs. 1</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>4 vs. 1</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>4 vs. 2</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>5 vs. 2</td>
<td>✓</td>
</tr>
<tr>
<td>Shooting game 2 vs. 1</td>
<td>3 vs. 1</td>
<td>✓</td>
</tr>
<tr>
<td>Go for Goal 2</td>
<td>3 vs. 2</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>4 vs. 3</td>
<td>✓</td>
</tr>
<tr>
<td>4 vs. 4 Mini Games</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Four goal soccer</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Figure 3.1 The Procedural Checklist for the CK Workshop
Six primary tasks based on specific tactics and techniques were included in the knowledge packet based on the play practice concept proposed by Alan Launder (2001). These six tasks were sequentially organized based on developmental level. The tasks were also closely related to each other and included tactical aspects as well as basic techniques in soccer. Six tasks were:

1. Dribbling, screening, and passing game (2 vs. 2)
2. Passing and possession games (e.g., 3 vs. 1, 4 vs. 1, 4 vs. 2, 5 vs. 2)
3. Shooting game (i.e., 2 vs. 1 give and go)
4. Continuous “go for goal” games (e.g., 3 vs. 1, 3 vs. 2, 4 vs. 3)
5. Mini game with no goalie (4 vs. 4)
6. Four goal soccer with no goalie

Definition and Measurement of the Dependent Variables

In this study, variables related to both student and teacher behaviors were measured.

Shulman (1986) described pedagogical content knowledge (PCK) as having several characteristics such as “analogies, illustrations, examples, explanations, and demonstrations” (p. 8). Shulman’s definition of PCK can be divided into several variables based on these characteristics. These variables can be further classified into two broad categories: PCK is represented by verbal and visual ways. In addition, the categories can be further expanded to include additional pedagogical variables to describe PCK. A diagram of these categories and the variables is shown in Figure 3.2.
Teacher Variables

Three levels of teacher behavior variables were used in this study. The first level included two variables: maturity and appropriateness. The second level consisted of two variables: (a) verbal representations, and (b) visual representations. The third level was a measure of task adaptations made by the teacher. These three levels of teacher variables are shown in Figure 3.3.

Figure 3.2 A Diagram of the Variables Related to Shulman’s Definition of PCK

Teacher and student variables are investigated in this study.
Levels | Teacher Variables
---|---
Level 1 | Maturity
| Appropriateness
Level 2 | Verbal representations
| Visual representations
Level 3 | Task adaptations

**Figure 3.3 A Diagram of the Three Levels of Teacher Variables**

**LEVEL 1 Variables**

**Maturity:** Refers to the degree to which a task is well represented to the students. It may include cues, descriptions, analogies, metaphors, or demonstrations so that students clearly understand what to do. What distinguishes maturity in task representations is the quality and sophistication of the representation to the students.

- Example teacher statement: “You are going to be practicing a 4 vs. 1 passing game. I need five volunteers: one of you is a defense and four of you are offense. I want the offense to absorb and cushion the ball like an egg when you receive a pass from one of your team mates. Read the defense’s position, make a decision, and then pass the ball to another offense that is open. The defender needs to do warm defense (i.e., walking defense: the defender is only allowed to walk). Watch the volunteers’ demonstration of the 4 vs. 1 passing game.” This is a concise and clear statement that students can understand what they are exactly supposed to do. This statement shows that
the teacher had some depth of knowledge about the content.

**Immaturity:** The task was presented in an unsophisticated manner with simplistic or poor descriptions or illustrations.

- Example teacher statement: “Now I want you to practice a 4 vs. 1 passing game, one defense and four offense practice together, ready, go.” This is a very simple and unsophisticated instruction. This statement is immature because students may not understand what the focus of the practice is because it has been represented poorly.

**Appropriateness:** The task that the teacher provided was developmentally appropriate, content specific, and context specific. Developmentally appropriate refers to “activities geared toward a student’s developmental status, previous movement experience, fitness and skill levels, body size, and age” (Siedentop & Tannehill, 2000, p. 119). Content specific refers to using a particular activity for the students, and context specific refers to using appropriate facilities, equipment and space.

- Example: the teacher provided a 4 vs. 1 passing game (content specific) to 8th graders as a warm up activity (developmentally appropriate) using cones (context specific) to prepare for the soccer unit. This task is appropriate because it is developmentally appropriate and equipment is ready to use for the task.

**Inappropriateness:** The task that the teacher provided was NOT developmentally appropriate, and/or content specific, and/or context specific.
Example: the teacher provided a partner passing game (i.e., practice passing back and force with a partner) to 8th graders without defensive players. This task is developmentally inappropriate because the partner passing game is too easy for 8th graders. This task is also inappropriate because the partner passing back and force does not happen during game-like situations.

Coding the Level 1 Categories: After running a pilot study, it was determined that combining categories provided for richer understanding of PCK. Four combinations of maturity and appropriateness were used. Figure 3.4 shows the four scales of combining coding categories. The coding sheet is shown in Figure 3.5. Observers determined in which category the presented task would be included based on the definitions. Observers also determined if the task was delivered to an individual, a small group, or the whole group. These data were analyzed using a graphic display (i.e., line graph).

Figure 3.4 Combining Coding Categories (i.e., 4 scales)
Example of Maturity and Appropriateness, and Task Adaptation Coding Sheet

<table>
<thead>
<tr>
<th>Task</th>
<th>What teacher mentioned about the task (verbatim)</th>
<th>Maturity &amp; Appropriateness</th>
<th>Teachers’ adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
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<td>7</td>
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</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maturity and Appropriateness</th>
<th>Teachers’ adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mature &amp; appropriate - #4</td>
<td>Taught/appropriate - #4</td>
</tr>
<tr>
<td>Mature &amp; inappropriate - #3</td>
<td>Taught/inappropriate - #3</td>
</tr>
<tr>
<td>Immature &amp; appropriate - #2</td>
<td>Not taught/appropriate - #2</td>
</tr>
<tr>
<td>Immature &amp; inappropriate - #1</td>
<td>Not taught/inappropriate (not good) - #1</td>
</tr>
</tbody>
</table>

Figure 3.5 Teachers’ Maturity and Appropriate, and Task Adaptation Coding Sheet
■ **#4 - Mature & appropriate:** This category includes well represented and developmentally appropriate tasks with instructional cues, descriptions, analogies, metaphors, or demonstrations.

- Example: in a soccer unit for 8\textsuperscript{th} graders, the statement by the teacher was, “You are going to be performing an inside pass. In the inside pass, you need to have your kicking ankle fixed like a rock with your support foot a little behind and beside the ball and bent, and your body facing towards where you want to pass. Watch, as I demonstrate the inside pass for you.” Then the students performed the inside pass.

■ **#3 - Mature & inappropriate:** This category includes well represented but developmentally inappropriate tasks with instructional cues, descriptions, analogies, metaphors, or demonstrations.

- Example: in a soccer unit for 8\textsuperscript{th} graders, the statement by the teacher was, “You are going to be practicing a 4 vs. 3 continuous “go for goal” game. In this game, for defensive players, three of you are in field and one of you is out of the field for the substitution. Four of you are offensive players. You need to move towards the goal to score if you are the offensive players. You need to delay the offensive players’ play and prevent them from scoring if you are the defensive players. If the defensive players steal the ball, the defensive and the offensive players need to change their roll. In this time, the offensive player who lost a ball goes out of the field and the defensive player, who was outside of the
field, comes to the field to play this game. Watch. Joe, Kevin, Emily, Jessica, Mark, Ann, and I will demonstrate a 4 vs. 3 continuous “go for goal” game for you.” Then the students performed this game.

■ **#2 - Immature & appropriate**: This category includes unsophisticated but developmentally appropriate tasks with simple or poor instructional cues, descriptions, analogies, metaphors, or demonstrations.

  ◆ Example: in a soccer unit for 8th graders, the statement by the teacher was, “You are going to be practicing a 3 vs. 1 passing game. Three of you are offensive players and one of you is defensive player. This is a keep away game.” Then the students practice this game.

■ **#1 - Immature & inappropriate**: This category includes unsophisticated and developmentally inappropriate tasks with simple or poor instructional cues, descriptions, analogies, metaphors, or demonstrations.

  ◆ Example: in a soccer unit for 8th graders, the statement by the teacher was, “You are going to be performing an instep pass. In the instep pass, you need to pass a ball towards the wall and try to practice it 20 times by yourself.” Then the students performed the instep pass.

**LEVEL 2 Variables**

The two variables in the second level are verbal and visual representations.

*Verbal representations.* The verbal representations were composed of five subcategories: (a) instructions, (b) descriptions, (c) analogies and metaphors, (d) cues, and (e) specific congruent feedback. Observers recorded each category of verbal
representations and who is the recipient (i.e., individual, small group, and whole group) within each task while watching video clips. Data were reported as a frequency measure and tallied as to how many of each category occurred per day. Then these data were analyzed using a graphic display (i.e., bar graph). Figure 3.6 shows the teachers’ verbal representation coding sheet. Each sub-category was defined as follows:

Instructions: “Teacher is verbally describing to the students how to do a skill, or is using a verbal prompt to direct students in attempting a skill or activity” (Hawkins & Wiegand, 1989, p. 279).

Example: in a basketball unit, the teacher states “We are going to do a 3 vs. 1 passing game using the inside pass and the ball control for five minutes.”

Descriptions: Descriptions are the teacher’s verbal explanation or illustration on what a particular skill (activity) is like.

Example: The teacher states, “Critical elements of an inside pass in soccer are to use the inside of your foot, face the target, and contact the center of the ball.”

Analogies and metaphors: Analogies are the teachers’ use of similar or different examples to explain the skills. Metaphors are teachers’ imaginative ways of describing something using different names with the same characteristics.

Example: the teacher states, “When you perform a 4 vs. 4 mini game, make sure you try to keep a diamond formation to attack your opponents.” She explains the important formation in soccer using an analogy.

Cues: Cues are not full sentences (i.e., clauses), but shortened groups of words (i.e.,
phrases) that relate to the information about the performance of the movement provided by the teacher (Rink & Werner, 1989; Rink, 2006). Cues can be technical, visual, or metaphoric (Kutame, 1997). The technical cues are directly related to critical elements of the activity (Kutame, 1997). The visual cues are objects (e.g., taped line) the teacher uses to correct the students’ performance (Kutame, 1997). The metaphoric cues are related to using images (Kutame, 1997).

- Examples: the teacher provides skill related cues using technical words such as “go deep” in soccer. Another example is the teacher providing cues using a metaphor such as “like an egg” for ball control in soccer.

**Specific congruent feedback**: Specific congruent feedback is “the degree to which teacher feedback during an activity is congruent with (matched to) the focus of the task” (Rink, 2010, p. 372).

- Example: the teacher explained and emphasized the follow through in the inside pass in soccer. The teacher looked around the class and provided skill related congruent feedback such as, “Way to follow through! Short and smooth.”

**Visual representations.** The second variable was the teachers’ visual representations. The visual representations were composed of five sub categories: (a) demonstrations, (b) gestures, (c) task cards, pictures, and diagrams, (d) video clips, and (e) physical assistance. The observer recorded each category of visual representations and who is the recipient within each task (i.e., individual, small group, and whole group) while watching video clips. Data were reported by the frequency measure and these data
were analyzed using a graphic display (i.e., bar graph). Figure 3.7 shows the teachers’ visual representation coding sheet. Each sub category was defined as follows:

**Demonstrations**: Demonstrations are “modeling desired performance executed by teacher, student(s), and/or visual aids” (Rink, 2010, p. 372).

- Example: the teacher showed the desired or undesired shooting, or asked students to show it to the class in soccer.

**Gestures**: Gestures are positive nonverbal behaviors for students’ effort or success. It includes “a body contact, hand gesture, or facial expression” (Quarterman, 1989, p. 330).

- Example: Patting on the shoulders, hugging a student, mussing a student’s hair, clapping, making an “OK” signal, making a “number one” signal, smiling, raising the eyebrows, and nodding the head are all examples of gestures used.

**Task cards/pictures/diagrams**: Task cards, pictures, or diagrams are visual strategies to help students understand what to perform and how to perform.

- Example: when a teacher explained ball control in soccer, she could show them a big picture of foot position in soccer ball control for students to understand how to perform ball control skill correctly. In addition, the teacher could show students task cards that included critical elements of ball control in soccer.
Example of Verbal Representation Coding Sheet

<table>
<thead>
<tr>
<th>Task</th>
<th>Teacher: Kathy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instructions</td>
</tr>
<tr>
<td>1</td>
<td>/</td>
</tr>
<tr>
<td>2</td>
<td>/</td>
</tr>
<tr>
<td>3</td>
<td>/</td>
</tr>
<tr>
<td>4</td>
<td>/</td>
</tr>
</tbody>
</table>

- Tally (/) if it occurs

Figure 3.6 Teachers’ Verbal Representation Coding Sheet
Example of Visual Representation Coding Sheet

<table>
<thead>
<tr>
<th>Task</th>
<th>Demonstrations</th>
<th>Gestures</th>
<th>Task Cards</th>
<th>Pictures</th>
<th>Diagrams</th>
<th>Video Clips</th>
<th>Physical Assistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td></td>
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<tr>
<td>2</td>
<td>/</td>
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<td>3</td>
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<td>4</td>
<td>//</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>//</td>
<td></td>
</tr>
</tbody>
</table>

- Tally (/) if it occurs

Figure 3.7 Teachers’ Visual Representation Coding Sheet
**Video clips:** Video clips can be used either to motivate or to help in the understanding of particular content or skill (i.e., task).

Example: when the teacher taught a soccer unit, she could show a professional soccer game to students to motivate them at the beginning of the unit.

**Physical assistance:** Physical assistance is “physically moving the player’s (student’s) body to the proper position or through the correct range of motion of a skill” (Lacy & Darst, 1989, p. 371).

- Example: teacher corrected students’ foot movement in soccer through physical touch.

Four variables are in the third level. Observers determined in which category the presented task would be included based on the above definitions. Observers coded using the scale numbers 1-4. These data were analyzed using a graphic display (i.e., line graph). Figure 3.5 shows the teachers’ adaptation coding sheet. Each category was defined as follows:

**#4 - Taught/appropriate:** The teacher used content that they were previously taught in the CK workshop and it was an appropriate task for students. The appropriate task is developmentally appropriate, content specific, and context specific.

**#3 - Not taught/appropriate:** The teacher used content that they were not taught in the CK workshop but it was an appropriate task for students. The appropriate task is developmentally appropriate, content specific, and context specific task.

**#2 - Taught/inappropriate:** The teacher used content that they were previously taught in the CK workshop but it was an inappropriate task for students. The
inappropriate task is not developmentally appropriate, and/or content specific, and/or context specific.

#1 - Not taught/inappropriate: The teacher used content that they were not taught in the CK workshop and it was an inappropriate task for the students. The inappropriate task is not developmentally appropriate, content specific, or context specific.

**Student Variable**

One dependent variable related to student behavior was selected in this study. The dependent variable measured was students’ correct, incorrect, or off task performance. The student variable is related to the teacher variables. For example, if teachers have mature and appropriate PCK, students are more likely to perform correctly. If teachers have sophisticated verbal representations and clear visual representations, students are more likely to perform correctly. If teachers choose appropriate tasks learned from the workshop, students are also more likely to perform correctly.

Two observers watched each lesson on site and recorded all students’ performance based on teachers’ criteria (i.e., critical elements). If the teacher mentioned what to expect in terms of critical elements, two observers would make a decision on which two critical elements best represent the teacher’s intent. If the teacher did not mention what critical elements are, observers would look at what two common outcome measures are in that activity. In this observation, two observers divided all students into two parts and coded the designated part of the students’ performance.

Momentary time sampling was used for the dependent variable (i.e., student correct, incorrect, or off task performance). It is defined as “the observer using
momentary time sampling records whether the target behavior is occurring at the moment that each time interval ends” (Cooper et al., 2007, p. 93). The observers determined whether a student’s performance is correct, incorrect, or off task. The teachers were asked to signal to observers 3 minutes before they moved on to the next task. Two observers split the class into two and each recorded their own half. The observers scanned from left to right and counted how many students correctly performed the task. The observers watched one trial per student and moved on to the next student from left to right. The observers recorded the students’ correct performances based on what the teachers stated as their criteria during the task introduction.

There were three scanning guidelines: 1) observe each student once; 2) if an observed student reappears in the scan area, do not record a second time; 3) do not backtrack to count new students entering the scan area; and 4) if someone blocks the view of a student, wait for 30 seconds and move to the next student.

Data from live coding were analyzed by calculating the trials in terms of students’ correct, incorrect, or off task performance per lesson. The number of students who performed the task correctly was divided by the number of students in the class and then was multiplied by 100. The data were reported by a percentage of total interval measures per lesson and these data were analyzed using a graphic display (i.e., bar graph). Figure 3.8 shows the students’ correct performance coding sheet. These categories are defined as follows:

**Correct trials:** Students met the criteria (i.e., critical element outcome) that teachers provided for them. Two critical elements were chosen from the criteria teachers
mentioned. If the teacher stated one outcome criterion, then it was used. If the teacher stated more than two, the observer chose the two main criteria in consultation with the other observer from what the teachers mentioned.

- Example: the student performed an inside pass in soccer using the appropriate critical elements (e.g., use the inside of the foot and face the target) that the teacher mentioned.

Incorrect trials: Students did NOT meet the criteria that teachers provided for them.

- Example: the student performed a dribble in soccer without the proper critical elements (e.g., caress ball in stride and keep head up) that the teacher mentioned.

Off task: Students did NOT perform the activity that teachers provided for them.

- Example: the student was goofing around or talking and not paying attention to the teacher.

Observation and Recording Procedures

This section describes the equipment used, participant reactivity, the description and training of observers, and interobserver agreement (IOA) procedure.

Equipment

All lessons were conducted on the same fields. The lessons were videotaped using two digital camcorders to create a permanent product. The camcorders recorded the lesson in wide range of view positioned in two corners of the field during the lesson. One was the main camcorder and the other one was for back-up.
Example of Students’ correct performance coding sheet (Scanning)

<table>
<thead>
<tr>
<th>Task</th>
<th>Critical Elements (TWO) Or Tactical Position</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>Correct</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inside of the foot Facing target</td>
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<td>V</td>
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<td>V</td>
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<td>V</td>
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<td>.</td>
<td>V</td>
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<td>25</td>
<td>40</td>
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</tbody>
</table>

Figure 3.8 Students’ Correct Performance Coding Sheet (Scanning)
Videotaping began when the teacher started talking to students on the field and finished when all students were off the field. The teachers wore a wireless microphone, connected to the camcorder so that the observers could listen to the teachers’ voice. The videotaped data were used only to analyze the teacher data (i.e., teacher’s maturity, appropriateness, verbal representations, visual representations, and task adaptations). Figure 3.9 shows a diagram of the location of the camcorders. These camcorders videotaped the entire playground field so that all students and the teacher could be captured in one range of view.

![Diagram of Location of Camcorders](image)

**Figure 3.9 A Diagram of Location of Camcorders**

*Participant Reactivity*

Participant reactivity is when “the person being observed is aware of the observer’s presence and purpose” (Cooper et al., 2007, p. 55). The presence of observers and observers’ obtrusive behaviors could influence a participant’s behavior. To collect
more accurate data, participants’ reactivity should be reduced.

To reduce participants’ reactivity, the following strategies were implemented in this study.

1. Prior to the study, the investigators were present in the class two times for one hour to minimize the reaction against the novel presence of the investigators.
2. The investigators tried not to talk with any students and the teacher during the lesson.
3. The investigators were located out of the designated lesson area and in an unobtrusive position.

The investigators were introduced to the classes and the purpose of the presence of the investigators was explained before the unit started.

*Description and Training of Observers*

Both live coding and video coding were conducted during this study but the training procedures for observers were the same. In each case, two observers conducted data coding while watching either actual classes or the video clips. One observer was a soccer player and she is currently working as an international referee. The other observer was the primary investigator in the Physical Education Teacher Education (PETE) program at the Ohio State. The definitions of dependent variables (See Appendix F and G) were provided to the observers before the training session started. The training of the observers began with understanding the definition of the variables related to both student behavior or teacher behavior and then the observers were asked to take a written test. Subsequently, an accuracy assessment was conducted using videotapes for each coding
category. Finally, IOA between the observers was obtained. The following is the training procedure for the observer to code:

1. *Understanding of definitions:* The observers were provided with the definitions of each variable and required to learn all definitions independently. The investigators and the observers then discussed the definitions and made clarifications if necessary (See Appendix F and G).

2. *Written test:* The observers took written tests that included all variables. They were required to categorize all variables according to the definitions (See Appendix H and I).

3. *Videotape code and live code:* The observers watched a 15-minute video clip of a physical education lesson and live soccer practice or game. During the observations, they were required to practice coding in each coding category using the coding sheets.

4. *Accuracy assessment:* The primary investigator coded one 15-minute video clip of a physical education lesson and then observers coded the same video clip. IOA between the investigator and the observers was calculated.

5. *IOA between observers:* IOA between the observers was obtained on 35.7% of the data.

*Interobserver Agreement*

IOA refers to “the degree to which two or more independent observers report the same observed values after measuring the same events” (Cooper et al., 2007, p. 113). The purpose of doing IOA is to reduce observer subjectivity and drift, and to increase
confidence about the definitions of target behavior (Cooper et al., 2007). IOA was conducted between the primary investigator and another observer and between the observers. IOA was conducted on 35.7% (15 of 42 classes) of all dependent measures in comparison and experimental data. The percentage of agreement was calculated using the following formula: the agreement divided by total trials (i.e., agreement plus disagreement) and then multiplied by 100 in order to compute the percentage of agreement (Cooper et al., 2007). The IOA data presented using a table in chapter 4.

The Research Design and Treatment Integrity

In this section, the research design and the treatment integrity are described.

Research Design

In this study, the CK workshop serves as the independent variable. Through the CK workshop with the knowledge packet, the intervention effect was demonstrated by showing the change in the dependent variables (i.e., student behaviors and teacher behaviors) after intervention (i.e., the CK workshop for teachers using the soccer knowledge packet).

Block design was used in this study. The teachers served as a block and they taught both the comparison and the experimental conditions. The researcher randomly selected two classes for the comparison group and two classes for the experimental group from the list of classes provided by the teachers. The investigators observed a soccer unit with two comparison groups of classes each teacher. After each teacher’s teaching of a soccer unit in the comparison group, the researcher took part in a CK workshop using a soccer knowledge packet. The investigators observed another soccer unit with two
experimental groups of classes per teacher to see whether there were any differences in students’ learning and teacher behaviors before and after the CK workshop. Figure 3.10 shows a diagram of the research design.

![Figure 3.10 A Diagram of Research Design](image)

The descriptive statistics was selected to assess the effects of intervention (i.e., a CK workshop) on the dependent variables (i.e., student behavior and teacher behavior). Different intact classes were selected as a comparison group and experimental group to reduce the potential learning effect. Therefore, the investigator was able to test the variability of teachers and students as well as the difference between the two
groups. This study consisted of two independent studies with two teachers. Figure 3.11 shows the research design for direct observation data collection.

![Research Design for Direct Observation Data Collection](image.png)

**Figure 3.11 Research Design for Direct Observation Data Collection**

In this study, there were three phases. Phase 1 included data collected from the comparison group. Among four different classes for each teacher, the investigator randomly selected two of them as the comparison group and the rest of them as the experimental group to reduce group effect. Phase 2 was the intervention phase in which teachers were provided with a CK workshop with a soccer knowledge packet. Lastly,
phase 3 began with data collected from the experimental group. A diagram of all three phases of this study is shown in Figure 3.12.

Two teachers taught two intact classes for the comparison group and then two intact classes for the experimental group. The intervention was implemented between two conditions: the comparison condition, and the experimental condition. Each teacher taught both conditions of classes to reduce the potential teacher effects.

![Figure 3.12 A Diagram of Three Phases of the Study](image)

**Treatment Integrity**

Treatment integrity refers to “the extent to which the independent variable is implemented and carried out as planned” (Cooper et al., 2007, p. 235). To determine the degree to which the teacher correctly implemented the components of the knowledge
packet, two strategies were used. First, the researcher had a rehearsal session to provide correct information to teachers. The aim of this rehearsal session was to maximize the investigator’s competence level for conducting the workshop and to minimize any problems that might happen during the workshop.

Second, the investigator used the checklist (See Appendix J) to ensure that the teacher implemented the treatment correctly. This checklist was completed in each lesson for the experimental group.

The primary purpose of this study was to examine the effects of a CK workshop on the improvement of teachers’ PCK. A secondary purpose was to examine the effects of changes in teachers’ PCK on student learning in a middle school soccer unit.

Data Analysis

The dependent variables were measured using direct observation to answer the research questions. The data were displayed by graphic presentations.

Student Variables

The Statistical Package for the Social Science (SPSS) v17 was used to run descriptive statistics for students’ percent correct, incorrect, and off task performance. Descriptive statistics (i.e., means, standard deviations, and range) were computed for both the comparison group and the experimental group. The data were displayed by graphic presentations (e.g., bar graph).

Teacher Variables

SPSS (v17) was used to run descriptive statistics for maturity, appropriateness, verbal representations, visual representations, and task adaptations. Descriptive statistics
(i.e., means, range, and modal) were computed for both the comparison and the experimental group. The data were displayed by graphic presentations (e.g., bar graph, and line graph).

Summary

Table 3.5 summarizes all variables that were measured, how the data were collected and how they were reported. The results are presented in chapter 4.
<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 level of task maturity and appropriateness occurred in the comparison and the experimental group lessons?</td>
<td>Maturity, Appropriateness, Effectiveness</td>
<td>Event recording</td>
<td>Descriptive statistics (e.g., modal scores), Graphic presentation (Line graph)</td>
</tr>
<tr>
<td>2</td>
<td>What were the differences in the number and types of teachers’ verbal and visual representations between the comparison and the experimental groups?</td>
<td>Instructions, Descriptions, Analogies and metaphors, Cues, Specific congruent feedback, Demonstrations, Gestures, Task cards/pictures/diagrams, Video clips, Physical assistance</td>
<td>Event recording</td>
<td>Descriptive statistics (e.g., means and range), Frequency measure, Graphic presentation (bar graph)</td>
</tr>
<tr>
<td>3</td>
<td>What level of task adaptation occurred in the comparison and the experimental groups?</td>
<td>Adaptations, Appropriateness of tasks</td>
<td>Event recording</td>
<td>Descriptive statistics (e.g., modal scores), Graphic presentation (Line graph)</td>
</tr>
<tr>
<td>4</td>
<td>What was the percentage of correct, incorrect, and off task performance by students in the comparison and the experimental groups?</td>
<td>Percent correct, incorrect, and off task performance</td>
<td>Momentary time sampling</td>
<td>Descriptive statistics (e.g., percentiles), Percentage measure, Graphic presentation (bar graph)</td>
</tr>
</tbody>
</table>

Table 3.5 Summary of Research Questions, Type of Variables Measured, Data Collection Method, and Data Report Method
Table 3.5 Continued

<table>
<thead>
<tr>
<th>5</th>
<th>What was the percentage of correct performance by students in the comparison and the experimental groups when the data were coded using appropriate and inappropriate task criteria?</th>
<th>Correct performance</th>
<th>Incorrect performance</th>
<th>Off task performance</th>
<th>Momentary time sampling</th>
<th>Descriptive statistics (e.g., percentiles)</th>
<th>Percentage measure</th>
<th>Graphic presentation (bar graph)</th>
</tr>
</thead>
</table>


CHAPTER 4

RESULTS

The results of the study are reported in this chapter. Interobserver agreement (IOA) data are presented first. Next, the results for each research question are presented in order. Kathy’s results are presented first, followed by Lisa’s.

Interobserver Agreement

IOA data were collected for 35.7% (15 of 42 classes) on teacher variables in the comparison and the experimental groups. IOA data were not collected on student variables. Table 4.1 and Table 4.2 summarize the percentage of IOA for Kathy’s and Lisa’s lessons in the comparison and the experimental groups.

<table>
<thead>
<tr>
<th>Teacher Variables</th>
<th>Mean and range of Kathy’s class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Comparison</td>
</tr>
<tr>
<td></td>
<td>Class 1</td>
</tr>
<tr>
<td>Maturity &amp; Appropriateness</td>
<td>100.0%</td>
</tr>
<tr>
<td>Verbal</td>
<td>98.9%</td>
</tr>
<tr>
<td>Representations</td>
<td>(96.0-100.0%)</td>
</tr>
<tr>
<td>Visual Representations</td>
<td>100.0%</td>
</tr>
<tr>
<td>Task Adaptations</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 4.1 Percentage of Interobserver Agreement for Kathy’s Lessons in the Comparison and the Experimental Groups
### Table 4.2 Percentage of Interobserver Agreement for Lisa’s Lessons in the Comparison and the Experimental Groups

#### Research Questions Results

**Research Question 1: What level of task maturity and appropriateness occurred in the comparison and the experimental group lessons?**

This question explored the teachers’ task maturity and appropriateness. The data for task maturity and appropriateness were recorded on a scale of one to four:

1 — reflecting that the task is “immature and inappropriate”

2 — reflecting that the task is “immature and appropriate”

3 — reflecting that the task is “mature and inappropriate”

4 — reflecting that the task is “mature and appropriate”

The data are presented first as an aggregate, then day-by-day.

#### Aggregate Data for Task Maturity and Appropriateness

**Kathy**

The modal scores for Kathy’s task maturity and appropriateness in the comparison and the experimental groups were 1 and 4, respectively (See Figure 4.1).
Maturity and Appropriateness

Figure 4.1 Modal Scores for Kathy’s Task Maturity and Appropriateness in the Comparison and the Experimental Groups

Lisa

The modal scores for Lisa’s task maturity and appropriateness in the comparison and the experimental groups were 1 and 4, respectively (See Figure 4.2).

Day-by-Day Data for Task Maturity and Appropriateness

Kathy

The level of Kathy’s task maturity and appropriateness was stable in class 1 in her comparison group. Twelve out of thirteen tasks were coded as immature and inappropriate. One task on day-6 was mature, but inappropriate. In class 2 in her comparison group, the level of maturity and appropriateness was stable from day-2 to day-6, but three tasks on day-1 were variable. Although two tasks were introduced in mature ways by the teacher, these tasks were inappropriate. Kathy’s task maturity and
appropriateness in class 1 and 2 in the comparison group are presented in Figure 4.3.

Twelve out of eighteen tasks in Kathy’s class 1 in her experimental group were coded as mature and appropriate tasks. Although five out of eighteen tasks were explained in immature ways by the teacher, these tasks were appropriate tasks. Similarly, thirteen out of eighteen tasks in class 2 in her experimental group were coded as mature and appropriate tasks. Three out of eighteen tasks were coded as immature but appropriate tasks, and two tasks were coded as mature but inappropriate. Kathy’s task maturity and appropriateness in class 1 and 2 in the experimental group are presented in Figure 4.4.
The level of Lisa’s task maturity and appropriateness was variable in class 1 in her comparison group. All tasks were coded as inappropriate tasks and only six out of sixteen tasks were explained in mature ways by the teacher. Similar to her class 1, all
tasks were coded as inappropriate tasks and twelve out of sixteen tasks were immature tasks. Lisa’s task maturity and appropriateness in class 1 and 2 in the comparison group are presented in Figure 4.5.

Figure 4.4 Kathy’s Task Maturity and Appropriateness in Class 1 and 2 in the Experimental Group
All tasks in Lisa’s class 1 and 2 in her experimental group were coded as mature and appropriate tasks. Lisa’s task maturity and appropriateness in class 1 and 2 in the experimental group are presented in Figure 4.6.
Research Question 2: What were the difference in the number and types of teachers’ verbal and visual representations between the comparison and the experimental groups?

This question examined teachers’ verbal and visual representations of tasks to students. The data are reported by the number per lesson of each variable according to the teacher behaviors. The data are presented first as an aggregate, then day-by-day.

Figure 4.6 Lisa’s Task Maturity and Appropriateness in Class 1 and 2 in the Experimental Group
Aggregate Data for Teachers’ Verbal and Visual Representations

**Kathy**

In the category of verbal representations in the comparison group, Kathy used instructions ranging between 1 and 5 per lesson (mean of 2.4), descriptions ranging between 2 and 27 per lesson (mean of 9.3), cues ranging between 1 and 19 per lesson (mean of 5.8), and specific congruent feedback ranging between 0 and 10 per lesson (mean of 2.7). She did not use any analogies or metaphors. In the experimental group, she used instructions ranging between 3 and 15 per lesson (mean of 5.7), descriptions ranging between 17 and 59 per lesson (mean of 34.8), analogies or metaphors ranging between 1 and 12 per lesson (mean of 4.7), cues ranging between 2 and 14 per lesson (mean of 9.3), and specific congruent feedback ranging between 6 and 17 per lesson (mean of 10.0). The mean of the number of verbal representations in Kathy’s comparison and experimental groups is presented in Figure 4.7.

In the category of visual representations in the comparison group, Kathy used demonstrations ranging between 0 and 2 per lesson (mean of 0.3) and gestures ranging between 0 and 2 per lesson (mean of 0.4). She did not use any task cards, pictures, diagrams, video clips, nor did she provide physical assistance. In the experimental group, she used demonstrations ranging between 0 and 12 per lesson (mean of 5.8), gestures ranging between 0 and 3 per lesson (mean of 1.2), and task cards, pictures, or diagrams ranging between 1 and 3 per lesson (mean of 1.6). She did not use any video clips or physical assistance. The mean of the number of visual representations in Kathy’s comparison and experimental groups is presented in Figure 4.8.
Figure 4.7 Mean of Number of Verbal Representations in Kathy’s Comparison and Experimental Groups

Figure 4.8 Mean of Number of Visual Representations in Kathy’s Comparison and Experimental Groups
Lisa

In the category of verbal representations in the comparison group, Lisa used instructions ranging between 2 and 9 per lesson (mean of 4.5), descriptions ranging between 1 and 22 per lesson (mean of 13.1), analogies and metaphors ranging between 0 and 4 per lesson (mean of 1.5), cues ranging between 2 and 18 per lesson (mean of 9.7), and specific congruent feedback ranging between 0 and 8 per lesson (mean of 4.0). In the experimental group, she used instructions ranging between 2 and 9 per lesson (mean of 4.6), descriptions ranging between 16 and 38 per lesson (mean of 27.0), analogies and metaphors ranging between 0 and 7 per lesson (mean of 4.0), cues ranging between 12 and 49 per lesson (mean of 24.3), and specific congruent feedback ranging between 4 and 19 per lesson (mean of 9.1). The mean of the number of verbal representations in Lisa’s comparison and experimental groups is presented in Figure 4.9.

Figure 4.9 Mean of Number of Verbal Representations in Lisa’s Comparison and Experimental Groups
In the category of visual representations in the comparison group, Lisa used demonstrations ranging between 1 and 11 per lesson (mean of 4.7), gestures ranging between 0 and 4 per lesson (mean of 1.5), and physical assistance ranging between 0 and 2 per lesson (mean of 0.3). She did not use any task cards, pictures, diagrams, or video clips. In the experimental group, she used demonstrations ranging between 1 and 9 per lesson (mean of 6.0), gestures ranging between 0 and 6 per lesson (mean of 3.1), task cards, pictures, or diagrams ranging between 0 and 1 per lesson (mean of 0.3), and physical assistance ranging between 2 and 13 per lesson (mean of 8.8). She did not use any video clips. The mean of number of visual representations in Lisa’s comparison and experimental groups is presented in Figure 4.10.

![Bar graph showing the mean number of visual representations in Lisa’s comparison and experimental groups. The x-axis represents different types of visual representations: Demonstrations, Gestures, Task card, pictures, and diagrams, Video clips, and Physical assistance. The y-axis represents the number of visual representations. The bars for the comparison group are lighter, while the bars for the experimental group are darker.]

**Figure 4.10 Mean of Number of Visual Representations in Lisa’s Comparison and Experimental Groups**
Day-by-Day Data for Teachers’ Verbal and Visual Representations

Kathy

Comparison class 1. In the category of verbal representations, Kathy used instructions ranging between 1 and 5 per lesson (mean of 2.5), descriptions ranging between 2 and 27 per lesson (mean of 11.5), cues ranging between 1 and 8 per lesson (mean of 5.2), and specific congruent feedback ranging between 0 and 10 per lesson (mean of 3.5). She did not use any analogies or metaphors. In the category of visual representations, Kathy used demonstrations ranging between 0 and 2 per lesson (mean of 0.5) and gestures ranging between 0 and 2 per lesson (mean of 0.7). She did not use any task cards, pictures, diagrams, video clips, or physical assistance. Kathy’s verbal and visual representations in comparison class 1 are presented in Figure 4.11.

Comparison class 2. In the category of verbal representations, Kathy used instructions ranging between 1 and 4 per lesson (mean of 2.3), descriptions ranging between 2 and 12 per lesson (mean of 7.7), cues ranging between 2 and 19 per lesson (mean of 6.5), and specific congruent feedback ranging between 0 and 7 per lesson (mean of 1.8). She did not use any analogies or metaphors. In the category of visual representations, Kathy used demonstrations ranging between 0 and 1 per lesson (mean of 0.2) and gestures ranging between 0 and 1 per lesson (mean of 0.2). She did not use any task cards, pictures, diagrams, video clips, or physical assistance. Kathy’s verbal and visual representations in comparison class 2 are presented in Figure 4.12.
Figure 4.11 Kathy’s Verbal and Visual Representations in Comparison Class 1
Figure 4.12 Kathy’s Verbal and Visual Representations in Comparison Class 2
Experimental class 1. In the category of verbal representations, Kathy used instructions ranging between 3 and 8 per lesson (mean of 5.5), descriptions ranging between 17 and 46 per lesson (mean of 30.3), analogies and metaphors ranging 1 and 12 per lesson (mean of 4.2), cues ranging between 6 and 13 per lesson (mean of 9.5), and specific congruent feedback ranging between 7 and 17 per lesson (mean of 10.8). In the category of visual representations, Kathy used demonstrations ranging between 0 and 12 per lesson (mean of 5.2), gestures ranging between 0 and 3 per lesson (mean of 1.2), and task cards, pictures, or diagrams ranging between 1 and 2 (mean of 1.3). She did not use any video clips or physical assistance as she did in her comparison conditions. Kathy’s verbal and visual representations in experimental class 1 are presented in Figure 4.13.

Experimental class 2. In the category of verbal representations, Kathy used instructions ranging between 3 and 15 per lesson (mean of 5.8), descriptions ranging between 22 and 59 per lesson (mean of 39.3), analogies and metaphors ranging between 1 and 11 per lesson (mean of 5.2), cues ranging between 2 and 14 per lesson (mean of 9.0), and specific congruent feedback ranging between 6 and 17 per lesson (mean of 9.2). In the category of visual representations, Kathy used demonstrations ranging between 0 and 11 per lesson (mean of 6.3), gestures ranging between 0 and 3 per lesson (mean of 1.2), and task cards, pictures, or diagrams ranging between 1 and 3 per lesson (mean of 1.8). She did not use any video clips or physical assistance. Kathy’s verbal and visual representations in experimental class 2 are presented in Figure 4.14.
Figure 4.13 Kathy’s Verbal and Visual Representations in Experimental Class 1
Lisa

Comparison class 1. In the category of verbal representations, Lisa used instructions ranging between 3 and 9 per lesson (mean of 5.4), descriptions ranging between 1 and 22 per lesson (mean of 12.6), analogies and metaphors ranging between 0 and 2 per lesson (mean of 1.0), cues ranging between 9 and 18 per lesson (mean of 11.0), and specific congruent feedback ranging between 3 and 8 per lesson (mean of 4.8). In the category of visual representations, Lisa used demonstrations ranging between 1 and 9 per lesson (mean of 4.2), gestures ranging between 0 and 4 per lesson (mean of 1.6), and physical assistance ranging between 0 and 2 per lesson (mean of 0.4). She did not use any task cards, pictures, diagrams, or video clips. Lisa’s verbal and visual representations in comparison class 1 are presented in Figure 4.15.

Comparison class 2. In the category of verbal representations, Lisa used instructions ranging between 2 and 6 per lesson (mean of 3.6), descriptions ranging between 7 and 22 per lesson (mean of 13.6), analogies and metaphors ranging between 0 and 4 per lesson (mean of 2.0), cues ranging between 2 and 12 per lesson (mean of 8.4), and specific congruent feedback ranging between 1 and 6 per lesson (mean of 3.2). In the category of visual representations, Lisa used demonstrations ranging between 1 and 11 per lesson (mean of 5.2), gestures ranging between 0 and 4 per lesson (mean of 1.4), and physical assistance ranging between 0 and 1 per lesson (mean of 0.2). She did not use any task cards, pictures, diagrams, or video clips. Lisa’s verbal and visual representations in comparison class 2 are presented in Figure 4.16.
Figure 4.14 Kathy’s Verbal and Visual Representations in Experimental Class 2
Figure 4.15 Lisa’s Verbal and Visual Representations in Comparison Class 1
Figure 4.16 Lisa’s Verbal and Visual Representations in Comparison Class 2
*Experimental class 1.* In the category of verbal representations, Lisa used instructions ranging between 3 and 5 per lesson (mean of 4.3), descriptions ranging between 18 and 38 per lesson (mean of 29.0), analogies and metaphors ranging 0 and 7 per lesson (mean of 4.3), cues ranging between 14 and 29 per lesson (mean of 22.0), and specific congruent feedback ranging between 5 and 10 per lesson (mean of 7.0). In the category of visual representations, Kathy used demonstrations ranging between 2 and 9 per lesson (mean of 5.8), gestures ranging between 0 and 4 per lesson (mean of 2.5), task cards, pictures, or diagrams ranging between 0 and 1 per lesson (mean of 0.3), and physical assistance ranging between 9 and 12 per lesson (mean of 10.8). She did not use any video clips as she did in her comparison conditions. Lisa’s verbal and visual representations in experimental class 1 are presented in Figure 4.17.

*Experimental class 2.* In the category of verbal representations, Lisa used instructions ranging between 2 and 9 per lesson (mean of 5.0), descriptions ranging between 16 and 38 per lesson (mean of 25.0), analogies and metaphors ranging 2 and 5 per lesson (mean of 3.8), cues ranging between 12 and 49 per lesson (mean of 26.5), and specific congruent feedback ranging between 4 and 19 per lesson (mean of 11.3). In the category of visual representations, Kathy used demonstrations ranging between 5 and 8 per lesson (mean of 6.3), gestures ranging between 2 and 6 per lesson (mean of 3.8), task cards, pictures, or diagrams ranging between 0 and 1 per lesson (mean of 0.3), and physical assistance ranging between 2 and 13 per lesson (mean of 6.8). She did not use any video clips. Lisa’s verbal and visual representations in experimental class 2 are presented in Figure 4.18.
Figure 4.17 Lisa’s Verbal and Visual Representations in Experimental Class 1
Figure 4.18 Lisa’s Verbal and Visual Representations in Experimental Class 2
Research Question 3: What level of task adaptation occurred in the comparison and the experimental groups?

This question examined the teachers’ task adaptations. The data for the task adaptations were recorded on a scale of one to four:

1 — reflecting that the task is “not taught and inappropriate”
2 — reflecting that the task is “not taught but appropriate”
3 — reflecting that the task is “taught but inappropriate”
4 — reflecting that the task is “taught and appropriate”

The data are presented first as an aggregate, then day-by-day.

Aggregate Data for Teachers’ Task Adaptation

Kathy

The modal scores for Kathy’s task adaptation in the comparison and the experimental group were 1 and 4, respectively (See Figure 4.19).

Figure 4.19 Modal Scores for Kathy’s Task Adaptation in the Comparison and the Experimental Group
Lisa

The modal scores for Lisa’s task adaptation in the comparison and the experimental group were 1 and 4, respectively (See Figure 4.20).

![Figure 4.20 Modal Scores for Lisa’s Task Adaptation in the Comparison and the Experimental Group](image)

Day-by-Day Data for Teachers’ Task Adaptation

Kathy

The level of Kathy’s task adaptations was stable in both classes in her comparison group. She used no task from the content knowledge (CK) workshop. The tasks that she used were all coded as inappropriate (See Figure 4.21). The level of Kathy’s task adaptations in her experimental class 1 was stable. The first task in day 1 did not come from the CK workshop and this task was coded as inappropriate, but the other tasks came from the workshop and these were all coded as appropriate. In Kathy’s experimental class 2, sixteen out of eighteen tasks were taught from the CK workshop and these were all appropriate tasks (See Figure 4.22)
Figure 4.21 Kathy’s Task Adaptations in Class 1 and 2 in the Comparison Group

Figure 4.22 Kathy’s Task Adaptations in Class 1 and 2 in the Experimental Group
Lisa’s level of task adaptations was stable in both classes in her comparison group. All tasks were not taught from the CK workshop and these tasks were all coded as inappropriate (See Figure 4.23). Her level of task adaptations was also stable in both classes in her experimental group. All tasks came from the workshop and these were all appropriate tasks (See Figure 4.24).
Research Question 4: What was the percentage of correct, incorrect, and off task performance by students in the comparison and the experimental groups?

Each teacher taught two classes in the comparison and the experimental groups. The data are reported for three forms of performance: correct, incorrect, or off-task. Mean group difference data are presented as percentage measures. The data are presented first as an aggregate, then day-by-day.

Aggregate Data for Student Performance

Kathy

Student performance data were collected during six-day soccer units taught in both groups. The mean of student correct performance in Kathy’s comparison class 1 was
29.3% (range, 10.0–50.0%) and class 2 was 22.8% (range, 0–45.8%). The mean for both classes was 25.9%. The mean of student incorrect performance in Kathy’s comparison class 1 was 39.3% (range, 15.0–65.0%) and class 2 was 33.3% (range, 8.3–75.0%). The mean for both classes was 36.2%. The mean of student off task performance in Kathy’s comparison class 1 was 29.3% (range, 0–55.0%) and class 2 was 43.9% (range, 4.2–87.5%). The mean for both classes was 38.0%.

The mean of student correct performance in Kathy’s experimental class 1 was 43.9% (range, 15.4–84.6%) and class 2 was 35.0% (range, 4.2–62.5%). The mean for both classes was 39.4%. The mean of student incorrect performance in Kathy’s experimental class 1 was 28.7% (range, 3.9–53.9%) and class 2 was 35.2% (range, 8.3–79.2%). The mean for both classes was 31.9%. The mean of student off task performance in Kathy’s experimental class 1 was 25.6% (range, 3.9–57.7%) and class 2 was 29.8% (range, 4.2–79.2%). The mean for both classes was 28.7%. The data are presented in Figure 4.25.

Lisa

Student performance data were collected during five-day soccer units taught in the comparison group and four-day soccer units taught in the experimental group. The mean of student correct performance in Lisa’s comparison class 1 was 44.4% (range, 24.0–80.0%) and class 2 was 39.3% (range, 23.3–66.7%). The mean for both classes was 41.9%. The mean of student incorrect performance in Lisa’s comparison class 1 was 37.0% (range, 16.0–64.0%) and class 2 was 39.1% (range, 10.0–60.0%). The mean for both classes was 38.0%. The mean of student off task performance in Lisa’s comparison
class 1 was 18.6% (range, 0–56.0%) and class 2 was 21.6% (range, 0–66.7%). The mean for both classes was 20.0%.

The mean of student correct performance in Lisa’s experimental class 1 was 50.5% (range, 33.3–80.0%) and class 2 was 35.9% (range, 23.1–53.9%). The mean for both classes was 43.8%. The mean of student incorrect performance in Lisa’s experimental class 1 was 29.5% (range, 0–60.0%) and class 2 was 37.8% (range, 19.2–50.0%). The mean for both classes was 33.4%. The mean of student off task performance in Lisa’s experimental class 1 was 21.0% (range, 6.7–40.0%) and class 2 was 26.3% (range, 19.2–38.5%). The mean for both classes was 22.9%. The data are presented in Figure 4.26.

Figure 4.25 Means of Students’ Percent Correct, Incorrect, and Off Task Performance in Kathy’s Comparison and Experimental Groups
Day-by-Day Data for Student Performance

The data are presented day-by-day in the comparison and the experimental groups. Three criteria have been used to classify the data. Data are reported as stable or with low variability if they vary less than 19 percentage points. Data are reported as moderate variability if they vary by more than 20-40 percentage points. Data are reported as highly variable if they vary more than 41 percentage points.

*Kathy*

The data for correct performance were moderately variable ranging between 20.0% and 40.0%, incorrect performance were moderately variable ranging between 23.3% and 48.3%, and off task behavior were highly variable ranging between 0% and 46.7% over the six days in class 1 in Kathy’s comparison group.

The data for correct performance were moderately variable ranging between 12.5% and 33.3%, incorrect performance were highly variable ranging between 9.7% and
68.0%, and off task behavior were also highly variable ranging between 9.7% and 77.8% over the six days in class 2 in Kathy’s comparison group. The students’ percent correct, incorrect performance, and off task performance per day in Kathy’s comparison group are presented in Figure 4.27.

![Figure 4.27 Students’ Percent of Correct and Incorrect Performance per Day in Kathy’s Comparison Group](image-url)
The data for correct performance were slightly variable ranging between 37.5% and 50.0%, incorrect performance were slightly variable ranging between 19.2% and 37.5%, and off task behavior were moderately variable ranging between 12.8% and 34.6% over the six days in class 1 in Kathy’s experimental group.

The data for correct performance were stable ranging between 31.3% and 38.9%, incorrect performance were moderately variable ranging between 16.7% and 53.1%, and off task behavior were also moderately variable ranging between 13.5% and 50.0% over the six days in class 2 in Kathy’s experimental group. The students’ percent correct, incorrect performance, and off task performance per day in Kathy’s experimental group are presented in Figure 4.28.

Lisa

The data for correct performance were moderately variable ranging between 30.0% and 70.0%, incorrect performance were moderately variable ranging between 22.0% and 44.0%, and off task behavior were moderately variable ranging between 8.0% and 29.3% over the five days in class 1 in Lisa’s comparison group.

The data for correct performance were slightly variable ranging between 33.3% and 46.7%, incorrect performance were slightly variable ranging between 31.7% and 46.7%, and off task behavior were also moderately variable ranging between 14.2% and 35.0% over the five days in class 2 in Lisa’s comparison group. The students’ percent correct, incorrect performance, and off task performance per day in Lisa’s comparison group are presented in Figure 4.29.

The data for correct performance were little variable ranging between 42.2% and
61.7%, incorrect performance were moderately variable ranging between 16.7% and 43.3%, and off task behavior were stable ranging between 16.7% and 24.4% over the four days in class 1 in Lisa’s experimental group.

![Figure 4.28 Students’ Percent of Correct and Incorrect Performance per Day in Kathy’s Experimental Group](image)

The data for correct performance were stable ranging between 34.6% and 38.5%,
there was no trend in incorrect performance ranging between 34.6% and 42.3%, and off
task behavior were also stable ranging between 23.0% and 28.9% over the four days in
class 2 in Lisa’s experimental group. The students’ percent correct, incorrect performance,
and off task performance per day in Lisa’s experimental group are presented in Figure
4.30.

Figure 4.29 Students’ Percent of Correct and Incorrect Performance per Day in
Lisa’s Comparison Group
Research Question 5: What was the percentage of correct performance by students in the comparison and the experimental groups when the data were coded using appropriate and inappropriate task criteria?

In this research question, data were collected on student correct performance in
the context of whether the task was appropriate or inappropriate. The data are reported by the percentage of students’ correct performance excluding incorrect and off-task performances. The data are presented first as an aggregate, then day-by-day.

**Aggregate Data for Student Correct Performance**

**Kathy**

Kathy used only inappropriate tasks in the comparison group. The percent correct performance of the inappropriate tasks in the comparison group ranged between 0% and 50.0% (mean of 25.9%). There were 0% of correct performances for appropriate tasks in the comparison group because she did not use any appropriate tasks in this group. She used both appropriate and inappropriate tasks in the experimental group. The percent correct performance of the appropriate tasks in the experimental group ranged between 4.2% and 58.3% (mean of 38.3%). The percent correct performance of the inappropriate tasks in the experimental group ranged between 25.0% and 84.6% (mean of 49.8%). The mean of student percent correct performance for Kathy’s appropriate and inappropriate tasks in both groups is presented in Figure 4.31.

**Lisa**

There were 0% of correct performances for appropriate tasks in the comparison group because Lisa used only inappropriate tasks in this group. The percent correct performance of the inappropriate tasks in the comparison group ranged between 23.3% and 80.0% (mean of 41.9%). She used only appropriate tasks in the experimental group. The percent correct performance of the appropriate tasks in the experimental group ranged between 23.0% and 80.0% (mean of 43.8%). There were 0% of correct
performances for inappropriate tasks in the experimental group because she did not use any inappropriate tasks in this group. The mean of student percent correct performance for Lisa’s appropriate and inappropriate tasks in both groups is presented in Figure 4.32.

Figure 4.31 Mean Student Percent Correct Performance for Kathy’s Appropriate and Inappropriate Tasks in Both Groups
Kathy used inappropriate tasks in both classes in the comparison group. The percent correct performance of the inappropriate tasks ranged between 20.0% and 31.7% in class 1, and between 12.5% and 33.3% in class 2, respectively. There were 0% of
correct performances for appropriate tasks in both classes in the comparison group because she did not introduce appropriate tasks in this group. The students’ percent correct performance using criteria of appropriate and inappropriate tasks in Kathy’s comparison group is presented in Figure 4.33.

In Kathy’s experimental group, the percent correct performance of the appropriate tasks ranged from 30.8% to 50.0% in class 1, and from 20.8% to 38.9% in class 2, respectively. She used inappropriate tasks in day 1 and 3 in both classes. The percent correct performance in inappropriate tasks was highly variable ranging between 26.9% and 84.6% in class 1, and from 25.0% and 62.5% in class 2, respectively. The students’ percent correct performance using criteria of appropriate and inappropriate tasks in Kathy’s experimental group is presented in Figure 4.34.

Lisa

Lisa used inappropriate tasks in both classes in the comparison group. The percent correct performance of the inappropriate tasks ranged between 30.0% and 70.0% in class 1, and between 33.3% and 46.7% in class 2. There were 0% of correct performances for appropriate tasks in both classes because she did not introduce any appropriate tasks in the comparison conditions. The students’ percent correct performance using criteria of appropriate and inappropriate tasks in Lisa’s comparison group is presented in Figure 4.35.
Figure 4.33 Students’ Percent Correct Performance Using Criteria of Appropriate and Inappropriate Tasks in Kathy’s Comparison Group
Figure 4.34 Students’ Percent Correct Performance Using Criteria of Appropriate and Inappropriate Tasks in Kathy’s Experimental Group
Figure 4.35 Students’ Percent of Correct Performance Using Criteria of Appropriate and Inappropriate Tasks in Lisa’s Comparison Group
Lisa used appropriate tasks in all experimental conditions for both classes. The percent correct performance of the appropriate tasks ranged between 42.2% and 61.7% in class 1, and between 34.6% and 38.5% in class 2. There were 0% of correct performances for inappropriate tasks in both classes in the experimental group because she did not provide inappropriate tasks in this group. The students’ percent correct performance using criteria of appropriate and inappropriate tasks in Lisa’s experimental group is presented in Figure 4.36.

Treatment Integrity

Treatment integrity was checked in all classes in the experimental group using a treatment integrity checklist (Appendix J). Even though there were many off task students and both teachers spent some time to deal with them, the teachers conducted their lessons as planned.

Table 4.3 and Table 4.4 display the treatment integrity of the experimental group for both teachers. Above 80% of treatment integrity was required per lesson. Kathy’s overall treatment integrity was 85.0% for both class 1 and class 2. Lisa’s overall treatment integrity was 92.5% for both class 1 and class 2. The results of treatment integrity scores showed that both teachers effectively implemented the soccer units based on Play Practice, which they learned from the content knowledge (CK) workshop, in their teaching in the experimental group. Kathy’s score was lower than Lisa’s score because they have different preferences in terms of how to teach. For example, Lisa prefers to use physical assistant, but Kathy were not likely to use it. Overall, the data showed that both teachers followed the content of the intervention (i.e., the CK workshop).
Figure 4.36 Students’ Percent of Correct Performance Using Criteria of Appropriate and Inappropriate Tasks in Lisa’s Experimental Group
Lesson Percent Agreement (%)  
<table>
<thead>
<tr>
<th>Class 1</th>
<th>Class 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>80.0</td>
</tr>
<tr>
<td>2</td>
<td>90.0</td>
</tr>
<tr>
<td>3</td>
<td>80.0</td>
</tr>
<tr>
<td>4</td>
<td>90.0</td>
</tr>
<tr>
<td>5</td>
<td>90.0</td>
</tr>
<tr>
<td>6</td>
<td>80.0</td>
</tr>
<tr>
<td>Mean</td>
<td>85.0%</td>
</tr>
</tbody>
</table>

Table 4.3 Treatment Integrity Data for Kathy’s Experimental Group

Lesson Percent Agreement (%)  
<table>
<thead>
<tr>
<th>Class 1</th>
<th>Class 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90.0</td>
</tr>
<tr>
<td>2</td>
<td>90.0</td>
</tr>
<tr>
<td>3</td>
<td>100.0</td>
</tr>
<tr>
<td>4</td>
<td>90.0</td>
</tr>
<tr>
<td>Mean</td>
<td>92.5%</td>
</tr>
</tbody>
</table>

Table 4.4 Treatment Integrity Data for Lisa’s Experimental Group

Summary of Aggregate Data

In order to provide a snapshot of the relationship between all the variables, the mean data of both classes for Kathy’s comparison and experimental groups are presented in Figure 4.37. The mean data of both classes for Lisa’s comparison and experimental groups are presented in Figure 4.38.
Figure 4.37 Kathy’s Summary Data
Figure 4.38 Lisa’s Summary Data
Chapter 5 is organized into six sections: section one presents the answers for each of the research questions. Section two discusses the conceptual contributions. Section three discusses methodological contributions. Section four discusses the limitations and delimitations of the study. Section five discusses possible future directions for research. Finally, section six suggests implications for preservice and inservice teachers.

The Research Questions

Answers are presented below for each research question.

Research question 1: What level of task maturity and appropriateness occurred in the comparison and the experimental group lessons?

The purpose of this question was to identify the differences in teachers’ task maturity and appropriateness in the comparison and the experimental groups. Task maturity and appropriateness were used because it is hypothesized that these variables could differentiate between the groups. The data show that there were large differences between the groups resulting in remarkably different types of tasks. The modal scores for both Kathy’s and Lisa’s task maturity and appropriateness were level 1 (i.e., immature
and inappropriate) in the comparison group, and level 4 (i.e., mature and appropriate) in the experimental group. Kathy used 24/27 immature and inappropriate tasks in the comparison group and 25/36 mature and appropriate tasks in the experimental group. Similarly, Lisa used 22/32 immature and inappropriate tasks in the comparison group, and all 18 tasks were mature and appropriate in the experimental group. In short, both teachers used more immature and inappropriate tasks in the comparison group, and more mature and appropriate tasks in the experimental group.

Task Maturity

In this study, task maturity was treated as one of the indicators of pedagogical content knowledge (PCK). Shulman (1986) has defined PCK as “the most powerful analogies, illustrations, examples, explanations and demonstrations — in a word, the ways of representing and formulating the subject that make it comprehensive to others” (p. 9). Different presentations of the content are likely to produce students’ different understanding. In this respect, the variable of task maturity is an indicator of PCK. Thus, task maturity is defined as “the degree to which a task is represented to the students.” If teachers used accurate descriptions with some examples, analogies, or demonstrations, the teachers’ PCK is more likely to be described as mature. In other words, if teachers are able to explain what they want their students to perform in terms of critical elements of the activity and common mistakes, and then demonstrate the activity, the students are likely to more easily understand what they are supposed to do, and they are more likely to be successful.

Task maturity can be placed on the continuum (Ayvazo, 2007; Ward et al., 2006;
Ward, 2009b). One end is immature and the other end is mature. Consider the following two descriptions of a task:

Description 1: “What we are going to do today is a 3 vs. 1 game. Three of you are offense and one is defense. It is a keep-away game.”

Description 2: “What we are going to do today is a 3 vs. 1 game. What you’ve got here is a triangle. Each of you stands at a corner of the triangle and one is in the middle. If you are forming the triangle, you are the offense. Your job is to, (1) keep the ball away from the student in the middle, (2) pass the ball to your partners so that the defender, the student in the middle, cannot steal or intercept it. This is a keep-away game.”

The first description can be placed somewhere closer to the immature end and the second can be placed closer to the mature end of the task maturity continuum.

A teacher’s use of verbal and visual representations (e.g., analogies, illustrations, examples, explanations, and demonstrations) can help researchers determine where the teacher’s task maturity is located in terms of the continuum. In this study, in the comparison group, the majority of tasks for both teachers were placed closer to the immature end of the task maturity continuum. In contrast, the teachers’ tasks in the experimental group were mostly placed closer to the mature end. The change of tasks from immature to mature occurred following the content knowledge (CK) workshop. The CK presented in the workshop included critical elements of activities, students’ common mistakes, and verbal and visual representations. As the results for question 5 will show, this change in CK also affected student performance.
Ideally, when a teacher notices an incorrect performance, an alternative appropriate and mature task can be presented to the student. If a teacher does not have sufficient CK, it will be difficult to provide additional tasks. In short, if teachers have stronger CK, they have many choices in terms of the tasks and they can in turn provide mature tasks. This finding supports Ayvazo (2007) who found that teachers showed more mature PCK in the content area that they knew best. Two teachers in her study showed different teaching in terms of PCK maturity depending on whether it was a weaker unit or a stronger unit. For example, the teachers used more cues in their stronger unit than in the weaker unit (Ayvazo, 2007). Schempp, Manross, Tan, and Fincher (1998) found that teachers had different instructional abilities and strategies to teach different levels of learner based on their subject area of expertise (i.e., expert areas or nonexpert areas). The teachers who teach in subject areas of expertise were more flexible and were willing to change activities (Schempp et al., 1998). In contrast, the teachers who teach in nonexpert areas were likely to select fewer activities and these teachers’ descriptions of the activities were vague (Schempp et al., 1998). In Schempp et al.’s (1998) study, the expert areas indicate the areas that the teachers have mature PCK, and the nonexpert areas indicate the areas that the teachers have immature PCK in a specific content. In this manner, Schempp et al. (1998) study supported the result of the present study that the teachers’ behaviors were different based on the task maturity of PCK (i.e., mature vs. immature). The present study, like many prior studies, reinforces the belief that PCK is informed by CK (i.e., subject expertise) and other factors such as context, pedagogy, student, and curriculum (Doutis, 1997; Grossman, 1990; Jenkins et al., 2005; Jenkins & Veal, 2002; Kutame,
Task Appropriateness

Appropriateness is also one of the indicators of PCK. Appropriateness of PCK can be divided into three sub categories: (a) developmentally appropriate; (b) content specific; and (c) context specific (Ayvazo, 2007; Ward et al., 2006; Ward, 2009b). Developmentally appropriate PCK can be explained using the example of a 3rd grade soccer class vs. a 12th grade soccer class. Some teachers have appropriate PCK to teach a 12th grade soccer class, but they may not teach a 3rd grade soccer class well. The way of presenting the content in two different grade levels of soccer classes can be different. For example, in a 12th grade soccer class, a teacher would use cognitively higher levels of analogies or metaphors to explain the tasks than she might in a 3rd grade soccer class. Teachers should choose different tasks (i.e., progressions) based on students’ grade levels and skill levels. Teachers should use developmentally appropriate simple words in their descriptions, cues, analogies, and metaphors to present the content, and they should demonstrate the tasks step by step for the 3rd grade soccer class. Teachers should also break down skills into several parts if the skills are complicated, and have students practice each part of the skill first in the 3rd grade soccer class.

In terms of content specificity, a teacher may have stronger PCK in soccer because of many experiences in teaching soccer, but weak PCK in swimming because of little or no experience in teaching swimming. This same teacher might teach soccer exceptionally well, but may not teach swimming well because of the different PCK. In this case, the teacher could provide appropriate tasks when she teaches soccer, but she
would not be able to offer any appropriate tasks in swimming.

Context specificity refers to the use of appropriate facilities, equipment, and space based on the context (e.g., student skill level). A teacher who can teach a beginning 4th grade soccer class well may not teach a high school soccer class effectively because of the different instructional demands, facilities, equipment, and space of the soccer classes. For example, high school students with experience in soccer are able to practice a 4 vs. 2 passing game using a one touch pass, but this task is not appropriate for beginning students. A 4 vs. 1 passing game allowing multiple touches is a more appropriate task for the beginning students.

The data show that there were differences in terms of the appropriateness of the tasks in the comparison and the experimental groups. In the comparison group, Kathy’s tasks were developmentally inappropriate and context inappropriate and Lisa’s tasks were only context inappropriate. For example, Kathy had her students stand on each side (i.e., each team has their side), and the ten balls were in the middle. When she blew the whistle, the students needed to get a ball, and dribble back to their side (i.e., context inappropriate). If one team had more balls than the other team, then that team would receive a point. The students were allowed to steal the balls before the students on the other team passed through their sideline. Kathy’s task may be appropriate for elementary students, but not for middle school students (i.e., developmentally inappropriate) because this task is too easy for middle school students.

Three of Kathy’s tasks in the experimental group were inappropriate tasks. Two of the tasks occurred during warm-up. Even though these two tasks were warm-up tasks,
they should have been developmentally appropriate, content specific, and context specific (Ayvazo, 2007; Ward et al., 2006; Ward, 2009b). Chandler (1996) defines decontextualized skills as those “learned in isolation from the context of the game” (p. 49), which, as a result, make little sense to learners. In this manner, warm-up tasks should include contextualized skill practice using game-like situations (Launder, 2001). If a task is not related to the context of the game, it is categorized as an inappropriate task. For example, as a warm-up task, “dribble the ball down the line, around the cone, and come back” is not as appropriate as “3 vs. 1 passing and possession game focusing on the concept of depth, width, and support.”

What to select from one’s knowledge base is one of the most crucial things in terms of task appropriateness. Teachers can choose a task and this task can be either appropriate or inappropriate. According to what tasks teachers select, student learning may vary. If teachers select appropriate tasks, student performance will be more successful. In contrast, if teachers select inappropriate tasks, student performance will be less successful.

Summary

In this study, both teachers’ PCK was weak in the comparison group as evidenced by the level (i.e., level 1: immature and inappropriate) of task maturity and appropriateness. The maturity and appropriateness data suggest that there was a stronger PCK level (i.e., level 4: mature and appropriate) in the experimental group than that in the comparison group. These data also show that the CK workshop with the knowledge packet was effective in changing the level of task maturity and appropriateness in both
classes, in the experimental group taught by each teacher.

The data provide a validation for the variables of task maturity and appropriateness, because the data demonstrated that tasks can be coded using these categories and that these variables can differentiate between the comparison and the experimental groups. This finding also provides further validation for a central hypothesis of this dissertation that PCK exists on a continuum from immature to mature (Ayvazo, 2007; Ward et al., 2006; Ward, 2009b).

Teachers’ task appropriateness should be determined based on student skill level. Beginning teachers are inclined to blame their students for their lack of success rather than viewing it as a teaching outcome (McCaughtry & Rovegno, 2003). McCaughtry and Rovegno (2003) concluded that if teachers do not consider students’ skill levels and do not provide appropriate tasks, their PCK is often immature. Teachers may recognize students’ skill level, but if they do not have some depth of CK in that activity, they have little to draw on to create PCK. Being able to provide appropriate tasks to students in mature ways suggests that teachers have strong CK because they can select and present more appropriate tasks.

Research question 2: What were the difference in the number and types of teachers’ verbal and visual representations between the comparison and the experimental groups?

The purpose of this question was to examine the differences of each teacher’s verbal and visual representations of the content to the students in the comparison and the experimental groups based on Shulman’s (1986) definition of PCK. Five verbal representations (i.e., instructions, descriptions, analogies and metaphors, cues, and
specific congruent feedback) and five visual representations (i.e., demonstrations, gestures, task cards, pictures, and diagrams, video clips, and physical assistance) were used as variables in this question.

Verbal and visual representations are interrelated with task maturity (discussed in question 1) because if teachers are able to use verbal and visual representations in their tasks, it may indicate that the teachers have more mature PCK. If teachers are able to select an appropriate task, but are not able to explain it properly in terms of using verbal or visual representations, their PCK is less mature. In this study, the teachers’ PCK was likely to be less mature in the comparison group because they did not select appropriate tasks or use many representations. Conversely, in the experimental group, the teachers’ PCK was likely to be more mature because they chose appropriate tasks and used more representations.

The data show that there were differences in teachers’ behaviors in the comparison and experimental groups. In the comparison group, Kathy used four types of verbal representations (i.e., instructions, descriptions, cues, and specific congruent feedback) and only two types of visual representations (i.e., demonstrations and gestures). After the CK workshop, she used all five types of verbal representations and three types of visual representations (i.e., demonstrations, gestures, and task cards, pictures, and diagrams). She not only used different types of verbal or visual representations, but also increased the number of verbal and visual representations in the experimental group. This finding is similar to Lisa’s verbal and visual representations.

Students have different learning styles (e.g., visual learners, audio learners, or
kinesthetic learners) and preference, so students need to receive knowledge through
different types of representations. For example, some students may easily understand
what to do via a demonstration and even though these same students are listening to what
the teacher is saying, their focus is more on what teachers are performing in terms of
demonstrations. Others may understand the tasks from what teachers are saying (i.e.,
audio learners) and less so from the demonstration. Still other students may understand
the tasks via a physical assistance even though this group is still listening and watching
the teachers.

If teachers have stronger CK, they can use many verbal and visual
representations when they are teaching. If verbal and visual representations are used
effectively, students will understand what they are supposed to do. For example, if
teachers use clear verbal instructions, descriptions, and technical cues with full
demonstrations and gestures, students will learn effectively. Conversely, if teachers’
representations are not clear, students will be more likely to be less successful in the
activity.

In terms of the number of verbal and visual representation, one clear
representation can be more effective than several ambiguous representations. It is also
true that a variety of verbal and visual representations will be more effective than no
representations if teachers clearly delivered the representations. Therefore, it is important
to note that teachers should provide clear and various verbal and visual representations
regardless of the number of representations.

*Verbal Representations*
Instructions. In verbal representations, the number of times instructions were used was different in the comparison and the experimental groups. Instructions are defined as a teacher’s verbal description or prompt to the students about how to perform a skill (Hawkins & Wiegand, 1989). Kathy used more than twice as many instructions in the experimental group as those in the comparison group. Lisa used almost same number of instructions in both groups because she repeatedly provided her instructions to small groups. This finding provides some initial support for the argument that, if a teacher has strong CK, then she is more likely to use more instructions.

Descriptions. In terms of descriptions, there were large differences for both teachers in the comparison and the experimental groups. Kathy used almost four times as many descriptions in the experimental group as those in the comparison group. Lisa used twice as many descriptions in the experimental group as those in the comparison group. Descriptions are defined as a teacher’s verbal explanation or illustration on what a particular skill is like. Descriptions also included critical elements of an activity or a skill. If teachers use many descriptions, they will possibly have deeper and stronger CK and PCK in a unit or an activity.

During the observations in both groups, the investigator and the co-investigator noticed that Kathy used descriptions to the whole class and then repeatedly provided the same descriptions to the small group that she assigned. When the instructions were not clear, Kathy repeatedly used same descriptions to the small group or individual students. In addition, both teachers used descriptions repeatedly, when the students were engaging in off task behaviors or when the students seemed like they did not understand what they
were supposed to do in terms of the activity. Although using a number of descriptions can represent deeper and stronger PCK, it is not always the case. Sometimes less is better than more — Kathy’s explanations were unclear so she had to repeat them over time. It would be better for her clearly to explain what the students need to do to the whole group at the beginning of each task.

If teachers use clear and high-quality descriptions, it will be more effective for the students’ understanding without restating the tasks or stopping the class (Rink, 2010). In this study, student performance was more successful with high-quality descriptions. In the comparison group, Lisa used repeated descriptions to her students because her explanation was not clear and accurate. In contrast, in the experimental group, Lisa used the descriptions with technical cues and specific congruent feedback, and her descriptions were effective. She did not have to use many repeated descriptions because her descriptions included all important components of the activity and her explanations were clear in the experimental group. Thus, the quality of the descriptions is more important than the number or amount.

*Analogies and metaphors.* There were large differences for Kathy in this category in her two groups because she did not use any analogies or metaphors in her comparison group, but then she did start to use them in the experimental group. Lisa used approximately three times more analogies and metaphors in the experimental group than the comparison group. One of the analogy examples was “triangle” when Kathy explained the formation of a 3 vs. 1 passing game. Both teachers used only analogies in their lesson in both groups. One particular reason for this might be that the investigator
used only analogies when he implemented the CK workshop. The investigator verbally explained that metaphors could be one option to use in the lesson but he did not show them any metaphor examples. The other reason might be most teachers seldom used metaphors in their lesson (Ayvazo, 2007).

This finding showed that the teachers’ analogies or metaphors were developed after the CK workshop. The teachers learned how to use analogies or metaphors and they learned several examples of analogies in soccer. If teachers use analogies or metaphors, it is an indication that they have more mature and stronger PCK for the content because analogies or metaphors are one of the ways of representing the content. If teachers do not have CK, it will be not easy for them to deliver any analogies or metaphors to the class.

Cues. There were differences in the number of cues both teachers used in the comparison and experimental groups. Kathy used almost twice as many cues in the experimental group as those in the comparison group. Kathy repeatedly used only a few of same cues in her lesson. Lisa used almost three times as many cues in the experimental group as those in the comparison group. If teachers have strong CK, they will be likely to use cues in their lesson. The finding is supported by Ayvazo (2007) who found that two teachers in her study used more cues in their strong unit than the less strong unit. Graham, Hopple, Manross, and Sitzman (1993) also supported the finding that experienced teachers (i.e., the teachers in the experimental group in this study) provided more cues than novice teachers (i.e., the teachers in the comparison group in this study). However, the finding in this study is inconsistent with Rovegno et al. (2003), who found that experienced teachers used a small number of learning cues. Therefore, it is true that the
number of cues used is an indicator of PCK, but the quality of cues needs to be considered.

Specific congruent feedback. In terms of specific congruent feedback, there were large differences for both teachers in the comparison and the experimental groups. Kathy used specific congruent feedback five times more in the experimental group than the comparison group. Lisa used specific congruent feedback twice as much in the experimental group than the comparison group. This finding showed that the CK workshop helped both teachers learn how and when to use specific congruent feedback in a soccer unit because there were differences in the number of specific congruent feedback between the two groups. Increasing the number of specific congruent feedback statements can influence students’ success. In the experimental group, the students were more likely to achieve success in terms of their correct performance. This finding is supported by Cohen’s (2007) findings that the types of feedback (i.e., aligned developmental feedback or inappropriate feedback) were significantly different after “throwing intervention using specific feedback based on the developmental sequence (Cohen, 2007, p. 101).” In her study, this intervention improved student learning of overhand throw. Schempp et al. (1998) also found subject matter expertise plays a critical role in teaching and teachers are likely to provide more appropriate feedback when they teach their expert area.

Visual Representations

Demonstrations. In the category of visual representations, the number of demonstrations was largely different for both teachers in the comparison and the experimental groups. Kathy performed five times as many demonstrations in the
experimental group than those in the comparison group. The number of Lisa’s demonstrations was also a little more in the experimental group (mean of 6.0) than the comparison group (mean of 4.7). The reason Lisa used the large number of demonstration in the comparison group is that one of her preferred presentation techniques is demonstration. Kathy’s demonstrations were visually effective in helping students understand what to do in the experimental group, when comparing to only a few demonstrations in the comparison group. Both teachers used their students to demonstrate tactics, but demonstrated the technique by themselves. The teachers used demonstrations at least once per lesson in the experimental group.

The finding supports the assumption that if teachers have little CK, they are not likely to use demonstrations in their lessons. They may not have competence to perform demonstrations because they are not proficient in the activity. When teachers introduce a new task, it is better to have at least one demonstration because accurate demonstrations can enhance the clarity of the task (Rink, 2010). Through the demonstration, students will know what they are supposed to do and what a successful task will achieve (Siedentop & Tannehill, 2000). More than one demonstration of a task is preferable when the task is difficult to perform. In this case, teachers can break down the skills into several parts and separately demonstrate each part.

**Gestures.** In terms of gestures, there were differences in the number of gestures for Kathy and Lisa in the comparison and the experimental groups. Kathy used three times as many gestures in the experimental group as those in the comparison group. Lisa used twice as many gestures in the experimental group as the comparison group.
Compared to the other visual representations, it seemed that both teachers showed a preference not to use gestures. However, the real reason may be that the camcorders were not able to capture the teachers’ behaviors because some students blocked the teachers’ movement (e.g., teachers’ facial expression). Even though the observers’ under-recording of gestures is taken into account, the number of gestures was still lower than the other visual representations.

Task cards, pictures, or diagrams. In task cards, pictures, or diagrams, there were large differences for both teachers in the comparison and the experimental groups. Kathy did not use any task cards, pictures, or diagrams in the comparison group, but she used diagrams every lesson in the experimental group to help her students understand what she wanted them to perform. Lisa also did not use any task cards, pictures, or diagrams in the comparison group, but she used diagrams in the experimental group. Interestingly, the investigator provided how to use task cards, pictures, and diagrams without showing them any examples and then the teachers used only diagrams as their visual representations. This result indicates the teachers have their personal preferences because they did not use any task cards or pictures.

Both teachers used these visual tools (i.e., diagrams) for their lessons in the experimental group because they came to obtain deeper CK and PCK through the workshop. If teachers do not know the activities they need to teach, they cannot use any task cards, pictures, or diagrams. Being able to use these task cards, pictures, and diagrams as visual tools indicates that the teachers were able to present the CK to their students in different ways and this suggests that teachers who do this may have stronger
CK than those who do not.

*Video clips.* Neither teacher used video clips in the comparison or the experimental groups. There are several reasons that the teachers did not use video clips. One particular reason for this might be that the investigator and his assistants did not use it and just explained it when they provided the CK workshop. The other reasons for this might be that the teachers did not have any technological equipment, or they did not know how to use it. However, video clips might not have been necessary because the video clips could be replaced with task cards, pictures or diagrams. It is true that visual representations are necessary, but all types of visual representations do not need to be used together at once. This argument is supported by Rink (1994) that task presentation (e.g., teacher cues, demonstration) is important in student learning, but every task does not need to have “all the characteristics of the ideal task presentation (p. 276).” She also argued that the total score on the Qualitative Measures of Teaching Performance Scale (QMTPS) is more relevant to student learning than any single task presentation (Rink, 1994). It is also true that each visual representation may have different impacts on students because of the difference of students’ learning styles and preference.

*Physical assistance.* Kathy did not use any physical assistance for any of her classes in both groups even though the investigator demonstrated physical assistance in the CK workshop. Kathy’s teaching style was not tied to using any physical assistance, but she did use a lot of words. Kathy always had some distance between her and her students. Lisa used physical assistance 29 times more in the experimental group than the comparison group. Lisa was more active using touches in terms of correcting student
performance than Kathy. In the experimental group, it seemed like Lisa had more confidence to teach a soccer unit with enthusiasm because she used a lot more physical assistance to her students.

Summary

The data show that the CK workshop with the knowledge packet was effective in changing verbal and visual representations in both classes, in the experimental group taught by each teacher. The change of verbal and visual representations indicates that the number of verbal and visual representations increased and the teachers used a broad range of verbal and visual representations. Being able to use a variety of verbal and visual representations suggests that teachers have strong CK.

Research question 3: What level of task adaptation occurred in the comparison and the experimental groups?

The purpose of this question was to identify if there were differences in the teachers’ task adaptations in the comparison and experimental groups. Task adaptations were used because this variable can show if there were differences for using the tasks in the comparison and the experimental groups. The use of the task adaptations in Ayvazo’s (2007) study and this study are different. Ayvazo (2007) defined task adaptation as a “change of task or instruction to an individual student while considering student’s conceptions, preconceptions, misconceptions, and difficulties, language, culture, and motivations, social class, gender, age, ability, attitude, interests, self concepts, and attention” (p. 11) and she proposed several types of task adaptations (e.g., modifying task complexity, different task, extending up, breaking/refining the skills down, competitive
conditions, change of position, and restating the task). In this study, task adaptations indicate only whether a task was taught in the CK workshop. If the task that the teachers provided in their lessons was taught in the CK workshop, it would be categorized as “taught” vs. “not taught” if it was not taught.

The data show that there were large differences between groups, and this means that the teachers used the tasks from the CK workshop. The modal scores for both Kathy and Lisa’s task adaptation were level 1 (i.e., not taught and inappropriate) in the comparison group and level 4 (i.e., taught and appropriate) in the experimental group. In other words, both teachers used tasks that were taught in the CK workshop, and these tasks were likely to be appropriate in their experimental group. This result shows that the CK workshop was effective for the teachers to learn CK, to develop PCK, and to implement what they learned into their lessons.

Neither Kathy nor Lisa used any tasks in the category of “not taught, but appropriate” tasks. Had they used the tasks under this category, it might have provided the evidence that the teachers were applying Play Practice (Launder, 2001) beyond the workshop guidelines.

Research question 4: What was the percentage of correct, incorrect, and off task performance by students in the comparison and experimental groups?

The purpose of this question was to examine the differences in student performance in the comparison and the experimental groups with regard to the nature of the task (i.e., whether it was appropriate or not). Student performance was coded as correct, incorrect, or off-task. This question showed the relationship between teachers’
CK and student learning. If teachers come to understand the content, students can come to understand the tasks well because this process is connected with each other (Ma, 1999). Conversely, if teachers do not have CK, students cannot achieve success in terms of their correct performance because the students cannot understand what to do. In other words, teachers’ understanding and students’ understanding is not separated (Ma, 1999). Therefore, this question is important in determining the effectiveness of the CK workshop by comparing student performance in the comparison group with that in the experimental group.

The data show that there were differences in correct performance for Kathy (25.9% vs. 39.4%), but the data were stable for Lisa. The mean of student incorrect and off task performance in Kathy’s classes was stable or decreased after the CK workshop. The mean of student correct, incorrect, and off task performance in Lisa’s classes had no trend for either group.

There are problems with interpreting the data set because the tasks were not classified in terms of their appropriateness. Many tasks were coded as inappropriate (See question 5) in the comparison group. These tasks had extremely broad guidelines as to what was acceptable. Almost any responses would be coded as correct. Thus, if many students succeeded in a task but this task was inappropriate, a high percentage of student correct performance does not mean anything. For example, Kathy used close control dribbling practice using the inside of the foot without defenders. This task was not difficult for 8th grade students and it was an inappropriate task. Many students performed it correctly, and the observers recorded a higher percentage correct.
If teachers provide inappropriate tasks to their students, the students may learn incorrect movement patterns or the students may not understand how to develop their skills or even how to play the game. These students may also understand only some soccer technique, but they may not learn some tactics. The students also may not know what the correct or incorrect skills are because they practiced soccer with inappropriate tasks.

Research question 5: What was the percentage of correct performance by students in the comparison and the experimental groups when the data were coded using appropriate and inappropriate task criteria?

This question was designed to address the limitations in question 4. The purpose was to examine the differences of student correct performance in the context of whether the task was appropriate or inappropriate in the comparison and the experimental groups. One cannot use the totals of student correct performance without considering the context (i.e., appropriate or inappropriate tasks) because what students learn depends on the appropriateness of the task.

There were large differences in student correct performance on appropriate tasks for Kathy and Lisa in the comparison and experimental groups. According to the context of the data collected for question 1 to 3, the students were more successful in the experimental group than the comparison group. Because of the teachers’ clear directions and explanations about the appropriate tasks, the students understood what they were supposed to do in terms of the tasks. In addition, the students had more opportunities to practice the tasks because the teachers clearly introduced the tasks. The students also
received more specific congruent feedback and cues when they practiced the tasks
because of the teachers’ CK and PCK. The teachers’ strong CK and PCK would make the
students more successful.

The percentage of student correct performance in both teachers’ experimental
groups was approximately 40%. There are possible explanations for this. The investigator
recorded student correct performance only for the last 3 minutes of each task. That might
cause the percentage of student correct performance. The students might be master the
task, get bored, and did not participate in the task any more. Another reason might be
related to how to collect the data. The investigator used a momentary-time sampling
strategy to collect data. In this case, when the investigator observed one student and
moved on to next, the students might perform incorrectly or do off tasks because of the
different timing. The other reason might be classroom management. The investigator
observed and noticed that both teachers’ classroom management was not effective enough
to get students involved in the task. Therefore, there might be many off task students.

*Treatment Integrity*

The purpose of this question was to determine if the teachers implemented what
they were taught in the CK workshop. Kathy’s treatment integrity was 85%, and Lisa’s
was 92.5%. Because of both teachers’ teaching styles and preferences in terms of
teaching strategies, they did not meet all components of the treatment integrity checklist.
For example, Kathy did not use any physical assistance to help her students correct their
physical movement both in the comparison and in the experimental groups. In the
contrast, Lisa used physical assistance in both groups. However, overall, both teachers
showed a high percentage of treatment integrity (Cooper et al., 2007).

The results of this study show that intervention (i.e., the CK workshop with knowledge packet) was effective. A primary investigator and his assistants conducted the workshop with some students for three hours per teacher at each school using a knowledge packet. All components of the knowledge packet were covered during the workshop in both school sites.

Before the CK workshop, the teachers were asked to read the knowledge packet. Then the teachers watched and listened to what the investigator and his assistants were doing in terms of the demonstrations and explanations of the activities during the workshop. Subsequently, the teachers practiced teaching and took a test. As the teachers developed their CK from the workshop, they would also improve their PCK. The workshop provided many ways to present the content to the students well. Even though the workshop was more focused on CK, the ways of presenting CK was to develop teachers’ PCK in a soccer unit. Because the workshop provided opportunities to practice teaching, the teachers would experience some trial and errors, and come to understand what to choose in terms of appropriate tasks. Finally, the teachers arrive at their own decisions from their knowledge and based on their practices.

Kathy had some difficulties in understanding some tactics in soccer because her previous knowledge of soccer was weak. However, she practiced her teaching method with her husband who knows soccer very well, and prepared for her soccer unit after the CK workshop. The investigator provided some feedback everyday based on both teachers’ teaching. Although the CK workshop was effective, the investigator’s daily
feedback in terms of how to set up the activities, how to present the tasks, and how to correct student performance was also useful. It only took less than 5 minutes for the investigator to provide feedback to the teachers since they had classes back to back. As a result of the workshop and the investigator’s feedback, both teachers started to change her behaviors in terms of the ways of representing CK.

After the CK workshop, Kathy made note cards that included what she wanted to present in terms of the tasks, cues, diagrams, and critical elements and she always had the note cards in her hand during her lessons. Lisa brought the knowledge packet in each lesson and looked at it again right before the classes started.

The CK workshop provided the teachers with the opportunities to develop CK and PCK. The teachers made their students more successful in the experimental group than the comparison group in terms of student correct performance. For example, the teachers provided clearer directions and enough time and trials for their students in the experimental group. Because of the change of the teachers’ behaviors through the CK workshop, the students could have high-quality practice trials as well as more engagement in the activity. The practice trials were based on students’ skill level and had the appropriate level of difficulty (Silverman, 1985) so that they were effective. This can help improve the students’ performance.

*Connecting questions 1-5: Profiles of the Teachers*

In this section, I will connect findings of the five research questions drawing on the above analysis and figure 4.37 and 4.38 in chapter 4. Overall, there were two different profiles for each teacher in terms of PCK; one profile is for the comparison group, and
the other one for the experimental group. The profiles of each teacher showed that there were differences in terms of their content, pedagogy, and student correct performance. These profiles suggest that the CK workshop affected the teachers’ CK and PCK.

When you examine the results in Figures 4.37 and 4.38 collectively, two different profiles emerge. In the comparison group, there is not a lot of information presented, but in the experimental group there is a variety of information presented. There are inappropriate tasks presented in the comparison group, but there are appropriate tasks presented in the experimental group.

These reflect two very different scenarios under which children learn. The students were less successful in terms of their correct performance in inappropriate tasks (discussed in question 5) in the comparison group and students were more successful in appropriate tasks in the experimental group. In the comparison group, more inappropriate tasks were used and both teachers’ PCK can be described as immature. In the experimental group, more appropriate tasks were used and both teachers’ PCK can be described as mature.

The primary conclusion from an examination of Figures 4.37 and 4.38 is that different teaching behaviors make the learning process different for students. Changing teacher behaviors changes the learning environment. The teachers learned soccer CK from the workshop and applied it to their teaching in the experimental group. Though this was not verified statistically because of a limited sample size and the use of momentary time sampling that prevented individual student data from being reported, these findings are provide a basis on which to conduct experimental studies of the procedures used in
this study.

Conceptual Contributions

There are six assumptions that underlie this study.

Assumption 1: PCK is Observable and Measurable

It is important to observe and measure variables that indicate PCK because it will give researchers scientific understanding of a teacher’s behaviors within different environmental conditions (Cooper et al., 2007). However, in physical education, few studies to date have accomplished this. Most previous studies have examined PCK as a secondary variable using information from field notes, student and teacher interviews, observations of teaching practice, journals and reflections. Moreover, with the exception of Ayvazo, (2007), functional definitions of PCK and specific variables have not been used in previous studies.

The present study validated that PCK was able to be observed and measured using several variables: task maturity and appropriateness, verbal representations (i.e., instructions, descriptions, analogies or metaphors, cues, and specific congruent feedback), visual representations (i.e., demonstrations, gestures, task cards, pictures, and diagrams, video clips, and physical assistance), task adaptations and appropriateness. These variables were identified based on Shulman (1986)’s definition of PCK, and PCK continuum (Ayvazo, 2007; Ward et al., 2006; Ward, 2009b). The variables differed, as hypothesized, based on teachers’ CK. For example, the number of specific congruent feedback was different in the experimental group and in the comparison group. Kathy used five times more specific congruent feedback in the experimental group than the
comparison group. Lisa used twice more specific congruent feedback in the experimental group than the comparison group.

Assumption 2: PCK Can Be Described as Existing on a Continuum

Several studies in physical education have identified the existence of weak vs. strong PCK also calling it immature vs. mature PCK (Chen, 2004; McCaughtry & Rovegno et al., 2003; Rovegno, 1992; Tsangaridou, 2002). Even though the studies used different terms to describe PCK, there is a consensus that teachers’ PCK varies.

This study validated that PCK can be viewed as a continuum in terms of task maturity and appropriateness. Both variables distinguished between teachers’ PCK before and after the workshop. Before the CK workshop, both teachers identified the soccer unit as their weak unit, and their PCK in each lesson had seemed to place on the left end of the continuum (i.e., closer to immature). The data from the variables show that both teachers’ PCK improved following the CK workshop.

Assumption 3: Task Maturity and Appropriateness are Indicators in Determining the Existence of PCK and the Relationship between PCK and Student Effectiveness

According to Ward (2009b), there are four possibilities in terms of thinking about the relationship between task maturity, appropriateness, and effectiveness. In the following discussion, the term “task maturity” includes the meaning of task appropriateness because these two concepts should connect with and complement each other in the mutual goal of effectiveness. First, the task can be mature, but ineffective. For example, when a teacher states, “What we are going to do is play a 3 vs. 1 passing game. Three of you are offense, and one is a defense. Three of you need to make a
triangle and the one is in the middle. Offense, your job is to move to open space to receive the pass. Defense, you are going to move to steal the ball. Use the inside of your foot because it is more accurate. Try to make ten consecutive passes. If you make it, switch the defender,” it is a mature way of presenting the content. However, students may not be successful at performing this task because the students may not have the knowledge and skills of passing or the game prior to this task or they may not know how to move in terms of tactics and thus may not be able to understand the instructions. In this study, sometimes the students were less successful in certain tasks even though the teachers explained the tasks in a mature way.

Second, the task can be mature and effective. From the same example above, the task was mature, and the students would be successful. However, it is not easy to find teachers who are included in this category (Ward, 2009b). In the experimental group of this study, appropriate tasks were introduced in a mature way and the students were often more successful in terms of their performance under these conditions.

Third, the task can be immature and ineffective. For example, if a teacher states “What you are going to do is when you dribble the ball you need to follow this yellow line or other lines,” it is an immature task because the action practiced in this task will not happen in a real soccer game. In addition, student performance is often unsuccessful because the task was not clearly explained by the teacher. Many tasks in the comparison group in this study were inappropriate and the tasks were presented in an immature way. The students were often less successful in terms of their performance under these conditions.
Fourth, the task can be immature but effective. From the same example above, the task was immature, but sometimes teachers’ expectations are so loose that any response is acceptable to them, and thus students can be successful (Ward, 2009b). The tasks may be what students already learned previously or may be easy tasks for them to perform correctly. Although the tasks were inappropriate and were not presented well in this scenario, many students were often more successful because the tasks were easy.

Assumption 4: PCK is Developmentally Appropriate, Content and Context specific

Researchers argued that PCK is developmentally appropriate, content specific, and context specific (Ayvazo, 2007; Ward et al., 2006; Ward, 2009b). The knowledge packet in this study includes tasks that are developmentally appropriate for middle school students. In other words, it is important to note that the CK workshop was designed for middle school soccer CK in this study. Thus, using this knowledge packet, it cannot be assumed that the teachers can teach an elementary school or high school soccer unit.

The knowledge packet only focused on soccer units in terms of content specificity. A teacher cannot teach other units (e.g., tennis, basketball) in middle school using this knowledge packet. Because of the characteristics of content specificity, the knowledge packet was used as an intervention in this study. As a result of the intervention, there were differences between the two groups in terms of teachers’ behavior.

In terms of the context specificity of PCK, this study showed that the use of space and equipment was different in the comparison and the experimental groups. For example, Kathy used one large field in the comparison group, which is not appropriate. After the CK workshop, Kathy used the same field more efficiently in terms of dividing
the field into several small fields. She used appropriate space and equipment based on the tasks in the experimental group.

Grossman (1990) argued that PCK is informed by content, student, context, curriculum, and pedagogy. In this study, all of the knowledge bases were assumed to be fixed except content and pedagogy because the participants were grade 6 to grade 8 students in the middle school curriculum and context. During the CK workshop, the investigator provided specific content in terms of critical elements of activities, common mistakes, tasks, and organizational arrangement using the soccer knowledge packet. After the workshop, the teachers’ PCK was substantially different as a result of the change of their CK. This study showed that content and pedagogy influence over experienced teachers perhaps because context and student knowledge are well known. Therefore, this study supports Grossman’s (1990) conceptualizations of PCK.

Ward (2009a) viewed PCK in another way, comparing with Grossman and Shulman. In his view, PCK derives from past teaching experiences, current context, and professional knowledge. Past teaching experience in a specific grade level can influence the teacher’s PCK in that grade of students, which indicates that PCK should be developmentally appropriate, content specific, and context specific (Ayvazo, 2007; Ward et al., 2006; Ward, 2009b). Current context and professional knowledge also can influence the teacher’s PCK. This conceptualization of PCK includes all components that Grossman (1990) mentioned. The difference is that Ward (2009b) argued that past teaching experiences are the most important factor that can heavily influence the teachers’ PCK. Research conducted by Stuhr et al. (2007) supports this argument. They
compared players with non-players in terms of their CK and PCK. The result indicated that the players had much more CK and PCK in soccer and basketball. In this study, the teachers had opportunities to practice teaching soccer through the CK workshop which would, naturally, improve the teachers’ soccer PCK. This study manipulated the teachers’ CK using the CK workshop which in turn influenced the teachers’ teaching behaviors in terms of the teachers’ PCK.

Assumption 5: CK is Important in Improving PCK

This study demonstrated, albeit descriptively, that if teachers increased their CK then their PCK would improve. PCK was weak in the comparison group. After the CK workshop, PCK was stronger in the experimental group. In other words, this study showed improving CK is fundamental to develop teachers’ PCK.

Ball et al. (2008) proposed that there were two different types of CK: common content knowledge (CCK) and specialized content knowledge (SCK). Ball et al. (2008) argued that having CCK is important, but may not be enough for teaching. They also argued that SCK is more essential for teaching because it is a unique understanding of content in relation to teaching. In addition, Ball et al. (2008) described three domains of PCK, such as knowledge of content and students (KCS), knowledge of content and teaching (KCT), and knowledge of content and curriculum. KCS is the knowledge combination of content and students (e.g., student background, student previous experiences, and student skill level). KCT is the knowledge combination of content and teaching (e.g., teaching sequence, progressions, instructional models, content development). Ball et al. (2008) emphasize these two domains of PCK and these domains
include content. In other words, PCK should be developed and combined with CK. Therefore, CK is one of the most important knowledge in teaching.

Moreover, SCK is similar to PCK, but the difference is that SCK is merely focused on the content itself and PCK considers a number of other knowledge bases (i.e., content, context, student, pedagogy, and curriculum). In this manner, the knowledge packet should be focused more on SCK which is similar concept proposed by Ward (2009b). His argument was that it is not enough to know how to perform when you teach activities and teachers need to understand how to teach as well as how to perform (Ward, 2009b).

Ma (1999) argued that there are two types of knowledge: (a) simply knowing the content and (b) knowledge for teaching. In the knowledge packet from the CK workshop, most of the soccer content was a combination of CCK and SCK. Using the knowledge packet, the investigator and his assistants modeled lessons to the teachers. It indicates that the investigator showed PCK using CCK and SCK. Moreover, the teachers practiced teaching based on what the investigator showed in terms of task presentations and organizations.

**Assumption 6: CK as a Filter Plays an Important Role in Teaching**

This study validated that CK plays an important role in teaching as a filter. PCK is the complex and unique body of knowledge. PCK is the representation of the content in a specific situation, and it considers all of the components (i.e., curriculum, pedagogy, students, context, and content) that Grossman (1990) argued. When a teacher has strong PCK, she will be able to deliver her content to students with appropriate pedagogy based
on a specific context. This study showed that the teachers used inappropriate content and pedagogy in the comparison group because they had weaker CK. In other words, the teachers did not have CK to filter curriculum, pedagogy, students, and context. After the CK workshop, the teachers were able to use CK as a filter. The teachers began to use tasks that were developmentally appropriate, content specific, and context specific (Ayvazo, 2007; Ward et al., 2006; Ward, 2009b).

Curriculum, pedagogy, context, and student can be filtered through CK to become PCK. In this study, the CK workshop was implemented. According to curriculum, pedagogy, context, and student, the teachers selected appropriate tasks and represented them as PCK. In this manner, PCK can be defined as a variety of ways of delivering the content in a particular context based on the student’s skill level. The ability to present the tasks in different ways (i.e., verbal and visual ways) can be a part of PCK. It is important to consider the student’s skill level when a teacher teaches in terms of PCK. It is also important to deliver different tasks based on the context.

Methodological Contributions

Most studies examining PCK have used qualitative methods to collect data, including field notes, student and teacher interviews, observations of teaching practice, journals and reflections (Ayvazo, 2007). This study used quantitative strategies to collect data that have not been used before or not been used to collect PCK data before. This quantitative method provides different views of PCK and it contributes to adding new PCK variables in physical education literature. It also gives us a more accurate measure of PCK than relying on qualitative measure.
New variables were used to measure teachers’ PCK. Maturity and appropriateness variables differentiated between stronger and weaker instruction, and were easily collected. It is important that teachers know how to represent the content and what to select from their knowledge base in terms of the maturity and appropriateness variables. Maturity and appropriateness variables can be indicators that determine whether teachers have stronger PCK. Some of variables in the verbal and visual representation category were also used as new variables. For example, pictures, task cards, and diagrams were served as one of the indicators determining teachers’ PCK. If teachers use these visual representations, it will indicate that the teachers have stronger PCK.

The momentary-time sampling strategy to assess student learning is a new method in examining PCK. This strategy was accurate in recording student performance. The major advantage of this strategy is that an observer does not have to keep measuring student performance (Cooper et al., 2007). In this study, the advantage of the momentary-time sampling was that the observers assessed student performance only for the last 3 minutes of each task. It is reasonable to assess student performance right before a teacher moves on to a new task because students can perform the best during that time due to the length of time spent practicing. The investigator provided a task-by-task measure of student learning. This measure allowed PCK to be tied to student learning, and thus teacher effectiveness would be measured.

From a research perspective, it is better to use maturity and appropriateness variables together as one. If tasks were inappropriate, but were introduced in mature ways
by teachers, it is unclear whether the teachers had mature PCK. The reason is that the tasks were supposed to be appropriate in terms of developmentally appropriate, content specific, and context specific (Ayvazo, 2007; Ward et al., 2006; Ward, 2009b). In other words, if we only look at either task maturity or appropriateness, we may not know whether teachers have mature PCK.

Limitations and Delimitations

There were some limitations in the research design of this study. First, the teachers only taught a five- to six-day soccer unit in each group. Though a five- to six-day unit is typically found in schools and is ecologically valid in that sense, more than six days or might have produced different results and would be a better assessment of the principles of Play Practice.

Second, while this study was an experiment no inferential statistics were used because the momentary time sampling strategy did not allow the investigator to record an individual student’s performance task-by-task and day-by-day. Third, the findings in this study cannot be treated as casual because this was a descriptive study. Fourth, the percentage of student correct performance was about the same in both conditions. This is a represents an important caveat in interpreting the findings because the task appropriateness served as a modifying variable in this study.

This study is delimited to two physical education teachers and grade 6–8 students in public school settings in a large Midwestern city within the United States. It needs to be replicated using other physical education teachers and students of different grade levels in different locations. This study is also delimited to a specific subject matter (e.g.,
soccer). Future studies can replicate this study using different sports to verify the results found here.

Future Directions for Research

In future research, researchers should consider several research questions. Were there any group differences in teachers’ CK and PCK before and after CK workshop? Were there any group differences in student correct performance before and after the CK workshop? Through these research questions, the researchers can examine the effectiveness of the CK workshop and investigate whether there is a statistically significant difference in teachers’ CK and PCK after the CK workshop. Experimental research using inferential statistics is one way to investigate the effectiveness of the CK workshop through comparing the differences in teachers’ CK and PCK, and student learning in two different conditions. All variables used in this study well represented PCK so that they should be used again with new variables in future research. In experimental conditions, it is perfectly feasible to use the CK workshop with the knowledge packet as an intervention. A multiple baseline design is another possible way to investigate the effectiveness of the CK workshop with the knowledge packet. In this design, researchers can choose 3–5 teachers and observe the teachers’ behaviors before and after the CK workshop.

The Knowledge Packet

The knowledge packet used in this study represented a definable body of CK that can be replicated in other studies. The knowledge packet focused on a certain grade level (e.g., grade 9–12) in other units need to be developed and used for the CK workshop in
future research to examine the effectiveness of the knowledge packet. The knowledge
packet could be also developed using a video clip format instead of relying on a
document format. If future research includes a video format, it may be more efficient in
terms of the time devoted to the workshop.

The knowledge packet in this study was based on Play Practice (Launer, 2001). One of the important characteristics of Play Practice is using freeze-replay. Future studies may include freeze-replay strategy as a variable because if teachers do not have CK and PCK in a specific unit, they are not likely to use this strategy. Being able to use freeze-replay shows that teachers can recognize students’ errors or misunderstandings. The freeze-replay technique and how many times teachers use it in a lesson (e.g., 3 times a lesson) can be measured. This strategy can also be measured specifically in terms of what the teacher is saying (i.e., verbatim) and how much time the teacher spends (i.e., the average time spent in the freeze-replay was 2 minutes in one lesson) to correct student performance.

Variables

In future research, some variables need to be used differently. Video clips should be included in the category of task cards, pictures, and diagrams. Video clips were not used at all in this study by the teachers because other visual aides were used such as task cards, pictures, and diagrams. In addition, descriptions were sometimes merely repeated by the teachers. In this case, a number of descriptions may not be meaningful in terms of PCK. The problem with descriptions was that the teachers’ initial description was not clear and accurate, and because of that, they had to repeat the same description repeatedly
to each small group of students. It is important that the investigator not only records the number of descriptions but also determines whether the descriptions are clear and accurate. Therefore, descriptions should be recorded verbatim as well as the number because that would provide more information about what descriptions teachers used.

Gestures, one of visual representations, should be coded live. In this study, gestures were sometimes not visible or unclear. Sometimes it was hard to see if the teachers used facial expressions (i.e., smiling) and students sometimes also blocked the teachers’ gestures. Gestures should be specifically analyzed in terms of the quality of visual representations.

**Student Learning**

Future research should investigate direct relationships between teachers’ PCK and student learning by examining each student’s performances. The investigator should develop a method of recording each student’s performances within the task. However, in order to record both teachers’ PCK variables and student performance variables, many observers will be needed.

**Data Collection Methods**

Future research should quantitatively and qualitatively examine the relationships between CK and PCK. From the quantitative perspective, future research should examine the relationship between the frequency or the percentage of the CK variables and PCK variables using a scale system, such as Rink and Werner’s (1989) QMTPS. If this concept is adapted in CK and PCK studies, using an overall CK score and PCK score for each teacher as opposed to reporting the frequency or the percentage of CK and PCK variables
would greatly improve our ability to understand teacher effectiveness and to help teacher.

In terms of the qualitative analysis, future research should focus more on capturing what teachers are saying during the lesson and it should be transcribed verbatim for research purposes. In this study, the investigator only reported the teachers’ verbal explanations for tasks and did not report analogies, metaphors, cues and specific congruent feedback. This study presented only the number of these variables, but how many times each variable occurred in a lesson is not enough for the variables to represent PCK. For example, a teacher might use five different cues or might use one cue five times in their lesson. Frequently, teachers used only one type of cue in their lesson. In this case, it indicates that the number of cues may not be explained as a variable relative to PCK.

*The CK Workshop*

This study provided one example of how to conduct the CK workshop. Researchers should examine the effects of a longer workshop on teacher understanding. Researchers should also explore the way in which content can be delivered, and how teachers understand the content.

**Concluding Comments**

While this study did not use inferential statistics to examine the experiment conducted, it does support a large volume of literature in classroom (Ball et al., 2008; Ma, 1999) and in physical education (Ayvazo, 2007; Kutame, 2002; Sebren, 1995) that consistently points to increasing CK as an important intervention to influence PCK. CK is a precursor to good teaching (Ayvazo, 2007; Kutame, 2002; Sebren, 1995). PETE and
professional development programs need to provide in-depth CK in terms of common content knowledge (CCK) and specialized content knowledge (SCK) in order to impact PCK. The notion of a knowledge packet represents a new concept of content delivery and construction for PETE and it promises to be a very useful tool in helping to teach CCK and SCK.


Human Kinetics.


Review, 8, 21-36.


APPENDIX A

HUMAN SUBJECTS INSITUTIONAL REVIEW BOARD LETTER
April 26, 2010

Protocol Number: 2010B0108
Protocol Title: THE EFFECTS OF A CONTENT KNOWLEDGE WORKSHOP ON TEACHERS’ PEDAGOGICAL CONTENT KNOWLEDGE AND STUDENT LEARNING IN SOCCER UNIT IN MIDDLE SCHOOL PHYSICAL EDUCATION, Phillip Ward, Yun Soo Lee, Insook Kim, Physical Activities and Educational Services
Type of Review: Initial Review—Expedited
IRB Staff Contact: Michael Donovan
Phone: 614-292-6950
Email: Donovan.M@osu.edu

Dear Dr. Ward,

The Behavioral IRB APPROVED BY EXPEDITED REVIEW the above referenced protocol. The Board was able to provide expedited approval under 45 CFR 46.110(b)(1) because the research presents minimal risk to subjects and qualifies under the expedited review category(s) listed below.

Date of IRB Approval: April 26, 2010
Date of IRB Approval Expiration: April 14, 2011
Expedited Review Category: 6, 7

In addition, the protocol was approved for the inclusion of children (permission of one parent sufficient).

If applicable, informed consent (and HIPAA research authorization) must be obtained from subjects or their legally authorized representatives and documented prior to research involvement. The IRB-approved consent form and process must be used. Changes in the research (e.g., recruitment procedures, advertisements, enrollment numbers, etc.) or informed consent process must be approved by the IRB before they are implemented (except where necessary to eliminate apparent immediate hazards to subjects).

This approval is valid for one year from the date of IRB review when approval is granted or modifications are required. The approval will no longer be in effect on the date listed above as the IRB expiration date. A Continuing Review application must be approved within this interval to avoid expiration of IRB approval and cessation of all research activities. A final report must be provided to the IRB and all records relating to the research (including signed consent forms) must be retained and available for audit for at least 3 years after the research has ended.

It is the responsibility of the investigator to promptly report to the IRB any serious, unexpected and related adverse events or potential unanticipated problems involving risks to subjects or others.

This approval is issued under The Ohio State University’s OHRP Federalwide Assurance #00006378. All forms and procedures can be found on the OHRP website – www.orrp.osu.edu. Please feel free to contact the IRB staff contact listed above with any questions or concerns.

Jeanne Clement, EdD, Chair
Behavioral and Social Sciences Institutional Review Board
APPENDIX B

PARENTAL CONSENT FORM
The Ohio State University Parental Permission
For Child’s Participation in Research

Study Title: The Effects of a Content Knowledge Workshop on Teachers’ Pedagogical Content Knowledge and Student Learning in Soccer Unit in Middles School Physical Education

PI: Phillip Ward: ward.116@osu.edu - 614-688-8435
Yun Soo Lee: lee.2976@osu.edu – 773-290-7498
Insook Kim: kim.2477@osu.edu
Michelle Cowman: mccowman@att.net

Sponsor: The Ohio State University

This is a parental permission form for research participation. It contains important information about this study and what to expect if you permit your child to participate.

Your child’s participation is voluntary.

Please consider the information carefully. Feel free to ask questions before making your decision whether or not to permit your child to participate. If you permit your child to participate, you will be asked to sign this form and will receive a copy of the form.

Purpose: This study seeks to help your child’s teacher improve their knowledge of teaching. This will in turn add to the quality physical education your child already receives.

Procedures/Tasks: 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 6 days of soccer classes. 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 are asking your permission for the participation of your child in this study.

Duration: The investigators will observe this setting during spring quarter in the 2009-2010 school year.

Your child may leave the study at any time. If you or your child decides to stop participation in the study, there will be no penalty and neither you nor your child will lose any benefits to which you are otherwise entitled. Your decision will not affect your future relationship with The Ohio State University.
Risks and Benefits:
Potential benefits of the study include:

- Your child’s teacher will improve his/her knowledge and apply it to the teaching.
- Your child may receive more quality physical education.

No known risk will be present during this study.

Confidentiality:
Efforts will be made to keep your child’s study-related information confidential. However, there may be circumstances where this information must be released. For example, personal information regarding your child’s participation in this study may be disclosed if required by state law. Also, your child’s records may be reviewed by the following groups (as applicable to the research):
  - Office for Human Research Protections or other federal, state, or international regulatory agencies;
  - The Ohio State University Institutional Review Board or Office of Responsible Research Practices;

Incentives:
No incentives will be offered.

Participant Rights:
You or your child may refuse to participate in this study without penalty or loss of benefits to which you are otherwise entitled. If you or your child is a student or employee at Ohio State, your decision will not affect your grades or employment status.

If you and your child choose to participate in the study, you may discontinue participation at any time without penalty or loss of benefits. By signing this form, you do not give up any personal legal rights your child may have as a participant in this study.

An Institutional Review Board responsible for human subjects research at The Ohio State University reviewed this research project and found it to be acceptable, according to applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research.

Contacts and Questions:
For questions, concerns, or complaints about the study you may contact

PI: Phillip Ward: ward.116@osu.edu - 614-688-8435
Yun Soo Lee: lee.2976@osu.edu – 773-290-7498

For questions about your child’s rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team,
you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251.

If your child is injured as a result of participating in this study or for questions about a study-related injury, you may contact: Yun Soo Lee at 773-290-7498.

**Signing the parental permission form**
I have read (or someone has read to me) this form and I am aware that I am being asked to provide permission for my child to participate in a research study. I have had the opportunity to ask questions and have had them answered to my satisfaction. I voluntarily agree to permit my child to participate in this study.

I am not giving up any legal rights by signing this form. I will be given a copy of this form.

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**Investigator/Research Staff**
I have explained the research to the participant or his/her representative before requesting the signature(s) above. There are no blanks in this document. A copy of this form has been given to the participant or his/her representative.

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APPENDIX C

CHILD ASSENT VERBAL SCRIPT
Hello everyone,

I am Yun Soo Lee and I am a doctoral student at The Ohio State University.

I am studying at what your teacher asks you to do in physical education in effort to help your teacher to teach more effectively. You will be in this study for six days during your physical education soccer unit. Because you are doing your regular physical education, nothing will happen to you in physical education either good or bad. However, this study will help us understand how to help other children learn physical education better. It is okay to say “No” if you don’t want to be in the study. If you say “Yes”, you can change your mind and quit being in the study at any time without any problems. You will not be receiving anything from participating in this study.

During that time, I will be videotaping and I will ask you to take video of you. You can think about it and discuss it with your family or friends before you decide. You can ask any questions you have before making up your mind. If you have questions later, you can also contact your teacher, who will be able to contact me.

If you decide you want to be in the study, you parent or guardian will also need to give permission for you to be in the study.

I hope you will consider doing this.

Thank you!
APPENDIX D

TEACHER CONSENT FORM
The Ohio State University Teacher Consent
For Participation in Research

The Effects of a Content Knowledge Workshop on Teachers’ Pedagogical Content Knowledge and Student Learning in Soccer Unit in Middles School Physical Education

Study Title: Pedagogical Content Knowledge and Student Learning in Soccer Unit in Middles School Physical Education

PI: Phillip Ward: ward.116@osu.edu - 614-688-8435

Yun Soo Lee: lee.2976@osu.edu – 773-290-7498

Insook Kim: kim.2477@osu.edu

Michelle Cowman: mccowman@att.net

Researcher: The Ohio State University

Sponsor:

This is a consent form for research participation. It contains important information about this study and what to expect if you decide to participate.

Your participation is voluntary.

Please consider the information carefully. Feel free to ask questions before making your decision whether or not to participate. If you decide to participate, you will be asked to sign this form and will receive a copy of the form.

Purpose:
This study seeks to help you improve the knowledge of teaching. As a result of improving knowledge, your students may improve their performance in a soccer unit in terms of technical and tactical understandings.

Procedures/Tasks:
We are interested in examining the effects of teacher content knowledge intervention on student learning in middle school physical education. Our focus is primarily on the teacher’s behaviors during the lesson, and thus involves videotaping of teacher and student behaviors to learn more about how teachers’ content knowledge can influence on students’ learning in secondary physical education. We will be observing you for the six days of your soccer unit in four classes taught. All of the data collected and the videotapes will remain confidential.

Duration:
The investigators will observe this setting during spring quarter in the 2009-2010 academic school year. During the study, you will be asked to participate in a content knowledge workshop for two hours.

You may leave the study at any time. If you decide to stop participating in the study, there will be no penalty to you, and you will not lose any benefits to which you are otherwise entitled. Your decision will not affect your future relationship with The Ohio
Risks and Benefits:
Potential benefits of the study include:

- You will improve your knowledge and apply it to your teaching.
- Your students may receive more quality physical education.

No known risk will be presented during this study.

Confidentiality:
Efforts will be made to keep your study-related information confidential. First, pseudonyms will be used for teachers and schools when the data is reported. Second, all data including videotapes will be held in the co-investigator’s (Yun Soo Lee) cabinet in A216 PE building under lock and key. Last, there are no identifying information data used.

However, there may be circumstances where this information must be released. For example, personal information regarding your participation in this study may be disclosed if required by state law. Also, your records may be reviewed by the following groups (as applicable to the research):

- Office for Human Research Protections or other federal, state, or international regulatory agencies;
- The Ohio State University Institutional Review Board or Office of Responsible Research Practices;

Incentives:
No incentives will be offered.

Participant Rights:
You may refuse to participate in this study without penalty or loss of benefits to which you are otherwise entitled. If you are a student or employee at Ohio State, your decision will not affect your grades or employment status.

If you choose to participate in the study, you may discontinue participation at any time without penalty or loss of benefits. By signing this form, you do not give up any personal legal rights you may have as a participant in this study.

An Institutional Review Board responsible for human subjects research at The Ohio State University reviewed this research project and found it to be acceptable, according to applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research.

Contacts and Questions:
For questions, concerns, or complaints about the study you may contact
For questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251.

If you are injured as a result of participating in this study or for questions about a study-related injury, you may contact Yun Soo Lee at 773-290-7498.

**Signing the consent form**
I have read (or someone has read to me) this form and I am aware that I am being asked to participate in a research study. I have had the opportunity to ask questions and have had them answered to my satisfaction. I voluntarily agree to participate in this study. I consent the use of videotapes, I understand how the videotapes will be used for this study.

I am not giving up any legal rights by signing this form. I will be given a copy of this form.

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**Printed name of subject**

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**Signature of subject**

**Date and time**

**Printed name of person authorized to consent for subject**

(when applicable)

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**Signature of person authorized to consent for subject**

(when applicable)

**Date and time**

**Relationship to the subject**

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**Investigator/Research Staff**

I have explained the research to the participant or his/her representative before requesting the signature(s) above. There are no blanks in this document. A copy of this form has been given to the participant or his/her representative.

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**Printed name of person obtaining consent**

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**Signature of person obtaining consent**

**Date and time**

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APPENDIX E

LETTER TO TEACHERS
March 3, 2010

Ms. Andrea Smith
Columbus Public schools
5736 Lane St.
Columbus, OH 43071

Dear Ms. Smith:

I am beginning the dissertation phase of my Ph. D. program at the Ohio State University and I am working with Dr. Phillip Ward. I would like to invite you to participate in this study with me. The purpose of the study is to help teachers improve their content knowledge. The study will require me to observe two 6-day units of your classes.

This study is going to involve my watching you teach the parts of the unit (for six days) and my coming in giving you specific content ideas to help you teach that unit better and looking to see if those ideas occur in your practice. This may involve a little bit of time outside of school time or during school time. I can meet with you at your convenient. I will be videotaping your classes. I or another investigator is videotaping your classes in an unobtrusive position and coding some data out of your designated lesson area. Therefore, there are no interruptions during your lessons.

My phone number is (773) 290-7498 and email address is lee.2976@osu.edu. If there is any other information that you need, do not hesitate to contact me and I will provide it as soon as possible. Thank you for your attention.

Sincerely,

Yun Soo Lee
APPENDIX F

UNDERSTANDING OF DEFINITION (TEACHER VARIABLES)
Maturity & Appropriateness

*Maturity:* Refers to the degree to which a task is well represented to the students. It may include cues, descriptions, analogies, metaphors, or demonstrations so that students clearly understand what to do. What distinguishes among task representations is the quality and sophistication of the representation to the students.

*Immaturity:* The task was presented in an unsophisticated manner with simplistic or poor descriptions or illustrations.

*Appropriateness:* The task that teacher provided was developmentally appropriate, content specific, and context specific. Developmentally appropriate refers to “activities geared toward a student’s developmental status, previous movement experience, fitness and skill levels, body size, and age” (Siedentop & Tannehill, 2000, p. 119), content specific refers to using a particular activity, and context specific refers to using appropriate equipment and space.

*Inappropriateness:* The task that teacher provided was NOT developmentally appropriate, and/or content specific, and/or context specific.

*#4 - Mature & appropriate:* This category includes well represented and developmentally appropriate task with instructional cues, descriptions, analogies, metaphors, or demonstrations.

*#3 - Immature & appropriate:* This category includes unsophisticated but developmentally appropriate task with simple or poor instructional cues, descriptions, analogies, metaphors, or demonstrations.

*#2 - Mature & inappropriate:* This category includes well represented but
developmentally inappropriate task with instructional cues, descriptions, analogies, metaphors, or demonstrations.

#1 - Immature & inappropriate: This category includes unsophisticated and developmentally inappropriate task with simple or poor instructional cues, descriptions, analogies, metaphors, or demonstrations.

Teacher adaptations

#4 - Taught/appropriate: The teacher used what they were previously taught in the workshop and it was an appropriate task for students. The appropriate task is developmentally appropriate, content specific, and context specific task.

#3 - Not taught/appropriate: The teacher used what they were not taught in the workshop but it was an appropriate task for students. The appropriate task is developmentally appropriate, content specific, and context specific task.

#2 - Taught/inappropriate: The teacher use what they were previously taught in the workshop but it was an inappropriate task for students. The inappropriate task is not developmentally appropriate, and/or content specific, and/or context specific task.

#1 - Not taught/inappropriate: The teacher used what they were not taught in the workshop and it was an inappropriate task for students. The inappropriate task is not developmentally appropriate, content specific, and context specific task.

Verbal representations

Instructions: Teacher’s verbal description or prompt to the students about how to
perform a skill (Hawkins & Wiegand, 1989).

**Descriptions**: Descriptions are the teacher’s verbal explanation or illustration on what a particular skill (activity) is like.

**Analogies and metaphors**: Analogies are the teachers’ use of similar or different examples to explain the skills. Metaphors are teachers’ imaginative ways of describing something using different names with the same characteristics.

**Cues**: Cues are not full sentences (i.e., clause) but shorten words (i.e., phrase) that related to the information about the performance of the movement provided by the teacher (Rink & Werner, 1989; Rink, 2010). Cues can be technical, visual, or metaphoric (Kutame, 1997). The technical cues are directly related to critical elements of the activity (Kutame, 1997). The visual cues are objects (e.g., taped line) the teachers uses to correct students’ performance (Kutame, 1997). The metaphoric cues are related to using images (Kutame, 1997).

**Specific congruent feedback**: Specific congruent feedback is “the degree to which teacher feedback during activity is congruent with (matched to) the focus of the task” (Rink, 2010, p. 372).

**Visual representations**

**Demonstrations**: Demonstrations are “modeling desired performance executed by teacher, student(s), and/or visual aids” (Rink, 2010, p. 372).

**Gestures**: Gestures are positive nonverbal behaviors for students’ effort or success. It includes “a body contact, hand gesture, or facial expression” (Quarterman, 1989, p.
Task cards/pictures/diagrams: Task cards, pictures, or diagrams are visual equipment to help student understand what to perform and how to perform.

Video clips: Video clips are for student to get motivated or understand a particular content or skill (i.e., task).

Physical assistance: Physical assistance is “physically moving the player’s (student’s) body to the proper position or through the correct range of motion of a skill” (Lacy & Darst, 1989, p. 371).
Correct trials: Students met the criteria (i.e., critical elements) that teachers provided for them. If the students met at least three out of total criteria, it would be coded as a correct trial.

Incorrect trials: Students did NOT meet the criteria that teachers provided for them. If the students met less than three criteria, it would be coded as an incorrect trial.
APPENDIX H

WRITTEN TEST (TEACHER VARIABLE)
Written Test (teacher variable)

Please mark one of the following letters next to each statement: “M” for maturity, “IM” for immaturity, “A” for appropriateness, “IA” for inappropriateness, “MAA” for maturity and appropriateness, “IAA” for immaturity and appropriateness, “MAI” for maturity and inappropriateness and “IAI” for immaturity and inappropriateness.

1. “You are going to be performing a log roll; logs are long and straight, so in the log roll you need to stay really straight like a log with your arms together and extended and your legs together and straight, watch Susan’s demonstration of the log roll” ____ (M)
2. “Now I want you to perform a log roll, ready, go” ____ (IM)
3. The teacher provided a log rolling activity to 3rd graders as a warm up activity using mats to prepare for the gymnastics unit ____ (A)
4. The teacher provided a log rolling activity to 9th graders without any mats in gymnastics unit ____ (I)
5. In soccer unit for 8th graders, the statement by the teacher was “You are going to be performing a inside pass; in the inside pass you need to have your kicking ankle fixed like a rock with your support foot a little behind and beside the ball and bent, and your body facing towards where you want to pass, watch, I demonstrate the inside pass for you” and then the students performed the inside pass ____ (MAA)
6. In a soccer unit for 8th graders, the statement by the teacher was, “You are going to be practicing a 3 vs. 1 passing game. Three of you are offensive players and one of you is defensive player. This is a keep away game.” Then the students practice this game ____
7. In a soccer unit for 8th graders, the statement by the teacher was, “You are going to be practicing a 4 vs. 3 continuous “go for goal” game. In this game, for defensive players, three of you are in field and one of you is out of the field for the substitution. Four of you are offensive players. You need to move towards the goal to score if you are the offensive players. You need to delay the offensive players’ play and prevent them from scoring if you are the defensive players. If the defensive players steal the ball, the defensive and the offensive players need to change their roll. In this time, the offensive player who lost a ball goes out of the field and the defensive player, who was outside of the field, comes to the field to play this game. Watch. Joe, Kevin, Emily, Jessica, Mark, Ann, and I will demonstrate a 4 vs. 3 continuous “go for goal” game for you.” Then the students performed this game ____ (MAI)

8. In soccer unit for 10th graders, the statement by the teacher was “You are going to be performing an instep pass; in the instep pass you need to pass with a ball towards the wall and try to practice it 20 times by yourself” and then the students performed the instep pass ____ (IAI)

Please mark one of the following letters next to each statement: “I” for instructions, “D” for descriptions, “AM” for analogies and metaphors, “C” for cues, “S” for specific congruent feedback, “DM” for demonstrations, “G” for gestures, “TPD” for task cards, pictures, and diagrams, “V” for video clips, and “P” for physical assistance.
1. “we are going to do 3 vs. 3 passing game using chest pass and bounce pass for 2 minutes” (I)

2. “critical elements of set shot in basketball are have your elbow in, guide your non-dominant hand, and follow through with your elbow and wrist” (D)

3. “we are going to do racket control like pancake flip” (AM)

4. “bend your knees” (C)

5. “way to follow through low to high” (S)

6. The teacher showed desired or undesired lay-up shot, or asked students to show it to the class in basketball (DM)

7. Patting on students’ shoulders (G)

8. Teacher could show students task cards that included critical elements of forearm pass in volleyball (TPD)

9. When teacher taught a basketball unit, she could show one of OSU basketball games to students to motivate them at the beginning of the unit (V)

10. Teacher corrected students’ arm movement of set shot in basketball through physical touches (P)
APPENDIX I

WRITTEN TEST (STUDENT VARIABLE)
Written Test (student variable)

Please mark one of the following letters next to each statement: “C” for correct trial, and “I” for incorrect trial.

1. The student performed groundstroke in tennis using the appropriate critical elements (e.g., racket perpendicular to the floor and follow through low to high) that the teacher mentioned ____ (C)

2. The student performed volley in tennis without the proper critical elements (e.g., contact in front and abbreviated backswing) that the teacher mentioned ____ (I)
APPENDIX J

TREATMENT INTEGRITY CHECKLIST
<table>
<thead>
<tr>
<th>Questions</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. When the teacher introduces new task, she delivers clear instructions and descriptions of the skill.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. During the instructions, the teacher uses analogies or metaphors.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. During the student practice, the teacher provides students with appropriate cues.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. During the student practice, the teacher provides students with specific congruent feedback.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. When the teacher introduces new task, she clearly mentions the critical elements of the skill.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. When the teacher delivers instructions at the beginning of the lesson, she uses demonstrations.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. During the student practice, the teacher provides students with gestures.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. During the instructions, the teacher uses either video clips, task cards, pictures, or diagrams.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. During student practice, the teacher provides students with physical assistance.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. The teacher chooses developmentally appropriate progressions after initial tasks are provided.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total scores</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX K

QUESTIONS FOR TEACHERS’ UNDERSTANDING OF KNOWLEDGE PACKET

199
Questions for teachers’ understanding of knowledge packet

1. What was correctly or incorrectly performed?
2. What are the critical elements of the activity?
3. What are the common errors of the activity?
4. What kinds of feedback would you use?
5. What kinds of cues would you use?
6. What kinds of tasks would you provide?
7. What kinds of descriptions would you provide?
8. What kinds of analogies or metaphors would you use?
9. What kinds of demonstrations and physical assistant would you use?
10. What other visual aids would you use?
APPENDIX L

SOCCER KNOWLEDGE PACKET
Teaching Soccer

Play Practice (Launder, 2001)
<table>
<thead>
<tr>
<th>Task</th>
<th>Organizational arrangements</th>
<th>Critical Elements/Activities</th>
<th>Common errors/Progressions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2v2 Dribbling, screening, and passing game (10 × 10 square with small 1 yard goals)</td>
<td><img src="image" alt="Diagram" /></td>
<td><strong>Critical Elements (Dribbling):</strong></td>
<td><strong>Common Errors:</strong></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td>- Caress ball in stride</td>
<td>- Head down</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td>- Keep ball close</td>
<td>- Kick the ball (the ball is not close and cannot be under control)</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td>- Push ball firmly</td>
<td>- Do not bend knees</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td><strong>(Close Control):</strong></td>
<td><strong>Progressions:</strong></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td>- Bend knees</td>
<td>- Size of the goals</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td>- Use body fakes</td>
<td>- Size of the areas</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td>- Change speed/direction</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td>- Look for help</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td>- Move away from pressure</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td><strong>(Open Space):</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td>- Head up with vision on field</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td>- Outside surface of instep</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td>- Accelerate forward</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td>- Push ball to goal</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td>- Sprint to ball and push again</td>
<td></td>
</tr>
</tbody>
</table>
Passing and possession games (3v1, 4v1, 4v2, 5v2)

Critical Elements (Inside):
- Balance foot beside ball
- Ankle locked and foot firm
- Contact center of ball
- Short and smooth follow through
- After passing, prepare to move

Critical Elements (foot control):
- Locate ball
- Inside or outside of foot
- Absorb ball by moving foot away
- Cushion the ball (like an egg)

4v1 and 4v2 games:
- Control the ball quickly
- Read the defender’s position
- Decision making
- Accurate
- Execution under pressure from a defender

3v1 game:
- All the above (4v1 game)
- Move intelligently to make an angle for the pass
- Begin to learn the principle of support in attack
- The concept of triangles

5v2 game (no boundaries):
- Ability to read the display
- Support concepts
- Width and depth in attack

Common Errors:
- Foot location
- Body position
- Ankle locked and foot firm
- Contact the ball (center)
- Players stand flat footed and are not ready for ball

Common Errors:
- Do not absorb the ball

Progressions:
- Touches (multiple to two or one)
- Use different sizes of ball
Shooting game (give and go): 2v1

Critical Elements (Instep):
- Approach ball from behind
- Lean forward
- Support foot behind ball
- Square shoulders/hips to teammate
- Foot down and diagonal across ball
- Keep foot firm
- Short and Smooth follow through

Critical Elements (Moving Ball):
- Move to spot where ball will be located
- Face ball with shoulders square
- Supporting leg bent at knee
- Knee of kicking leg over ball
- Keep foot firm
- Contact center of ball with instep

Common Errors:
- Foot location
- Body position (shoulder & hip)
- Ankle locked and foot firm
- Contact the ball (center)

Progressions:
- Double Pass
- Speed (Pacing)
- Space (Large to small)
Continuous “Go for goal” games (3v1, 3v2, 4v3)

**Rules of the Game**
The principles of the fast break
After a score or a change of possession, the lone defender is joined by two teammates
They begin to counterattack against a single player
The game flows continuously

**Critical Elements (Defender)**
Delay and Channel the ball

**Critical Elements (Offender)**
The width to ensure ball possession and to outflank the defender

**Critical Elements (3v2)**
The first defender pressures the ball
The second defender covers the goal and looks for interceptions
The attackers must pass skillfully
The principle of support to retain possession
The principle of width and mobility to pull defenders out of position and create space

**Critical Elements (4v3)**
The balancing the defense and providing more cover
The first defender can put even

**Progressions:**
Size of the goals
Size of the areas
<table>
<thead>
<tr>
<th>4v4 mini games (20 × 30 pitch with no goalies)</th>
<th>more pressure on the ball player Attackers must be patient and counter this pressure by playing the ball back to a supporting player Using schemer role for attackers</th>
</tr>
</thead>
</table>
| **Critical Elements:** | **Common Errors:**  
Apply all skills  
Keep the ball on the ground with low passes  
Offensive players move into good positions (diamond formation)  
**Progressions:**  
Size of the goals  
Do not use depth, width, support concepts |
| Four-goal soccer | Critical Elements:  
Cross-field passes to switch play away from heavily defended areas | Common Errors:  
Do not use depth, width, support concepts |
|------------------|---------------------------------------------------------------|---------------------------------------------------------------|

![Diagram showing four-goal soccer with critical elements and common errors.|]