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The impact of content knowledge, specialized content knowledge, peer analysis and self-analysis on pre-service physical education teachers' error detection abilities

Debra S. Sazama
University of Northern Iowa

THE IMPACT OF CONTENT KNOWLEDGE, SPECIALIZED CONTENT KNOWLEDGE, PEER ANALYSIS AND SELF-ANALYSIS ON PRE-SERVICE PHYSICAL EDUCATION TEACHERS' ERROR DETECTION ABILITIES

An Abstract of a Dissertation

Submitted

in Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

Approved:

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Dr. Linda Fitzgerald, Committee Chair

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Dr. Kavita R. Dhanwada

Dean of the Graduate College

Debra S. Sazama

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July, 2017

ABSTRACT

This study investigated the change in specialized content knowledge (SCK), specifically error detection skills, and sought to answer the following questions: (a) Does attending a common content knowledge (CCK) and SCK workshop and assessing videotaped performances of a volleyball skill (forearm pass) result in increased ability to identify performance errors in that skill?, and (b) Does attending a CCK and SCK workshop and then assessing one's own performance have a greater impact on error detection skill development as compared to assessing the performance of a peer?

Participants were 20 undergraduate physical education teacher education (PETE) students (12 male and 8 female) enrolled in PETE courses. A pre-test, post-test experimental design was used to determine the effectiveness of increasing undergraduate students' SCK through a CCK and SCK workshop and video analysis. Pre-test procedures included participants viewing a middle school male and female performing a volleyball forearm pass and evaluating the performance by indicating if they observed or did not observe the critical elements. The CCK and SCK workshop included instruction of the critical elements of the pass and common errors typically demonstrated by beginners. Video analysis included participants evaluating a peer or themselves performing 10 volleyball passes. The study concluded with a post-test evaluating the same male and female middle school student.

A two-way repeated measures ANOVA was used to compare the pre- and post-test means. Results indicated post-test means for the peer analysis and self-analysis groups were significantly higher than pre-test mean scores. No significant difference was

found between groups. Results revealed a trend of participants scoring the lowest on the pre-test evaluation showing the largest change in error detection ability from pre-test to post-test.

This study demonstrated a short workshop and video analysis increased error detection ability for the volleyball forearm pass in undergraduate PETE majors. Physical education teacher education programs may want to consider implementing short instructional episodes to improve error detection skills. Future research should consider investigating the role of feedback on participants as they practice detecting errors and investigating if the number of errors performed by the model during video analysis effects error detection abilities.

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Dr. Ripley Marston, Committee Member

_____

Dr. Melissa Heston, Committee Member

_____

Dr. Jennifer Waldron, Committee Member

_____

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CHAPTER I

INTRODUCTION

The mission of physical education teacher education programs (PETE) is to instill physical educators with the skills, knowledge and dispositions to teach others how to become physically literate individuals. Developing students who are competent and skillful movers is one of the most important roles of a physical educator (Society of Health and Physical Educators [SHAPE], 2013). This emphasis is identified in SHAPE America National Physical Education Standard 1 which states, "physically literate individuals demonstrate competency in a variety of motor skills and movement patterns" (SHAPE, p.1). Motor skills are learned voluntary movements that are goal oriented and include one or more body parts and movement patterns that are an organized series of related movements (Gallahue, Ozmun, & Goodway, 2012). Fundamental movement patterns are observable performances of basic locomotor skills (i.e., walk, run, hop, leap, slide, gallop and skip), manipulative skills (i.e., throw, catch, kick, punt, dribble, volley, strike), and nonmanipulative skills (i.e., bending, twisting, stretching, rolling, balancing) (Graham, Holt Hale, & Parker, 2013). The importance of children developing motor skill competency cannot be overlooked. Hands (2008) concluded that children with high motor skill competence performed better on physical fitness measures than children with low motor skill competence. Stodden, Langdendorfer and Roberton (2009) suggested that developing motor skill competence may be essential for developing and maintaining physical fitness into adulthood.

Stroot and Oslin (1993) stated that when students were given appropriate feedback they were able to become more proficient movers and the quality of that feedback is based on the physical educator's ability to observe and analyze the performance. However, studies have repeatedly shown that both pre- and in-service physical educators are not very competent at observing and analyzing motor skill performance (Behets, 1996; Biscan & Hoffman, 1976; Imwold & Hoffman, 1983; Morrison & Reeve, 1989; Stroot & Oslin, 1993). According to both Siedentop (2002) and Ward (2009) pre- and in-service teachers lack of content knowledge may contribute to this inability to observe and analyze motor skills.

Content Knowledge

Shulman's View

Shulman (1986) identified content knowledge (CK) as "the amount of and organization of knowledge per se in the mind of the teacher" (p. 9). Shulman proposed three forms of CK: (a) subject matter content knowledge (i.e., the teachers' organization, depth and breadth of knowledge about a given subject matter), (b) pedagogical content knowledge (PCK) (i.e., ways to represent and formulate content that makes it understandable for students), and (c) curricular knowledge (i.e., variety of instructional materials for a range of programs designed to teach content). Shulman (1986) indicated that subject matter knowledge goes beyond facts and concepts and requires a way to organize and represent them.

In 1987, Shulman continued his work by organizing a teachers' knowledge base into seven categories: (a) content knowledge, (b) general pedagogical knowledge, (c)

curriculum knowledge, (d) pedagogical content knowledge, (e) knowledge of learners and their characteristics, (f) knowledge of educational contexts, and (g) knowledge of educational ends, purposes, and values. Shulman (1987) described the first source of knowledge base to be content knowledge which includes the knowledge, understanding, skills and dispositions that should be learned and grounded in the amassed literature and study within a content area.

Ball, Thames, and Phelp's View

Shulman's work increased interest in the study of teacher knowledge and the role content plays in teaching. Through several lines of research supported by the National Science Foundation, they explored Shulman's hypothesis of CK and PCK in the field of mathematics. Ball, Thames, and Phelps (2008) investigated the knowledge required for teaching based on the mathematical problems that appear during teaching. The focus of their work was on how teacher's showed students' how to solve problems, answered students' questions, and assessed students' work. Primary data for this work came from an entire year of teaching mathematics in a third grade classroom. Data included videotapes and audiotapes of lessons, transcripts, student work, homework, quizzes and the teacher's plans, notes, and reflections. They reviewed individual teaching episodes and studied instruction over time. The authors concluded that Shulman's CK could be further divided into common content knowledge and specialized content knowledge. Ball et al. (2008) defined common content knowledge as the mathematical knowledge and skills used in areas other than teaching but knowledge others have and utilize. Ball et al. (2008) defined specialized content knowledge as the mathematical knowledge and skill

that are unique to teaching and knowledge that is not typically needed in areas other than teaching mathematics. Teachers must have unpacked mathematical knowledge to be able to make content visible and learnable by students. An example of this would be explaining why students invert and multiply to divide fractions. Other examples include the accountant who calculates and reconciles numbers or engineers who use mathematics to model properties of materials. Of the last two groups, neither is required to know or explain why "a zero is added" when multiplying by 10 but a teacher must have the knowledge and skill to do that.

Siedentop's View

Daryl Siedentop (2002) pointed out that content knowledge in physical education is not as easily defined as it is in math, English, music or art because the pre-service teacher (PT) learns math, English, music or art content that the children are going to be learning in the schools. According to Siedentop (2002) PETE programs have had a consistent reduction of content courses such as sport performance and related courses that teach technical aspects of skills, strategic approaches, training implications, developmental considerations, norms, values, and traditions, the role in local and national sport cultures, developing technologies, individual and group dynamics, and ethical/moral dilemmas that are presented during performances and competition. Siedentop (2002) summarized:

> We have arrived at a point in our history 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. (p. 369)

The concern for Siedentop was that PETE programs were defining teaching through methods, process, organization, management, and pedagogy with little focus on physical education subject matter. Siedentop was not suggesting that all course work be subject matter based but courses should be based on and include what the physical educator will be teaching in the gymnasium. For example, Siedentop highlighted the Dance Education program at Ohio State University and the pre-professional tract which required 88 quarter hours. For dance education students, 40 of those 88 quarter hours were progressively scheduled performance courses with an emphasis in technique and eight quarter hours were devoted to pre-professional pedagogy courses. Siedentop argues that PETE programs have moved away from the focus on the physical experience as well as its value. Siedentop's (2002) view of CK is that physical education teachers and coaches need to have a reasonable mastery of sport activities they will teach. This includes technical aspects of the skills, strengths and weaknesses of strategy, training implications, developmental considerations, norms, values, traditions of the sport, its role in local and national sport cultures, technology in sport, psychosocial aspects of individual and group dynamics of players and ethical dilemmas in competition.

Ward's View

Ward's (2009) concept of CK parallels that of Ball et al.'s (2008) concept of CCK and SCK in mathematics. Following Ball et al.'s (2008) work, Ward (2009) identified two forms of subject matter knowledge in physical education, CCK and SCK. Ward (2009) identified CCK as knowing how to perform the activity and SCK as knowing what to teach as the activity (i.e., progressions) and skill discrimination, including the

knowledge of correct performances in order to identify errors in technique and tactics. For example, CCK would be described as the ability to perform in a game of volleyball which would require knowledge of the rules and etiquette, and the ability to perform the technique and tactics involved in the game. Performing the activity is very different from teaching the activity. Teaching the activity requires SCK which includes the ability to choose the appropriate progressions of tasks to assist student learning of the skills and the knowledge to identify student errors in performances. Subsequently, Ward's (2009) definition of CK was divided into the following "four domains and conceptualized on a continuum (a) knowledge of rules and etiquette, (b) knowledge of technique and tactics, (c) knowledge of skill discrimination (errors), and (d) knowledge of tasks" (p. 350). In this continuum (See Figure 1), the arrows display the degree of breadth of CCK and SCK. The continuum indicates that CCK includes knowledge of the rules, etiquette, technique and tactics which are required for someone to perform in an activity. Also included is knowledge of error detection and tasks which is minimal but useful. This knowledge enables performers to detect their own mistakes during practice or game play and choose a task that may help them improve their performance. Conversely, SCK includes significantly more knowledge of performers' errors, instructional tasks and the representation of those tasks. This knowledge is unique for the teacher and his or her ability to make learning comprehensible for the learner.

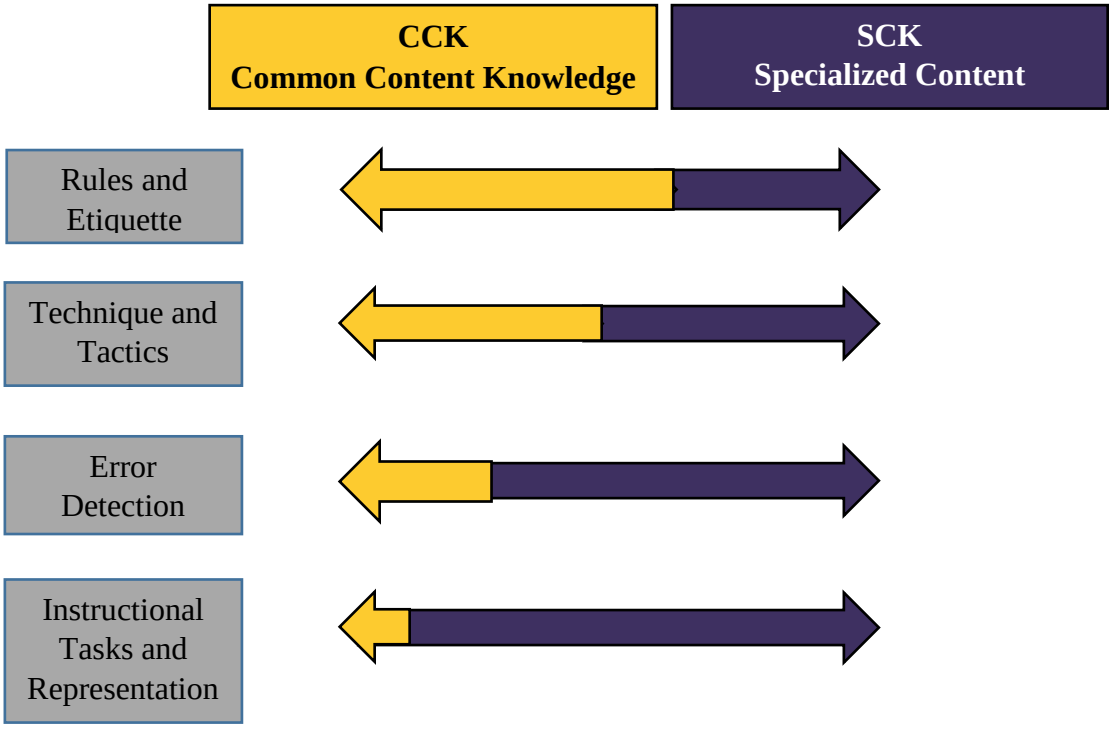

Figure 1. Continuum of Content Knowledge in Physical Education (Ward, 2010). Used with permission.

According to Ward (2009), subject matter content knowledge is acquired in four ways: (a) through PK-12 schooling, (b) during participation in organized extracurricular physical activities, (c) involvement in the planned experiences of a PETE program, and (d) through professional development as in-service teachers. Given the current administration of many PK-12 physical education programs it is unlikely that students entering PETE programs have gained the subject matter knowledge needed to teach through PK-12 schooling (Ward, 2009). The amount of time that PK-12 students are required to attend physical education is minimal. Only six states (Hawaii, Illinois, Massachusetts, Mississippi, New York, and Vermont) require physical education in every

grade K-12 and 16 states have established mandated minutes per week for elementary physical education, 18 states for middle school physical education, and only 10 for high school physical education (National Association for Sport and Physical Education & American Heart Association, 2012). Elementary school students often have physical education only one or two times per week, which is insufficient time to develop motor skills, while middle and high school physical education programs are often activity or sport based with little learning occurring (Locke, 1992; Ward & Doutis, 1999). With limited time and content covered, pre-service teachers are entering physical education preparation programs with very limited subject matter content knowledge.

The second way Ward (2009) identified that subject matter is learned through participation in organized physical activities both in and outside of school. However, Shulman (1986) stated that teaching is more than having subject matter knowledge; it includes the subject matter for teaching, which Shulman referred to as pedagogical content knowledge (PCK). Shulman (1986) defined PCK as the ability to take the subject and make it comprehensible to others through representations of ideas, analogies, illustrations, examples and demonstrations. Simply participating in an activity does not translate into the ability to present the information in a form that is understandable to others. Other aspects of PCK that are likely not learned through participation are having an understanding of what helps or hinders student learning and the conceptions and preconceptions that students bring with them to class. Physical educators must know and understand the misconceptions students will bring with them to class and have the ability to create an environment that corrects those misunderstandings.

Next, Ward (2009) suggested subject matter content knowledge can be gained through planned experiences in PETE programs. However, PETE programs do not always have the opportunity of choosing their objectives or how they will be achieved. Teacher education requirements (i.e., national and state), institutional requirements (i.e., general education requirements and liberal arts requirements) and disciplinary requirements (i.e., department courses) all influence PETE programs and often are not relevant to teaching practices (Locke, 1989). These constraints can minimize the amount of subject matter content knowledge courses that can be offered. Lastly Ward (2009) states that subject matter knowledge can be gained through professional development for in-service physical educators.

Skill Analysis

Walden and Travers (1963) offered a general law of teaching that suggested two processes are the essence of teaching motor skills. The first is diagnosis, which is the ability to compare a learner response that has been elicited, observed, and evaluated, to pre-established criteria (behaviors). The second, intervention or prescription, is based on the evaluation and the decision about what needs to happen next in order to narrow the gap between the observed performance and movement criteria. Within the framework of this model, Hoffman (1977) defined skill analysis as the "act of identifying errors in a learner's performance," (p. 3) which is a specific diagnostic task that is necessary for successful teaching. As far back as 1939, Huelster identified the need for specific movement analysis instruction in PETE programs. Physical educators are continually involved in the process of observing, evaluating, and interpreting student performance

during motor skill instruction and game play. Physical educators must know the critical elements of the movements to be able to identify any deviation from that established criteria. When a deviation is identified, they must then decipher the inaccuracies in the movement in order to provide constructive feedback to correct it. This feedback is contingent upon physical educators' accuracy of identifying errors. Traditionally coursework in biomechanics and kinesiology has been viewed as the sub-disciplines that provide the basis for learning how to analyze skills (Colfer, Hamilton, Magill, & Hamilton, 1986). Hoffman (1974) identified significant differences in analysis done by kinesiologists and physical educators and can be seen in Table 1.

Table 1.

Analysis Differences between Kinesiologists and Physical Educators

Kinesiologists (Analysis in a lab)	**Vs.**	**Physical Educator (Analysis in a Gymnasium)**
Quantitative and research based	Vs.	Qualitative, subjective and practical
Conducted to understand mechanical phenomena or theoretical specification	Vs.	Conducted to assess learner's behaviors
Controlled Setting and a lot of equipment	Vs.	No benefit of controls, cameras, motion analyzers or software

Skill analysis that is being taught in a lab setting does not provide the knowledge base for skill analysis done daily by physical educators in a gymnasium.

Overview of the Problem

Content knowledge has been defined as "the amount of and organization of knowledge per se in the mind of the teacher" (Shulman, 1986, p. 6) and divided into CCK

and SCK in mathematics (Ball et al., 2008) and in physical education (Ward, 2009). One aspect of SCK in physical education is error detection ability. Traditionally, PETE programs have relied on sub-disciplinary instruction, such as one or two biomechanics courses, to educate students on skill analysis. Research has indicated that physical educators are not proficient at observing and analyzing motor performance and this approach (e.g., biomechanics courses) to educating PETE students is not working (Overdorf & Coker, 2013). It is important that PETE programs understand how to increase error detection skills (SCK) in order to better prepare students for their teaching careers. The purpose of this study is to investigate the change in SCK, specifically error detection skills, as a result of a short workshop and either peer analysis or self-analysis of skill performance.

Research Questions

1. What change occurs in SCK as a result of attending a CCK and SCK workshop and analyzing videotaped performances?
2. What change occurs in SCK as a result of attending a CCK and SCK workshop and analyzing a peer's passing performance?
3. What change occurs in SCK as a result of attending a CCK and SCK workshop and completing a self-analysis of passing performance?
4. Following a CCK and SCK workshop does analyzing a peer's performance increase error detection ability more than self-analysis?

Significance of the Study

In order to teach students to become competent movers, physical educators must know the critical elements of motor skills (CCK). Critical elements of a movement are the key features required for optimal performance (Knudson, 2013). Physical educators must also develop the ability to identify errors in the critical elements and the source of those errors (SCK). Historically, PETE programs have not explicitly taught error detection skills (Hoffman, 1977) and continue to focus on CCK (Kim, Lee, Ward, & Li, 2015; Ward, Ayvazo, & Lehwald, 2014). If physical educators are unable to identify errors, they will also be insufficient in their ability to provide feedback to correct those errors, which will be detrimental to students' ability to become competent movers. It is important to identify how PETE programs can increase error detection skills in pre-service teachers in order to better prepare them to teach students to become competent and proficient movers.

CHAPTER II

REVIEW OF LITERATURE

Content Knowledge

Ward has stressed that physical educators must possess significantly more knowledge for teaching than simply knowing the rules, techniques, and tactics for performing the activities (CCK). In 2015, Kim et al. reviewed syllabi from content knowledge courses as well as surveying PETE program coordinators. Twenty six institutions from 22 different states provided syllabi and completed the questionnaire. Results indicated that 73% of the PETE programs reported a strong focus on CCK and 27% of the programs reported a focus on teaching SCK. In a similar study, Ward, Li, Kim and Lee (2012) analyzed content knowledge course syllabi from 38 PETE programs in the state of Ohio and the nation of South Korea and found that all of the Korean PETE programs and the majority of the Ohio PETE programs focused on CCK. In the state of Ohio, approximately 40% of the PETE programs included SCK. It is evident from the recent research that content knowledge courses are focused on increasing pre-service teachers CCK with much less focus on SCK which may hinder pre-service teachers' ability to effectively teach and improve children's motor skill performances. Hoffman (1987) stated that teachers need advanced knowledge of the content they are teaching so they are able to provide quality physical education for their students. The question was and still is how to measure content knowledge. Shulman (1986) identified the lack of research on teachers' understanding of CK as well as the decisions made when instructing as the "missing paradigm" (p. 6). According to Shulman (1986) the "missing

paradigm" is the lack of focus on subject matter and how it is transformed into the understandable content for the learners. This is referred to as pedagogical content knowledge (PCK) and in order to demonstrate PCK teachers must have an intimate understanding of content (CK), knowledge of pedagogy, their students and the curriculum and then translate the CK in a form that is comprehensible for students to learn.

Research in the physical education setting has established that when PCK improves, CK improves (Jenkins, Garn, & Jenkins, 2005; Jenkins & Veal, 2002, McCaughtry & Rovegno, 2003; Rovengno, Weiyn & Todorovich, 2003). Recently researchers have investigated the effectiveness of workshops to increase in-service teachers CK, PCK and student learning. Ward, Kim, Ko, and Li (2014) examined the effectiveness of a badminton CK workshop on in-service teachers' PCK and ultimately student learning. Participants in this study were four male middle school physical education teachers with 4 to 20 years of teaching experience. The teachers ranged in age from 34 to 47 years old and were not experts in badminton; they taught two 6-day badminton lessons to four intact classes. The content for the workshop was presented in the form of a knowledge packet that included task progressions (SCK) for teaching badminton skills, critical elements (CCK) for each of the six skills taught (serving, overhead strokes, underhand strokes, smash shots, drop shots, and doubles strategies), common errors and error corrections (SCK), and a recommended unit plan with task sequences and progressions (SCK). The workshop was provided over a 4 hour period and consisted of an overview and introduction, observing the workshop video, and

evaluation. The workshop video explained the objective of each task, appropriate examples (SCK), specific and sequenced task progressions (SCK), critical elements and tactics of each skill (CCK), and how to explain, demonstrate and adapt the sequence for lower skilled students (SCK). Teacher knowledge was evaluated after each skill was presented to ensure that they understood the content. Teachers were provided feedback following each experimental class lesson regarding their choices, implementation and modifications of the tasks during the lesson.

Analysis of student data included both descriptive (means, ranges, and percent of correct, incorrect, and other performances) and inferential statistics (ANOVA). Teacher data was analyzed through both descriptive (means and range) statistics and effect size. Results indicated that students in the experimental classes performed more correct trials than those in the comparison classes and students with high and medium skills displayed more correct trials than those identified with lower skills. Students in the comparison classes had a significantly higher percentage of incorrect trials than those in the experimental classes. Following the workshop teachers demonstrated improvement in their representation of tasks, their use of verbal descriptions, cues, and specific feedback. Teachers also used more correct demonstrations while incorrect demonstrations decreased and they also exhibited more task adaptations for the entire class as well as for individuals and small groups of student throughout the unit. In summary, these results indicated that a short (4 hour) CK workshop that taught both CCK and SCK can impact teacher PCK, specifically task representation, intertask development and task

modification (intratask). This is important to note as Ayvazo and Ward (2011) found that the ability to demonstrate intratask modification displays a depth in teacher knowledge.

In a very similar study, Sinelnikov, Kim, Ward, Curtner-Smith and Li (2015) investigated the effect of a badminton CK workshop on instructional quality and student learning. Participants in the study were beginning male and female physical education teachers with 3 years of teaching experience but no experience playing or teaching badminton. Both teachers were 25 years old. Single sex intact classes were used and 2 classes were randomly selected as comparison classes and two classes were selected as experimental classes. Using stratified sampling of ability, six students in each class were selected based on skill level (two high-, two middle-, and two low skilled students) to represent their class. The lesson organization for each teaching episode consisted of a warm up, practice activities, and concluded with badminton games or modified games. Just as in the previous study a CK packet was presented in the form of a knowledge packet that included task progressions (SCK) for teaching badminton skills, critical elements (CCK) for each of the skills taught (serving, overhead strokes, underhand strokes, smash shots, drop shots, and basic singles and doubles strategies), common errors and error corrections (SCK), and a recommended unit plan with task sequences and progressions (SCK). The workshop consisted of meeting on two days for two hours each day and began with an introduction and expectations for the workshop and then teachers observed the workshop video. The workshop video explained the objective of each task, appropriate examples (SCK), specific and sequenced task progressions (SCK), critical elements and tactics of each skill (CCK), possible errors and corrections for those errors

(SCK) and how to explain, demonstrate and adapt the sequence for lower skilled students (SCK). Following the workshop, teachers were asked to demonstrate the correct technique for each skill and they also answered a series of questions pertaining to technique, errors and error correction task presentations, progressions and modifications to ensure that they understood the content.

To analyze student data, descriptive (means, range and percent of correct, incorrect, and other performances) and inferential statistics (effect size) were used and teacher data was analyzed using descriptive statistics. As in the previous study, results indicated that students in the experimental classes performed more correct trials than those in the comparison classes and students with high skills displayed more correct trials than those identified with lower skills. There was not a significant difference of correct trials between the high- and medium skilled students or between the medium- and low-skilled students. Students in the experimental class also had significantly fewer incorrect trials than those in the comparison class. Following the workshop, both teachers demonstrated improvement in correct representation and increased their use of correct verbal descriptions and visual learning information. Teachers also used more correct demonstrations and more diverse forms of demonstrations and explanations while using less incorrect demonstrations. As in the previous study, results indicated that a relatively short (4 hour) CK workshop can provide significant gains for both teacher effectiveness and student learning.

Observing as a Teaching Skill

A physical educator needs to be competent in observing and identifying the errors in a student's performance because this is the critical foundation for providing feedback to support the student acquiring skills. Barrett (1983) has defined observing as the "ability to perceive accurately both the movement response of the learner and the environment in which the response is taking place" (p.22). For the purposes of this definition, Barrett (1983) defined accuracy as the ability to see what is actually viewed and not what is thought to be viewed. Bell, Barrett, and Allison (1985) investigated what pre-service physical education teachers see when they are in an unguided field experience. Twenty one pre-service physical educators enrolled in an introductory physical education course that included observing elementary physical education classes. During the first observational experience, participants were asked to observe a fourth grade class engaged in a 15-minute games lesson. The focus of the lesson was on catching a bean bag by moving -- sideways, forward, backward -- and focusing on arm extension. During the observation the participants were allowed to take notes on what they observed but were given no directions of what to observe. Thirty eight percent of the participant comments about their observation focused on the students, 38% of comments focused on the students and teacher and 14% focused on the teacher and lesson. Results also indicated that participants made non-evaluative comments regarding the teacher and when commenting on the students their comments were largely subjective. The authors noted that no comments were recorded that related to the combination of the teacher, students, and lesson but comments were made about each

individual group or a combination of the two groups. Also noted was the variability in the number of comments made about each of the groups which ranged from 1-5 comments about the students, 2-9 comments about the students and teacher, and 5-11 comments about the teacher and lesson. The variability in comments and the number of comments made may be explained by the background experience or lack of experience of the participants, participant inability to see what was actually occurring in the lesson, and the fact that they were just beginning the teacher education program and this was their first opportunity to observe an elementary school physical education lesson.

In a follow-up to this study (Barrett, Allison, & Bell, 1987) participants observed a fifth grade class engaged in a 15-minute games lesson with the same content as the previous study (bean bag catching while moving). Participates in this study were eight pre-service teachers who were in their final semester of the teacher preparation program. Of the eight participants, five had completed the previous study. Results indicated that 50% of the participants commented on the combination of the students, teacher, and the lesson, 25% commented on the combination of the students and the teacher, 12.5% commented on students only and students and the lesson. A comparison of the two studies and results of the participants' focus on attention are located in Table 2. Of particular interest in the current study was the marked improvement in participant's comments regarding the movement responses of the students. No comments were recorded addressing students, teacher, and the lesson in the first study but in the second study 50% of the participants commented on the combination, which demonstrated an increased ability to focus attention on multiple aspects rather than focusing on students

only or the teacher only. The authors suggested that this increased ability to focus on multiple aspects was due to the additional coursework and teaching practice that they had throughout the preparation program.

Table 2

Focus of Attention

	Study 1 Pre-Service Teacher (N = 21)				Study 2 Pre-Service Teacher (N = 8)			
Focus of Attention	No. of Majors	%	No. of Comments	%	No. of Majors	%	No. of Comments	%
Students	8	38.1	23	25.8	1	12.5	22	9.8
Teachers	1	4.8	2	2.2	0	0	0	0
Lesson	0	0	0	0	0	0	0	0
Students and teacher	8	38.1	38	42.8	2	25	63	28.1
Students and lesson	1	4.8	2	2.2	1	12.5	17	7.6
Teacher and lesson	3	14.2	24	27.0	0	0	0	0
Students, teacher, and lesson	0	0	0	0	4	50	122	54.5
Total	21	100	89	100	8	100	224	100

Note: Data for frequency distribution of observation for study 1 from Bell et al. (1985) and for study 2 from Barrett et al. (1987).

Table 3

Frequency Distribution of Observations

	Study 1 Pre-Service Teacher (N = 21)		Study 2 Pre-Service Teacher (N = 8)	
Category	Observation	Percentage	Observation	Percentage
Student Objective				
Student movement response - movement task	5	5.6	107	47.8
Student movement response - organizational task	2	2.2	10	4.5
Social Interaction	3	3.4	4	1.8
Personal Characteristics	7	7.9	1	.4
Cognitive Characteristics	0	0	0	0
Student Subjective				
Student movement response movement task	4	4.5	41	18.3
Student response organizational task	0	0	2	.9
Social interaction	6	6.7	0	0
Personal characteristics	12	13.5	2	.9
Cognitive characteristics	2	2.2	1	.4
Teacher objective				
Personal characteristics	9	10.1	0	0
Teaching techniques	11	12/4	47	21
Classroom climate	7	7.9	0	0
Teacher subjective				
Personal characteristics	0	0	0	0
Teaching techniques	12	13.5	2	.9
Classroom climate	1	1.1	0	0
Lesson				
Goals	5	5.6	5	2.2
Organization	3	3.4	2	.9
Total	89*	100	224	100

Note: *One observation could not be classified; Data for frequency distribution of observation for study 1 from Bell et al. (1985) and for study 2 from Barrett et al. (1987).

Another interesting comparison of the two studies was the frequency of the distribution of the observation into five subcategories of (a) student objective, (b) student subjective, (c) teacher objective, (d) teacher subjective, (e) lesson, and (f) other. Criteria for each of the subcategories and the frequency distribution of the observations can be found in Table 3. It was noted that only 10% of the comments were about movement responses in the first study and in the follow-up study 66.1% of the comments were about movement responses. The authors expected this increase because of the focus in the teacher preparation program. Of note is the acknowledgement by the authors that in the analysis they didn't determine whether this increase was accompanied by an increase in the observation of details which would have been beneficial.

The authors summarized that because of the focus within this particular preparation program, pre-service teachers are able to observe and see more during observations at the end of their program and that allows them to focus more attention on children's movement responses. In regard to both studies, the authors suggest that pre-service teachers need guidance in what to observe in an early field experience and without this guidance what they observe is limited in breadth and depth. If pre-service teachers can learn to focus their attention when they observe children they will acquire an invaluable skill that they can utilize throughout their teaching career.

Allison (1987) also investigated what and how six junior level physical education teacher education majors observed during an early field observation experience. The participants observed three videotaped 15 minute lessons (games, gymnastics and dance) with a 10 minute break in-between each of the lessons. As they

observed the lessons they were asked to speak into a recorder about anything that they were seeing during the observation. Following the observations the participants were interviewed and asked three types of questions. The questions largely addressed the observation and how they went about observing what they did, clarifying questions to ensure that participants were stating what they observed and not interpreting the observation, and any other clarifying questions to ensure the researcher interpreted the statements correctly. Results indicated that three observational content categories emerged with student movement response being mentioned 223 times and student non-movement characteristics (51) and organizational tasks and patterns (40) being mentioned as well. The movement response observations were then examined further to determine the type and amount of detail described across all three activities, the descriptions of the movement responses addressed and activities the body was performing. The author pointed out that even though the vast majority of the observation statements addressed movement, some statements also addressed a second category indicating that participants had progressed from observing a single dimension but had not progressed to a point where they could observe two or more dimensions.

Another aspect investigated by Allison (1987) was the perceptual process of how the participants gathered the information during the observation. Three categories emerged and were identified as the expectancy set, contrast and evaluation. The expectancy set included the verbal behaviors of the teacher, participant's personal background experiences, and their teacher preparation curricular experiences. Verbal behaviors of the teacher were identified as the participants used the exact vocabulary that

the teachers used during instruction in their observations, while participant's personal background experiences were identified during observations as well. For example, one participant identified that a child was not tucking her head during a forward roll just as she herself had failed to do as a child. Lastly, participants mentioned particular classes within the physical education curriculum that assisted in directing their attention to particular aspects of the movements.

The second category that emerged in the perceptual process was contrast. Contrast indicates that when nothing really catches the observer's attention, they compare similar qualities in order to highlight what was different. For example during games, one participant highlighted that some students were down low with their knees bent while other just stood straight up and down. The final category that emerged was evaluation and the participants used two types of evaluative observations, those with criteria and those without criteria. The majority of the evaluative observations were commented on without identifying the supporting criteria which may indicate that the evaluations were made too quickly and prior to observing what was actually happening.

Allison (1990) expanded the previous research to non-physical education pre-service teachers and described what a pre-service classroom teacher observes and what perceptual processes they use when observing physical education lessons. The participants were seven females who were junior elementary education majors and were enrolled in their only required physical education course, which was taken the semester prior to student teaching. Participants observed a video of two fifth grade classes, each 20 minutes long with one class focused on educational games with an emphasis on

dribbling a ball with a hockey stick and accelerating, decelerating and changing directions. Participants were given a 10 minute break between lessons. The other lesson focused on educational gymnastics with an emphasis on landing and rolling when jumping off an apparatus. During the lessons the participants were given recorders to speak into and instructed to say out loud what they were seeing. The week prior to the observations Laban's conception of movement was presented to the pre-service classroom teachers through lecture and readings. The movement framework classifies movement into four broad aspects of body, space, effort, and relationships. The pre-service classroom teachers were given an overview of the framework, definitions and examples that emphasized the different aspects of the framework. It was stressed that the framework could be used to assist in observing and analyzing movement. Results indicated that only one content theme emerged and that was the students' movement responses. All seven pre-service classroom teachers focused on the students' movement responses more than any other aspects in both the games and the gymnastics lesson. They also observed all four aspects of the framework and were able to attend to several details in the majority of the students' movement response observations. During the gymnastics lesson, the participants commented predominantly on the body aspect of the movement which according to Barrett (1984) is typical of unskilled observers. The pre-service classroom teachers also provided the majority of their observations without providing the criteria they based their evaluations on. The author indicated that the lack of supporting criteria suggested that the pre-service classroom teachers may have made

quick judgments which according to Barrett (1984) is a characteristic of an unskilled observer.

This study was similar to the study conducted by Allison (1987) with pre-service physical education teachers who were at the same point in the teacher education program. Both studies used the same methods and observations were done in a similar context and Allison found that the pre-service physical education majors also observed the students' movement responses more than any other aspect of the lesson. However, in comparing the comments of the physical education majors and the elementary education majors, Allison (1987) found that the elementary education majors commented in greater detail in their observations than the physical education majors. Allison (1987) suggested that the physical education majors brought experiences and consequently biases to their observations where the lack of physical education experience by the elementary education majors provided a non-biased view. The physical education majors had also been taught the framework but did not report using it to organize or direct their attention. It appeared that the biases that they brought to the observation were stronger than the idea of using the framework.

In the investigation of the perceptual process the elementary education majors utilized evaluation and contrast to make their observations. Each of the pre-service classroom teachers evaluated what they saw in both lessons and made judgements such as right/wrong, good/bad or successful/unsuccessful. Like the previous study, the majority of the evaluation was without explaining the criteria on which they based their judgement. Contrast as a process was likely used due to the lack of experience in

observing physical education lessons and increased experience and conceptual knowledge may help. Without the conceptual knowledge, the pre-service classroom teachers cannot apply it in a systematic way to observe the information necessary as their attention is directed at the contrasting elements rather than the critical elements that would help them understand what they are seeing.

The studies by Barrett et al. (1987), and by Bell et al. (1985) covered the spectrum of a physical education teacher preparation program. Utilizing the first and last field experience of the program they were able to highlight differences in pre-service teachers' observation abilities. In the first field experience observation the pre-service physical educators focused on a limited number of events, attended to the personal characteristics of the students and did not report many observations regarding student movement responses. Conversely, in the last field experience the pre-service physical educators vastly increased the number of observations, were able to observe a wider variety of events and focused on movement responses and teaching behaviors more often. Allison's work (1987) added to these findings by researching pre-service physical educators during the middle of their coursework. Findings indicated that when observing, participants paid particular attention to student movement responses but noticed little detail in in the movements, which demonstrated undeveloped observation skills such as where to look, what to look for, and which perceptual processes to use. What can be suggested from these studies is that observational skills can be developed over time in pre-service physical education students.

Skill Analysis

Skill analysis involves observing the movement, analyzing the movement, and making a determination of how closely the specific components and sequence of movements align with the accepted criteria (Morrison & Reeve, 1989). Researchers (Beveridge & Gangstead, 1984, 1988; Gangstead, 1984; Gangstead & Beveridge, 1984; Morrison & Reeve, 1986, 1989; Wilkinson, 1991) have found that instruction in skill analysis can significantly improve the performance of undergraduates on specific perceptual and diagnostic aspects of skill analysis.

Improving Skill Analysis through Instruction

Morrison and Reeve (1986) investigated the effectiveness of instructional videotapes in 84 elementary education teaching majors and their ability to analyze specific physical skills and then apply that knowledge in analyzing a non-related skill. Participants were divided into three groups: a control group received no instruction while the other two groups viewed an instructional video tape designed for them to analyze throwing, catching, and striking skills or the instep kick in soccer. Each tape was approximately 40 minutes long and showed children performing the skills both correctly and incorrectly. Tapes included the most important teaching cues and sequences as well as the common errors associated with those cues and sequences. Two days following the instructional tape both groups were shown a test videotape of children throwing, catching, and striking and asked whether the performances were correct or incorrect. If it was incorrect, they were asked to select the cue or cues that would correct the performance. Results indicated that the group shown the throwing, catching, and striking

videotape had the highest mean value, with the control group with the next highest mean and the group viewing the soccer instructional video with the lowest mean value. Morrison and Reeve were surprised that the control group scored higher than those viewing the soccer video due to the commonality of the teaching cues, the formats of the instructional and test tape, and that no parts of the instructional or test tapes were staged. They concluded that perhaps the principle of specificity applies to analysis of skills just as it does in skill acquisition.

Morrison and Reeve (1989) investigated the relationship of gender and utilization of two videotaped instructional units to determine skill analysis ability of undergraduate physical education students. The Group Embedded Figures Test (Witkink, Oltman, Raskin, & Karp, 1971) and an adaptation of Morrison and Harrison's skill analysis test (1985) was used to measure perceptual style and ability to analyze skills. Undergraduate physical education students took a pretest on skill analysis as a group and then were randomly assigned to one of two treatment groups. Instructional tapes were created to develop participants' ability to assess movement and included information on the skill's critical features and sequence for throwing, catching, and striking skills. One group viewed instructional tapes that included showing both good and bad examples of each skill and following the bad example, corrective information was presented. The second treatment group viewed the same instructional tape showing only the good examples with the bad examples being edited out. The Group Embedded Figures Test (GEFT) was given to the participants later in the semester. The GEFT is a timed test that requires participants to identify geometric patterns embedded in a complex array of geometric

shapes intended to be distracting. Participants are asked to find the embedded shape and match it to the predetermined shape. Results of the GEFT indicated that men had a higher mean than the women. Results from the skill analysis test indicated that both treatment groups benefited from instructional tapes and the group that was shown only the good examples benefited more than the group viewing both the good and bad examples. The researchers stated that stratifying treatment groups based on their perceptual style may have contributed to this effect due to the fact that perceptual style may affect both the discrimination and the retention of movement information. There were no effects found for gender, treatment program, or their interactions.

Morrison and Reeve (1992) also investigated non-physical education pre-service teachers and their ability to learn to analyze movement. The purpose of this study was to investigate the effects of perceptual style and instruction on the acquisition of skill analysis abilities in elementary education majors. Morrison and Reeve again used the GEFT and then stratified participants based on where their scores fell in a quartile. Following the determination of their quartile, the participants were randomly assigned to the control or instruction group. The instruction group viewed a videotape designed to teach elementary education majors how to analyze movements of elementary school children. The tape displayed the skills of throwing, catching, and striking and showed the major components and the sequence of the components. After this portion of the video the most common error(s) were depicted and explained. The post-test video tape displayed different children performing the same skills as those on the instructional tape. Participants were asked to decide whether the children's performance was correct or

incorrect and to select the cues to correct any errors they detected. The pre-test and post-test were viewed as individual groups and the instruction group viewed the tape together while the control group did an unrelated activity. The pretest was taken two days prior to the treatment and the post-test was given within two to five days of the treatment. Results indicated that those who saw the instructional tape made significantly fewer errors than those who received no instruction. There were no effects for perceptual style or any interactions. The authors summarized that the ability to analyze skills can be positively effected through instruction.

Biscan and Hoffman (1976) investigated whether physical education teachers and students had a unique ability to analyze skills and if they did was it generic in scope or limited to skills with which they were familiar. Participants were in-service teachers from a graduate motor learning class, students enrolled in an undergraduate biomechanics class and a group of junior high classroom teachers. Participants viewed a film of a student demonstrating two prototype cartwheels followed by 10 more, some of which were identical to the prototype and others that differed from the prototype. Participants then watched the film a second time and were given 20 seconds following each of the 10 cartwheels to indicate if the cartwheels were identical to the prototype or if not, to select from three descriptive phrases provided by the investigators that best specified how the cartwheel differed from the prototype.

A film demonstrating a novel motor prototype which incorporated many of the same components as a cartwheel (multiplanar component movements of the arms, legs, and torso) was shown to the participants and again they were asked to compare each of

the 10 alternative demonstrations to the prototype, similar to what they had done with the cartwheel. Results indicated significant differences in mean scores for the cartwheel analysis test but not for the novel movement analysis test. Results indicated that physical education teachers and students had an advantage in analyzing skills when they were familiar with the motor prototype but not any better than the junior high classroom teachers.

Gangstead (1984) engaged undergraduate physical education majors to determine the effectiveness of three different approaches to sport skill analysis. The approaches included an observational model (OM), common errors (CE) and correct-only (CO) analysis. Prior to orientation and intervention, the overarm throw subtest of the Utah Skills Analysis Test (USKAT) was utilized to assess overhand throw performance as well as a knowledge test of components of the overarm throw. The observational model was designed to organize the spatial and temporal components of movements. Body components were listed from the top to bottom on a table and the temporal components across the top. The model attempts to systematically direct the observers' attention from the slowest to fastest moving body components. During the OM approach participants were instructed on the process used with the observational model and during this time reviewed a highly skilled thrower's video to teach participants how to categorize the overarm throw into temporal and spatial components. Following this instruction, participants were asked to observe a beginning level learner and note differences in the learner's performance or the absence of correct movements and then make performance error judgements based on their observation. The CE group observed a beginning learner

and were instructed to pay particular attention to common errors of the overarm throw and indicate on a checklist the specific errors observed. Lastly, the CO group observed the same beginning learner and were instructed to indicate which of the corresponding correct criteria they observed. The control group viewed two videotaped illustration of a beginning level learner's attempts at a standing long jump. The video included both verbal and visual demonstrations and correct and incorrect characteristics. During the third performance the participants were asked to identify three major errors in the performance. All participants were able to identify two of the three errors correctly. Participants were given the same perceptual and knowledge tests at the conclusion of their instructional experiences. Results indicated that the OM group performed significantly better on the perceptual task than the CE, CO and control group on the post-test but no significant differences were found between the CE, CO and control groups. Even though not significant, the CE and CO groups did perform better on the perceptual task than the control group. The CE group had a slightly higher level than the CO Group. There was no significant difference between the CE and CO groups.

Knowledge task results indicated that both the OM and CE groups scored significantly better than the CO and control groups. The CO group performed only slightly better than the control group and no significant differences were found between the OM and CE groups on the knowledge task. Results also indicated that the observational experiences of the control group watching a jumping pattern did not transfer to observing the OT, which supports Morrison and Reeve's (1986) findings mentioned previously. Overall, the OM group outperformed all other groups on the

perceptual task but it should be noted that all groups except the control group did improve on the perceptual task as a result of treatment and support including skill analysis training as part of a PETE program.

Gangstead and Beveridge (1984) also investigated the effects of a methodological approach to sport skill analysis instruction on undergraduate physical education majors. Participants were physical education majors who had completed the prerequisites for the professional preparation course titled “Sport Skill Analysis” but had not yet enrolled in it. The control group participated only in the pretreatment and post treatment assessments. Participants in the experimental group received instruction in skill analysis for one hour, three times a week for eight weeks and used an observation model designed to assist in organizing the spatial and temporal components of movement. As in the previous Gangstead (1984) study, the USKAT was used to assess perceptual and diagnostic skills and videos of actual learners (male and female junior high students) performing the overarm throw, standing long jump, stationary kick and batting. Pre-test assessment included viewing nine trials of a skill, reading each movement description, and responding whether the movement described was observed (perceptual) and if it occurred, was it in a correct performance (diagnostic). The perceptual and diagnostic tests occurred independent of each other. The posttest was administered at the ninth week of the study and the procedures were identical to the pretreatment assessment. Pre-test data showed no significant differences between the two group performances on perceptual and diagnostic proficiency. Post-test data revealed significant differences in both perceptual and diagnostic efficiency with the experimental group being superior. Based on these

results, the authors concluded that systematic skill analysis instruction can significantly improve the performance of undergraduates on specific perceptual and diagnostic aspects of analysis and such strategies and instructional approaches should be considered for implementation in undergraduate courses of study in PETE programs.

In 1988, Beveridge and Gangstead extended previous research by continuing to explore the effects on skill analysis based on observational training by investigating whether participants with higher levels of perceptual proficiency or knowledge reacted in the same way as those with demonstrated average or lower levels of competency. The experienced secondary physical education teachers averaged just over 16 years of teaching experience and 9 years of coaching experience, while the novices (undergraduate physical education students) had no full-time teaching experience, just over one year of coaching experience, and 8.5 years of competitive sports. The USKAT was the assessment for performance on the perceptual test and knowledge test. The perceptual portion of the test was a series of junior high students performing the overarm throw, standing long jump, batting, and a cartwheel. Participants viewed the video performances and read and responded to each movement description and report either the presence or absence of the specific movement or body position. The instructional portion of the study spanned a 10 week period with participants meeting three times a week for an hour each meeting. Instructional videos showed both correct and incorrect performances of a variety of patterns and movements including: (a) overarm throw, (b) underhand and sidearm throwing and striking patterns, (c) nonsupport and suspension movements, and (d) twisting and rotational movements. During instruction, there was a

continued emphasis on the proper description of the skill, how the skill deviated from criterion performance, and the prescription of strategies to correct performance errors. As in the previous study, the observational model was used to organize the spatial and temporal components of movement and as the framework for discussion. Again, the model suggested a general order for the participants to observe from the slowest moving part of the body, progressively outward, to the fastest moving parts (extremities). Pretreatment perceptual scores displayed that females scored significantly higher than males prior to training and teachers slightly but not significantly better than undergraduates. Results indicated a significant treatment effect (pre- to posttest) for both groups in both perception and knowledge tests. In both perception and knowledge, undergraduates exhibited greater gains than teachers. The authors concluded that the results were inconclusive as to whether there was an effect of teaching experience on perceptual analytic ability but they also suggested that analytical skills may have been increased through systematic instruction.

Experience and Skill Analysis Ability

Armstrong and Hoffman (1979) examined whether experienced tennis teachers could determine common performance errors of a tennis forehand with more proficiency than undergraduate physical education students (inexperienced tennis teachers). The experienced group (professional tennis teachers) had an average of just over 7 years of teaching experience and 18.5 years of playing experience while the inexperienced group of undergraduate physical education majors had no instructional experience in tennis and just under two years of playing experience. Armstrong and Hoffman were also trying to

determine whether the difference in error detection would be greater when the participants were provided with pre-response information pertaining to the performer's level of skill competence (PCI) and post-response information regarding the outcome produced by the response (POI).

Participants were randomly assigned to one of four treatment groups: (a) performer competence information present/performance outcome information present (PCIP-POIP), (b) performer competence information present/performance outcome information absent (PCIP-POIA), (c) performer competence information absent/performance outcome information present (PCIA-POIP), and (d) performance competence information absent/performance outcome information absent (PCIA-POIA). The error detection test consisted of presenting the participants with 12 common forehand performance errors and having them view a video of 15 different examples of right-handed performers executing a forehand stroke. Each example was modeled and conformed precisely to the description in the error checklist. Prior to viewing the test films, participants in the PCIP-POIP group were read a statement that described the performer's level of competence. Following this information the participants immediately viewed the test films and a film that displayed the actual outcome of the performance they observed (relevant film). The PCIP-POIA group received information about the performers' level of competence prior to viewing the examples but were not provided with information regarding the outcome of the performance and were shown an "irrelevant" film of a ball projected from a ball machine and landing in a random area of the court. The PCIA-POIP participants viewed the test examples with no prior

information about the performer's level of competence but they were shown the outcome of their performance. The PCIA-POIA participants did not receive information about the performer's competency and were shown the "irrelevant" film following each performance. Test samples were shown 3 times and the outcome one time. The participants were asked to identify the location of where the ball landed and then the presence or absence of each of the 12 criterion error for the performance example.

Results indicated that experienced teachers were significantly better than inexperienced teachers in detecting errors. There was no significant effect found for pre-response information pertaining to the performer's level of skill competence (PCI) and post-response information regarding the outcome produced by the response (POI) and was only noticeable when the participants received PCI and were not supplied POI. When provided PCI the error detection rate for inexperienced teachers was within one percentage point of experienced teachers, which was not significantly significant. However, when experienced teachers were provided with POI they were significantly better at determining errors than the inexperienced teachers.

The analysis investigated the types of errors committed by the participants. Incorrect responses were identified as "misses" when the participant failed to indicate that an error was present and the second type was a "false alarm." A false alarm was an error that was identified by the participant but was not demonstrated by the performer. Results indicated that there was no difference in the number of misses by each group but the inexperienced teachers identified significantly more false alarms than the experienced group did. This suggests that the experienced teachers and inexperienced teachers are

both perceptive to error signals but experienced teachers are more proficient at discriminating errors than the inexperienced teacher.

Imwold and Hoffman (1983) also investigated experience and error detection skills by comparing three groups with different levels of gymnastic teaching experience. The groups were composed of 20 gymnastic coaches (specialists) with an average of 8.6 years of teaching and coaching experience and four years of coaching competitive gymnastics, 20 veteran elementary and secondary physical education teachers (generalists) with 5.4 years of teaching physical education and no formal training or competitive experience in gymnastics, and 20 pre-services physical education teachers (novices) who had no competitive experience or formal training other than what was received in public school physical education classes. For the movement component recognition test the participants viewed images of private gymnastic school students demonstrating the hurdle step, hand-placement, flight, and landing. Participants became familiar with the test and the four movement components by viewing sample performances and stopping at pre-selected frames. Prior to the presentation of the stimulus the participants were informed whether the response slides would require them to identify two, three or four components. Results indicated a significant main effect for groups, “target” (“target” refers to the number of components that were monitored on each trial) and movement component interactions. When means for the groups were collapsed across groups for target and movement components, the Specialists scored significantly higher than Generalists and Novices but the Generalists did not score

significantly higher than the novices. As expected, when the number of movement components increased, accuracy of recognition declined significantly.

Ian Franks (1993) also investigated the effect of experience on performance differences in the gymnastic movement of a front handspring. Novices in this study consisted of seven physical education students who had no gymnastic school experience other than public school physical education instruction. Experts were seven gymnastics coaches with 11.7 years of coaching or judging experience and 7.7 years of competitive gymnastics experience. Participants were shown two videotaped performances and then asked whether the second performance (test performance) was different than the first performance (criterion). A video was compiled of 64 handsprings with 32 pair that were criterion and 32 test performances. Of the 32 test performances, eight pair displayed different hand placements, different flight patterns, different landings, and eight were displayed entirely differently. Results indicated the ability to correctly determine the status of the pair of performances does not significantly differ between expert and novices. There was no significant difference between groups (expert vs novice) or stimulus type (same or different test pair). However, there was a significant difference between group and stimulus type. When the performances were the same, the experts made more mistakes (false alarms) than the novices did but when the performances were different, the experts were better at detecting the difference. If participants identified that there was a difference in pair of performances they were then asked to locate the difference (hand placement, flight, landing or all components were different). Results for locating the differences in pair performances revealed significant differences locating

where the differences occurred with the experts being better than the novices. This indicates that experienced gymnastics coaches are no better than novices at determining whether one performance is the same or different than another performance but they are superior at detecting differences when they actually do occur in the performance.

Motor Skill Competence and Skill Analysis Ability

Giardin and Hanson (1967) utilized upper division male physical education majors as participants to explore the relationship between ability to perform 11 tumbling skills and the ability to diagnose errors of execution in performance of those same skills. A knowledge test determined the participants' knowledge of the mechanics of execution of each skill. The participants' performance was photographed and evaluated by experts. The participants viewed a film of each of the 11 skills and diagnosed errors. The authors concluded that the ability to diagnose performance errors was related to ability to perform the same skills and knowledge of the mechanics. However, knowledge was not significantly related to the ability to perform the skills.

From the research reviewed here, the following conclusions can be drawn:

- the ability to analyze skill can be improved through instruction (Beveridge & Gangstead, 1988; Gangstead, 1984; Gangstead & Beveridge, 1984);
- experienced teachers are not superior to novices at analyzing skills (Armstrong & Hoffman, 1979; Imwold & Hoffman, 1983);
- those who are competent at particular skills are not necessarily proficient at skill analysis (Armstrong & Hoffman, 1979, Giardin & Hanson, 1967; Kretchmar, Sherman, & Mooney, 1949; Osborne & Gordon, 1972).

Video Feedback, Modeling and Self-Evaluation

Dowrick (1991) identified that an effective way to assist in skill acquisition is the use of video modeling and feedback. Video feedback typically involves a coach and an athlete reviewing a video recording of the athlete's performance (Boyer, Miltenberger, Batsche, & Fogel, 2009; Guadagnoli, Holcomb, & Davis, 2002; Stokes, Luiselli, Reed, & Flemming, 2010). Boyer et al. (2009) investigated the effectiveness of using both video modeling with video feedback in developing the gymnastics skills of a backward giant, a kip cast and a clear hop circle in four 7-10 year old competitive gymnasts. Data was collected using a 28 item checklist that was scored as either correct or incorrect. After a performance, the gymnast would view a performance of the same skill modeled by an expert gymnast and then her own video. Next, she viewed the two videoes side by side and it was "freeze-framed" at 5 different times, followed by another viewing of the expert model and the gymnast's performance. Following the review of the video, the gymnast then attempted the skill two more times and no feedback was provided. After the final intervention session a follow up session was conducted on a weekly basis but was completed without video modeling or feedback. The results indicated that the video modeling and feedback improved skill performance faster than practice and coaching only. The follow up procedures also demonstrated that the gymnasts maintained the higher level of skill performance following the intervention and after the intervention was over.

Guadagnoli et al. (2002) investigated the effectiveness of video, verbal and self-guided instruction on the outcome of a golf swing. The study included a pre-test, four 90

minutes practice sessions, an immediate post-test, and then a follow-up post-test two weeks later (post-test 2). Thirty 29-50 year-old participants from the community volunteered for this study and had golf handicaps that ranged from 7-16. They were divided into three groups: self-guided, verbal, and video. The participants were told that the success of their shots would be based on the combination of distance and accuracy. During the intervention portion the self-guided group practiced on their own as they would any other day at the driving range. The verbal group completed their session with a PGA teaching professional who provided verbal feedback (knowledge of results). The video group also had the same PGA professional, who provided both verbal feedback (knowledge of results) and video feedback (video knowledge of results). Results demonstrated a significant difference for accuracy distance and total distance with the video group being significantly better than the verbal group, which in turn was significantly better than the self-guided group. There was no significant difference or interaction found for error distance.

Because consistency is a key in golf, the researchers studied variability of shots. Variability of error distance demonstrated how consistent the shots were in relation to the target line. While the groups were not reliably different from one another on the pre-test or post-test 1, the two instruction groups were significantly less variable than the self-guided group on post-test 2. Variability for total distance showed that the groups were not reliably different on the pre-test but again, the two instructional groups were significantly more variable that the self-guided group on post-test 1. On post-test 2, the

video instruction group was less variable than both the self-guided and verbal instruction groups.

To summarize the results, when golfers were tested immediately after the training sessions, no significant improvements in accuracy distance scores were found for any group nor did the groups differ in performance. Those receiving instruction were more variable (less consistent) in total distance than the self-guided group (post-test 1). However, when tested two weeks later the two instruction groups showed a significant increase in accuracy distance with the video instruction group showing more improvement than the verbal instruction group and those receiving instruction showed less variability (more consistent) with only the video group being significantly less variable. Overall, this study suggests that both verbal and video instruction can hinder a golfer's performance immediately but can have a positive longer-term impact on distance and consistency of shots.

Stokes et al., (2010) evaluated how to improve high school football players' offensive line pass-blocking skills using descriptive feedback with and without video feedback and teaching with acoustical guidance (TAG). Participants for the study were five high school football lineman. To evaluate pass blocking skills a plus was awarded if the criteria were demonstrated and a minus if performed incorrectly. The criteria were listed in the order of execution on a 10 point task analysis, which was implemented at weekly practices sessions and reviewed on video tape following games. The coach provided descriptive feedback, which and included the coach responding to incorrect steps demonstrated by the athlete, explaining how they should have been executed, and

then having the athlete demonstrate the steps correctly one time prior to reentering the drill. Descriptive feedback plus video feedback included the athlete watching a videotape of the practice drill immediately upon completing the drill. Both the coach and the athlete viewed the video together and completed the task analysis form. Following the review of the video, each athlete performed the pass blocking sequence without any further feedback. Additionally, four of the five athletes received the TAG condition following the descriptive plus video feedback phase. The fifth was excluded as he earned a starting position. TAG is an auditory feedback system that signals when an athlete performs the desired behavior correctly. In this instance the coach would inform the athletes about the specific steps from the task analysis they would be focusing on; when the athlete performed the step correctly the coach sounded a bullhorn. No additional feedback was provided after this signal. To conclude the study, each athlete's pass blocking was evaluated when he returned for a second season. Results can be found in Table 4. It was concluded that descriptive feedback alone did not improve pass blocking performance but descriptive feedback and video feedback demonstrated an effective way to improve pass blocking technique in all five participants. Additionally, when participants received TAG they improved further. However, due to preceding conditions and aggregation of the data the authors determined that was difficult to isolate the specific effects of TAG.

Table 4

Mean Percentage of pass-blocking steps executed correctly

	Season 1					Season 2		
Athlete	Baseline	Descriptive feedback	Descriptive feedback + Video Feedback	TAG	Game	Baseline	Descriptive feedback + Video Feedback	Game
Dan	40	50	82	100	85	45	80	87
Steve	47	50	87	100		55	83	85
Logan	43	62	90	95				
Matt	59	71	84		83			
Russ	38	41	66	80/82 /88		27	67	65

Adapted from Stokes et al. (2010)

Research investigating CK in the physical education setting has established that PCK improves when CK improves (Jenkins et al., 2005; Jenkins & Veal, 2002; McCaughtry & Rovegno, 2003; Rovengno, Weiyn & Todorovich, 2003). More recently researcher have investigated the effectiveness of workshops to increase in-service teachers' CK, PCK and student learning and have found that short (4 hours) CK workshops increase teachers' content knowledge and positively affect student learning. As Ward (2009) indicated, error detection is one of the four domains that make up CK and none of these studies addressed if there was a change in error detection ability as a result of the CK workshop.

The ability to detect errors and analyze performance can be improved through instruction in pre-service undergraduate elementary education majors (Morrison &

Reeve, 1992; Morrison & Reeve, 1989; Morrison & Reeve, 1986), pre-service undergraduate physical education majors (Biscan & Hoffman, 1976; Gangstead & Beveridge, 1984; Morrison & Reeve, 1989;), and in-service teachers (Beveridge & Gangstead, 1988; Biscan & Hoffman, 1976). During each of these studies video-taped performances were utilized during the intervention or as a means for the participants to assess performance. Movement skills that were utilized and assessed by participants through video review included fundamental movement skills (throw, catch, strike, kick, jump, batting) and gymnastics (cartwheel) and no sport-specific (i.e., volleyball, basketball, football) skills.

Video feedback, modeling and self-evaluation have also been utilized by coaches and athletes to review an athlete's performance (Guadagnoli et al., 2002; Stokes et al., 2010), and with video modeling and feedback showing more effectiveness than practice and coaching only in improving competitive gymnasts' skills (Boyer et al., 2009). Video instruction and video instruction with feedback were more effective than self-guided instruction on a golf swing, and high school football players improved their pass blocking skills when analyzing a video of their own performance and when descriptive feedback were provided.

Experience in coaching and teaching have not been found to be significant assets in detecting errors and analyzing performances. Experienced tennis instructors and undergraduate physical education majors (Armstrong & Hoffman, 1979), experienced gymnastics coaches and veteran elementary and secondary physical education teachers (Imwold & Hoffman, 1983), and gymnastics coaches and physical education students

(Franks, 1993) have been compared. The researchers determined that both experienced and inexperience participants are perceptive to errors but that experienced teachers and expert coaches have the ability to discriminate errors more effectively.

Results of this review of literature reveal a need to continue to explore how CK in pre- and in-service teachers can be developed and specifically SCK and the ability to determine if and where errors are occurring in skill performances. Relatively short content knowledge workshops have demonstrated that CK can be increased but determining whether a short content knowledge workshop can increase error detection ability has not been explored. Video has been viewed to analyze fundamental movement skills, analyze performance models in developing gymnastics skills, and as a self-analysis tool in skill development. The use of video has not been investigated as a mode to enhancing CK.

CHAPTER III

METHODOLOGY

This study was designed to answer the following questions: (a) What change occurs in SCK as a result of attending a CCK and SCK workshop and assessing videotaped performances? (b) What change occurs in SCK as a result of attending a CCK and SCK workshop and analyzing a peer's of passing performance? (c) What change occurs in SCK as a result of attending a CCK and SCK workshop and completing a self-analysis of passing performance? (d) Following a CCK and SCK workshop does analyzing a peer's performance increase error detection ability more than self-analysis? Figure 2 illustrates the process of the study.

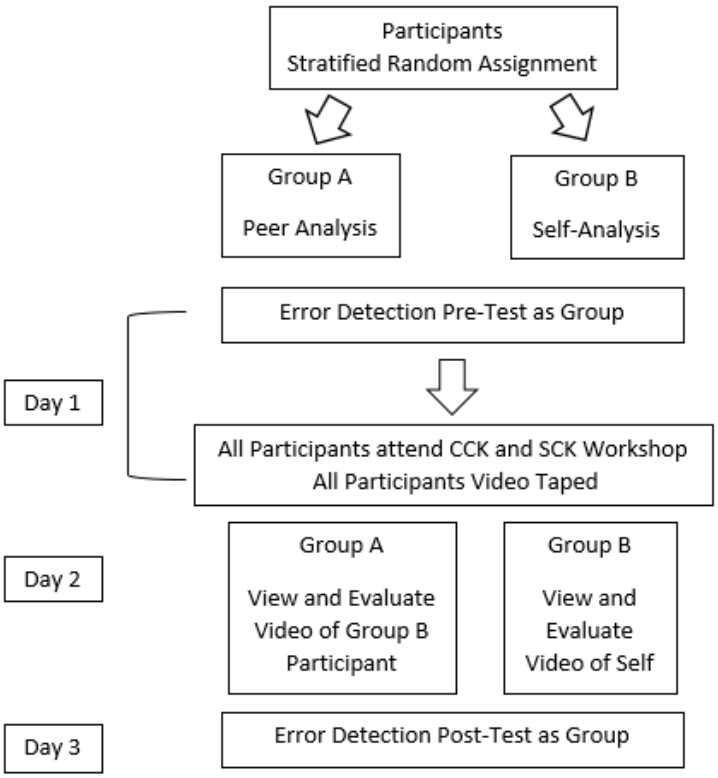

Figure 2. Study Process

Research Design

A pre-test, post-test experimental design was used to determine the effectiveness of increasing undergraduate students' SCK through a CCK and SCK workshop and video analysis (either peer or self-analysis). Stratified random assignment was utilized to group participants to control for participant variables, which content courses taken within the University PETE program, volleyball playing and coaching experience, and experience as a coach of any sport.

Participants

Participants for this study were undergraduate students enrolled in the PETE major courses at a Midwestern university with an undergraduate enrollment of approximately 10,000 students. Upon approval from the UNI IRB and the University IRB where the study took place, students enrolled in PETE major courses were sent a recruitment email (Appendix A). The next day that courses met, instructors were asked to distribute a recruitment letter and two days after the initial email a follow up email was sent (Appendix B). Students interested in participating in the study were asked to complete a Qualtrics survey (Appendix C). Participants completing the survey received an email (Appendix D) informing them of the day and time the study would begin. The Qualtrics survey questions included participant gender, year in school, PETE content courses currently enrolled in or taken, volleyball playing and coaching experience, and sport coaching experience. Information pertaining to enrollment and completion in two particular courses (net and wall and striking and fielding course and the invasion and target games course) was gathered because these particular courses focus on common

content knowledge and specialized content knowledge, including volleyball. Twenty participants (12 males and eight females) completed the Qualtrics survey and partook in the study. All 20 participants completed the pre-test, workshop, video analysis and post-test with no attrition of participants over the course of the study.

Participants were stratified and assigned to one of two experimental groups (Peer evaluation or Self-evaluation) based on gender, PETE major content courses enrolled in or completed, volleyball playing and coaching experience and coaching experiences in sports other than volleyball

Instrumentation

Pre- and Post-test Video

A video was created to evaluate participant error detection ability. A pre-and post-test video of two beginning learners (one male and one female middle school student) performing three volleyball passes was created. A class of local middle school students were asked to perform five forearm passes and each student's performance was captured using a Canon VIXIA HF R500 camcorder. The camcorder was placed on a tri-pod approximately eight feet from the performer and at a 45 degree angle in order to capture all of the performer's movements. The beginning learners being evaluated in the pre- and post-test video were chosen based on the common errors they demonstrated and errors a physical educator would typically observe in a beginning learner. These errors included body weight back and on heels with legs straight in the preparatory phase, thumbs crossed, ball contacted on the hands, arms swung during the execution phase, and

pass is off target due to uneven platform (Kenny & Gregory, 2006). The raw video was edited in Movie Maker into the final evaluation version.

The pre- and post-test videos were 4 minutes and 10 seconds in duration. The first 15 seconds of the video was a lead-in to the first performance with a visual five second countdown (5, 4, 3, 2, 1) to alert participants the performance was about to begin. The first performer was the middle school female and following a single passing performance the participants were given 30 seconds to complete the evaluation of the pass. For each of the 13 critical elements listed on the evaluation instrument, the participant either identified that they observed the performance of the critical element (yes) or did not see the critical element performed (No). The 30 seconds consisted of a countdown and number flashing every 5 seconds (30, 25, 20, 15, 10, 5) until 5 seconds remained prior to the second performance and then the countdown occurred every second (5, 4, 3, 2, 1). This sequence was continued following each of the three female and three male performances. The performances viewed of each the male and female were identical. The post-test video was identical to the pre-test video with the exception that the male performer was the first performer to be evaluated and the female performance was the second to be evaluated. The order of performers was reversed to minimize order or sequencing effects.

Evaluation Instrument

The evaluation instrument (Appendix E) was based on the work of Pinheiro and Simon (1992) and the motor skill diagnosis model (Figure 3), which incorporates the processes of cue acquisition, cue interpretation, and diagnostic decision.

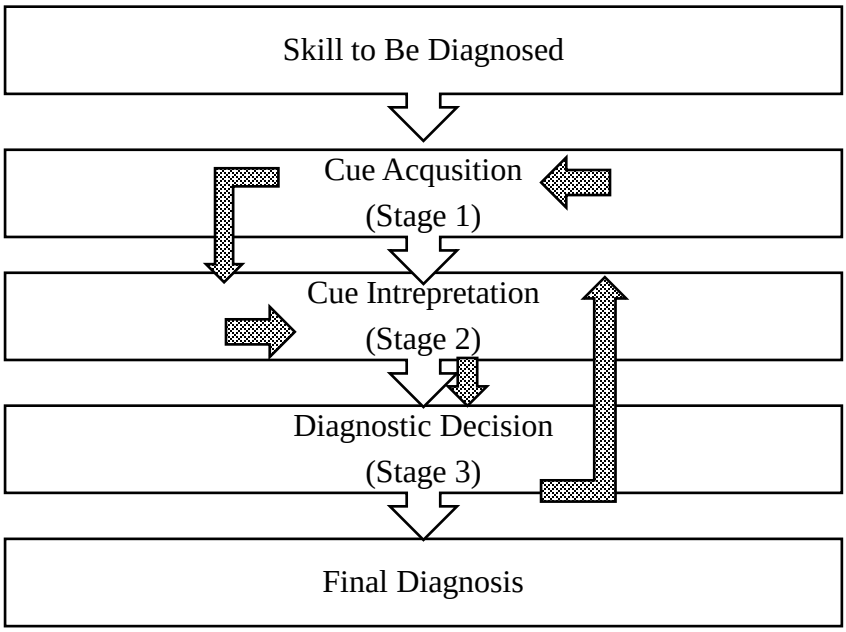

Figure 3. Diagnostic Process Model (Pinheiro & Simon, 1992). Used with permission.

Indicates re-evaluation at Stage 1, 2, and 3

In order to diagnosis a motor skill the observer must acquire information (performance cues) and this is based on systematically observing the performance and identifying discrepancies between the performance and the ideal model (Hoffman, 1977).

The second stage of the model is inferring the meanings of the cues and these inferences and evaluation are mainly based on information that has been previously learned. Novices often have a problem with these inferences (Pinheiro, 1989) because they make diagnoses that are insignificant and miss important errors.

The third and final stage of the model requires the observer to makes a judgment about the performance and specify which errors have been made. It is in this stage that

observers use the information gathered in the first two stages to reach a decision on what errors were observed. The accuracy of the diagnosis is related to the comprehensiveness of the cue acquisition and to the accuracy of the cue interpretation (Pinheiro & Simon, 1992).

Based on the Pinheiro and Simon (1992) model, Pinheiro (1994) developed a criteria sheet template that provides structure for novices to help them focus on what to look for. On the criteria sheet (Appendix F), the critical elements are arranged in three phases (preparatory, execution, and follow through). This arrangement promotes learning the critical elements of the skill both directly and indirectly and directs students to the specific movements of the skill. The criteria sheet also assists observers to systematically observe through a phase-by-phase and component-by-component process and allows errors to be recorded as observed. The critical elements were slightly modified from those listed in the Kenny and Gregory (2006) volleyball textbook, *Volleyball: Steps to Success*.

Content validity of the evaluation instrument and pre- and post-test video were established through a review by three volleyball experts. Each expert had seven or more years of college coaching experience and experience teaching volleyball skills to K-12 students and novice players. Each expert was independently emailed the evaluation instrument and the pre-test evaluation video. Experts were asked to review the critical elements and determine whether they were elements that are fundamental to learning the proper technique to a forearm pass. The experts all agreed that the critical elements listed were elements fundamental to performing a forearm pass with correct technique. They

were also asked to watch the video and instructed that they could view the video as many times as needed and could view in slow motion in order identify any errors that occurred in both the female performance and the male performance. After evaluation instruments were returned to the principal investigator by the 3 experts there was 86% agreement of the critical elements that were present and those that were absent (errors) during the performance by the female and 93% agreement on the performance by the male. In order to clarify discrepancies, each expert was contacted individually by the principal investigator and asked to explain why they either did or did not indicate if the critical element was present. Following the review by each expert, one identified an error was made when assessing the male performance and with that correction agreement reached 100%. Following the initial review, discrepancies in the female performance still existed so the comments from each expert were compiled and sent for review. Each expert was asked to review the others' comments, review the discrepancies and reach a conclusion. Following this process, 100% agreement was reached on the female performance.

Peer or Self Evaluation Video

During the workshop portion of the study, the peer and self-evaluation videos were also recorded using Canon VIXIA HF R500 camcorders. An "X" was placed on the floor for participants to stand on and the camera was placed approximately eight feet from the "X" at a 45 degree angle in order to capture all of the participant's movements during the pass. During the workshop, each participant was recorded demonstrating 10 forearm passes that were tossed to them by their partner. The raw video was then edited using Movie Maker into individual participant performances with a 15 second lead-in and

30 second intervals between performances that were identical to the pre-and post-test evaluation. The peer and self-evaluation videos were 11 minutes and 15 seconds in duration and contained one person completing the skill 10 times.

Pre-Test Evaluation

Day one of data collection required study participants to come to the university and to a classroom that is used for many of the PETE program courses. The participants entered a classroom that had five rows of moveable tables and chairs. Evaluation instruments and pencils were placed at each chair in the classroom and as students entered the classroom they choose where to sit. The evaluation instrument had a cover page with the instruction to not flip the page until told to do so in order to keep participants from viewing the critical elements of the skill they were about to observe. When all participants were present and seated, the evaluation instruction script was read (Appendix E). No questions were asked and participants were instructed to turn the cover page over and read the criteria. When all participants had picked up their pencils, indicating they were ready to begin, the pre-test evaluation video was played. The video was shown through a ceiling mounted liquid-crystal display (LCD) projector onto a 96" x 72" ceiling mounted drop down projection screen. At the conclusion of the video, the participants were asked to place their pencils on top of their evaluation instrument and transition into the gymnasium where the content knowledge workshop would be located. Prior to leaving the classroom, participants were asked to choose a time (Appendix G) to return to evaluate either themselves or a peer performing a forearm pass.

Content Knowledge Workshop

Prior to entering the gymnasium, five "X's" were taped on the floor along the sideline of the basketball court as markers on which the participants were to stand when being recorded. Five Canon VIXIA HF R500 camcorders were placed approximately 8 feet from the "X" at a 45 degree angle in order to capture all of the participant's movements during the pass. Also in the gym were 20 Tachikara volleyballs located in a ball cart on the opposite basketball side line from the cameras. Upon entering the gym, participants were asked to gather around the researcher for an overview of the workshop's goal and activities. The sequence for teaching the critical elements of passing was based on the professional experience of the researcher who has extensive experience teaching and coaching volleyball. Following the short overview participants were then instructed to find their own personal space where they could both see and hear the researcher. The researcher then demonstrated five forearm passes utilizing each of the critical elements on the evaluation instrument. Following this demonstration, the ball was set aside and the preparatory phase was demonstrated and described in detail and participants were asked to verbally repeat each of the critical elements in the preparatory phase. Next, participants demonstrated each of the critical elements and the researcher observed each participant to ensure that each was demonstrating the critical elements correctly. If one was not, corrective feedback was provided. This sequence was repeated for the execution and follow through phase and all without the use of a volleyball. The next activity required participants to pass a ball tossed from their partner who was standing 15 feet away. The focus of this activity was to practice utilizing the critical

elements. Each participant was asked to pass 10 times and then to switch roles. No feedback was provided from the researcher. After each set of partners had completed 10 passes they were brought together and asked to repeat the critical elements of passing. Next, they repeated the first activity but during this series of passes they were videotaped performing the passes. At the conclusion of being videotaped participants were again brought together and asked to repeat the critical elements.

The next activity had the participants stand directly across from their partners and pass the volleyball back and forth. The participants practiced passing back and forth for 30 seconds and at the end of each 30 seconds they were asked questions which led them to identify the critical elements. This pattern was repeated a total of 5 times. At the conclusion of this activity participants were asked to return the volleyballs to the ball cart and reminded of the time they signed up to evaluate either themselves or a peer and the location for that evaluation.

Peer or Self Analysis

Two days following the workshop, participants returned to individually assess either a peer's performance or their own performance. Prior to the participant's return, the video was edited into individual video performances that followed the same sequence as the pre- and post-test evaluation videos with a 15 second lead-in but instead of 30 seconds between performances, participants were given one minute. The extended time was provided for participants to review and enhance knowledge of the critical elements. If assigned to the peer analysis group, the participant observed and analyzed a peer of the same gender performing 10 passes. The male and female performer used for the peer

analysis were randomly chosen. If the participant was male they viewed the same male performer and if the participant was female they viewed the same female performer. Participants arrived at their scheduled time and the evaluation instrument was on the table in front of an Apple iMac 21.5 computer. The video was paused and when the participant was ready to begin she/he clicked play and viewed and evaluated the video. During the evaluation, no feedback was provided to the participant or their accuracy of error detection. The evaluation instrument was identical to the pre-test instrument with the exception of space to evaluate 10 performances instead of six. At the conclusion of the video the participants were reminded of the post-test assessment.

Post-Test Evaluation

To conclude the study, all participants returned two days later to the same classroom where the pre-test evaluation took place. The exact same protocols were followed as during the pre-test with the only difference being the order of the performers. During the post-test the male performer was first and the female was the second to be evaluated.

Data Analysis

Data for this study were gathered through the pre- and post-test evaluation instrument. For each of the 13 critical elements listed on the evaluation instrument, the participant either identified that they observed the performance of the critical element (yes) or did not see the critical element performed (No). Participant evaluations were compared to the expert evaluation which was used as a "key." One point was awarded for each critical element participants identified correctly for a total of 13 points per

performance. Participants observed and evaluated three performances by the female and three by the male performer for a total of six performances and a grand total of 78 points possible.

The data generated from the pre-test and post-test for both the peer analysis group and the self-analysis group was analyzed using the Statistical Package for the Social Sciences (SPSS) v. 24. A one-way ANOVA was used to compare pre-test group means to ensure that no significant differences existed in SCK following the pre-test. A two-way repeated measures ANOVA was used to compare the pre- and post-test means.

CHAPTER IV

RESULTS

This study was designed to answer the following questions: (a) What change occurs in specialized content knowledge (SCK) as a result of attending a common content knowledge (CCK) and SCK workshop and assessing videotaped performances? (b) What change occurs in SCK as a result of attending a CCK and SCK workshop and analyzing a peer's of passing performance? (c) What change occurs in SCK as a result of attending a CCK and SCK workshop and completing a self-analysis of passing performance? (d) Following a CCK and SCK workshop does analyzing a peer's performance increase error detection ability more than self-analysis?

The study included 12 males and 8 females for a total of 20 participants. Of those 20 participants, three were enrolled in their second year at the University, three were enrolled in their third year, six were enrolled in their fourth year and eight had been enrolled for five or more years. The majority of the participants had no volleyball playing or coaching experience, and over half of the participants had experience coaching another sport. Characteristics for each the peer analysis and self-analysis groups can be seen in Figure 4.

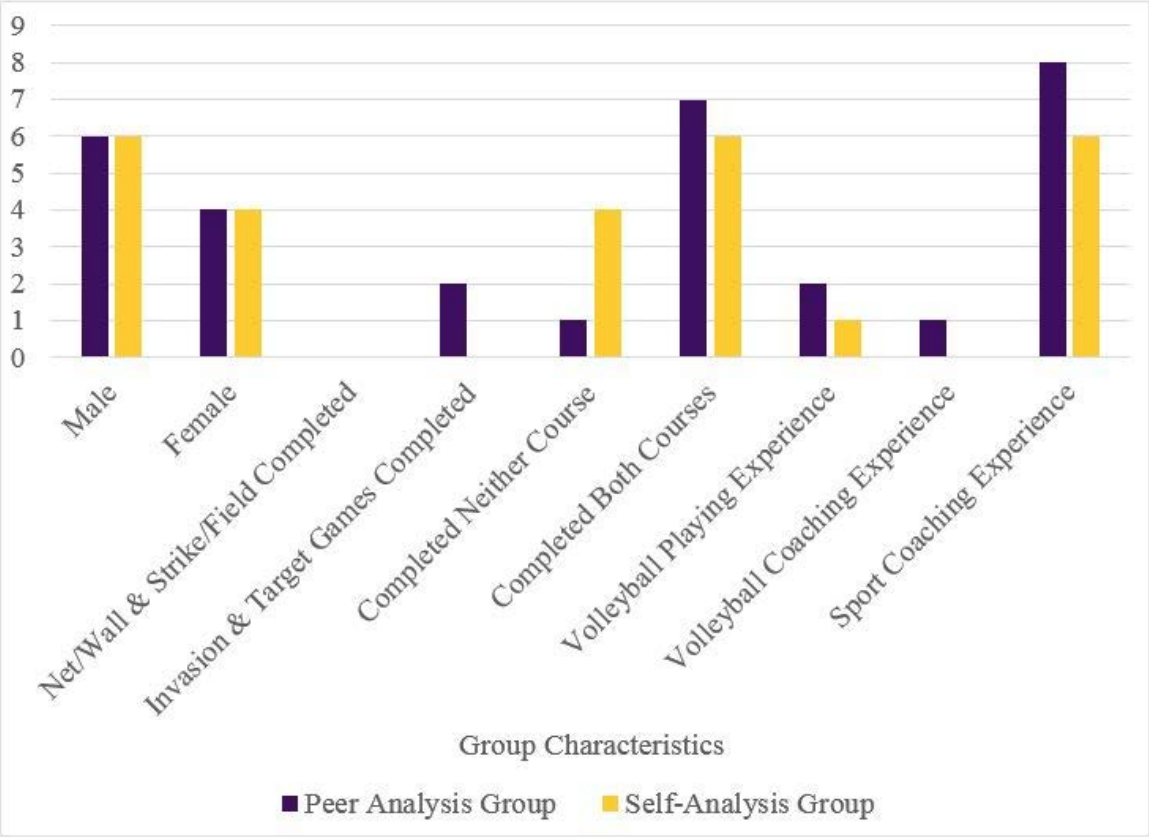

Figure 4. Characteristics of Peer Analysis and Self Analysis Groups

The mean score in this study indicates the average of each individual participants score and signifies the number of correctly identified critical elements during the pre- and post-test. Scores can range from 0 to 39 on each the pre- and post- test for a total possible score of 78. Range of scores for each group are located in Table 5.

Table 5

Range of Scores for Specialized Content Knowledge

	Pre-Test Range		Post-Test Range	
	N	Low	High	Low	High
Peer Analysis (Group A)	10	17	61	46	66
Self-Analysis (Group B)	10	16	57	41	65

The pre-test mean scores of participants in the Peer Analysis and Self-Analysis groups were compared using a one-way ANOVA to identify any significant differences between groups following the pre-test. No significant difference was found ($F(1,20) = .002$, $p=.966$).

A two-way repeated measures ANOVA was conducted on the influence of video analysis on error detection abilities. The pre-test and post-test means and standard deviations for each group and all participant's can be found in Table 6 and are represented in a bar graph in Figure 5.

Table 6.

Mean and Standard Deviation for Specialized Content Knowledge

	Pre-Test			Post-Test	
	N	Mean	SD	Mean	SD
Peer Analysis	10	40.2	14.53	57.4*	6.39
Self-Analysis	10	40.5	16.45	55.60*	7.94
All Participants	20	40.35	15.11	56.5*	7.08

Note: *Significant (p=.001)

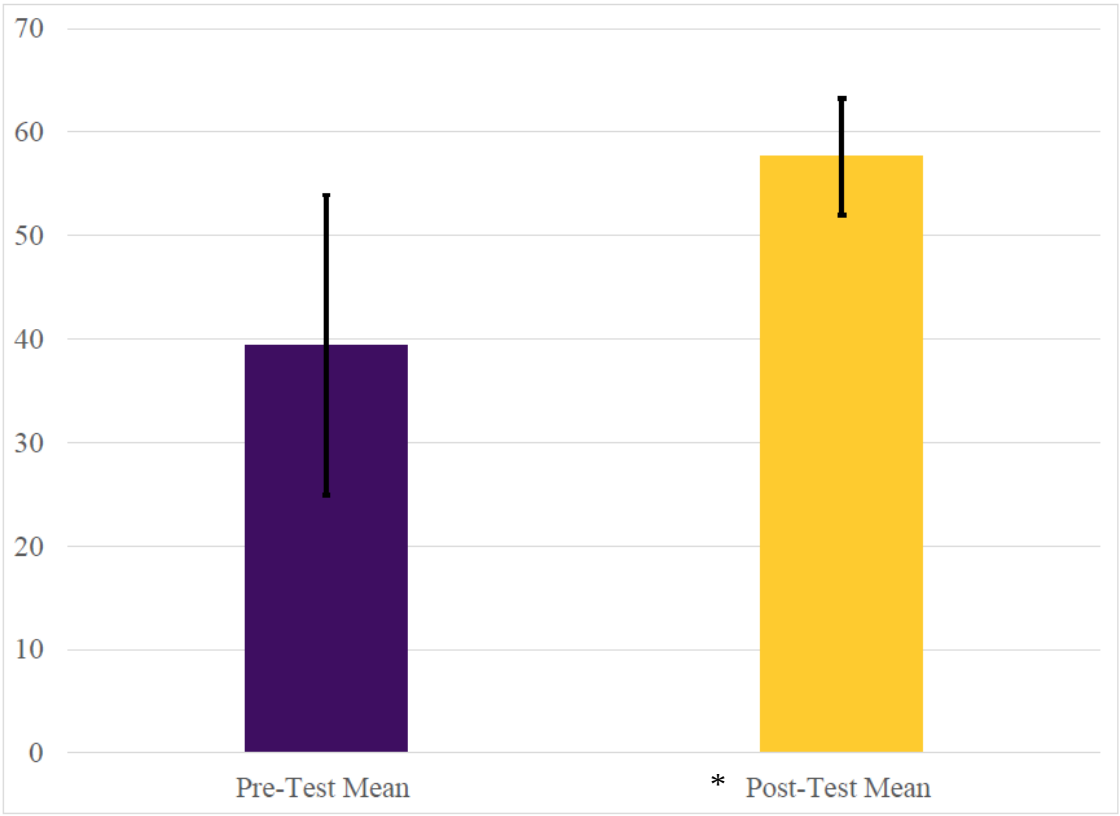

Figure 5. Pre- and Post-Test Mean for Peer Analysis and Self-Analysis Groups

The interaction between time (pre-test, post-test) and the independent variable treatment (peer analysis, self-analysis) was not significant $F(1, 18) = .066$, $p = .800$. Individual percentages for the critical elements identified correctly on the pre- and post-test for the Peer Analysis group can be found in Figure 6 and for the Self-Analysis group can be found in Figure 7.

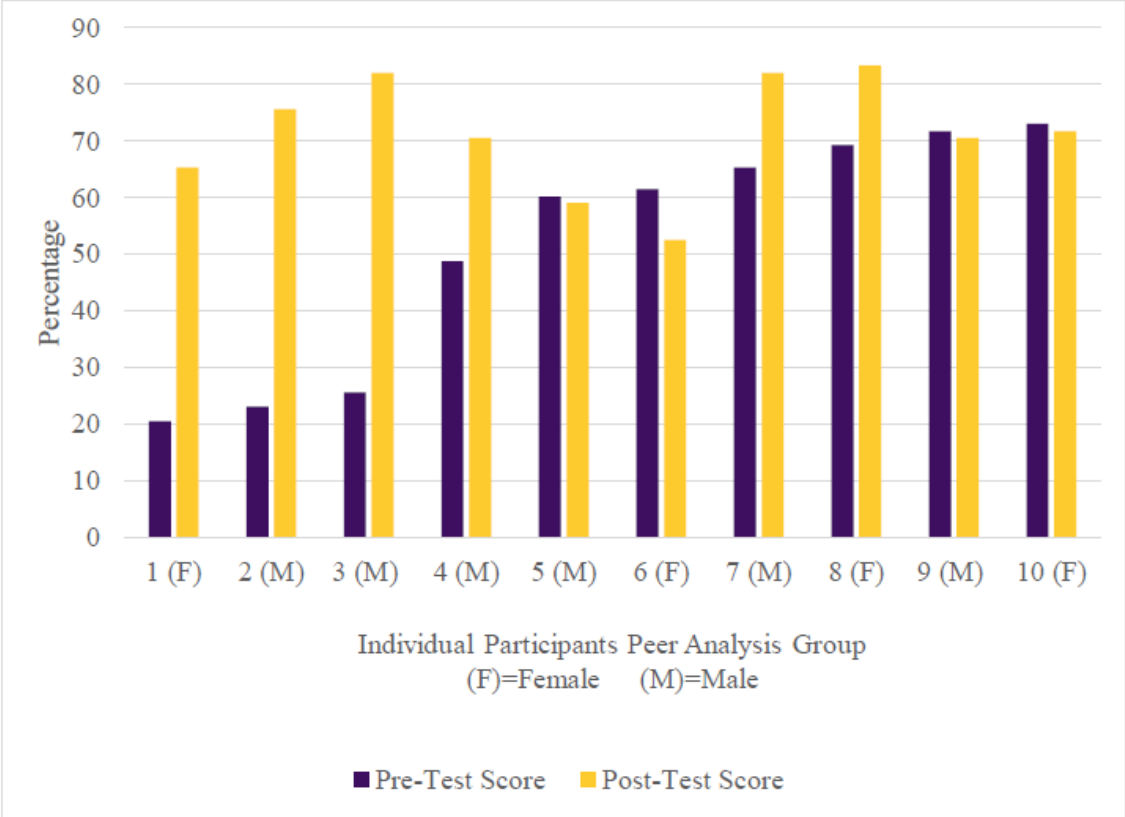

Figure 6. Percent of Critical Elements Identified Correctly by Individuals in the Peer Analysis Group

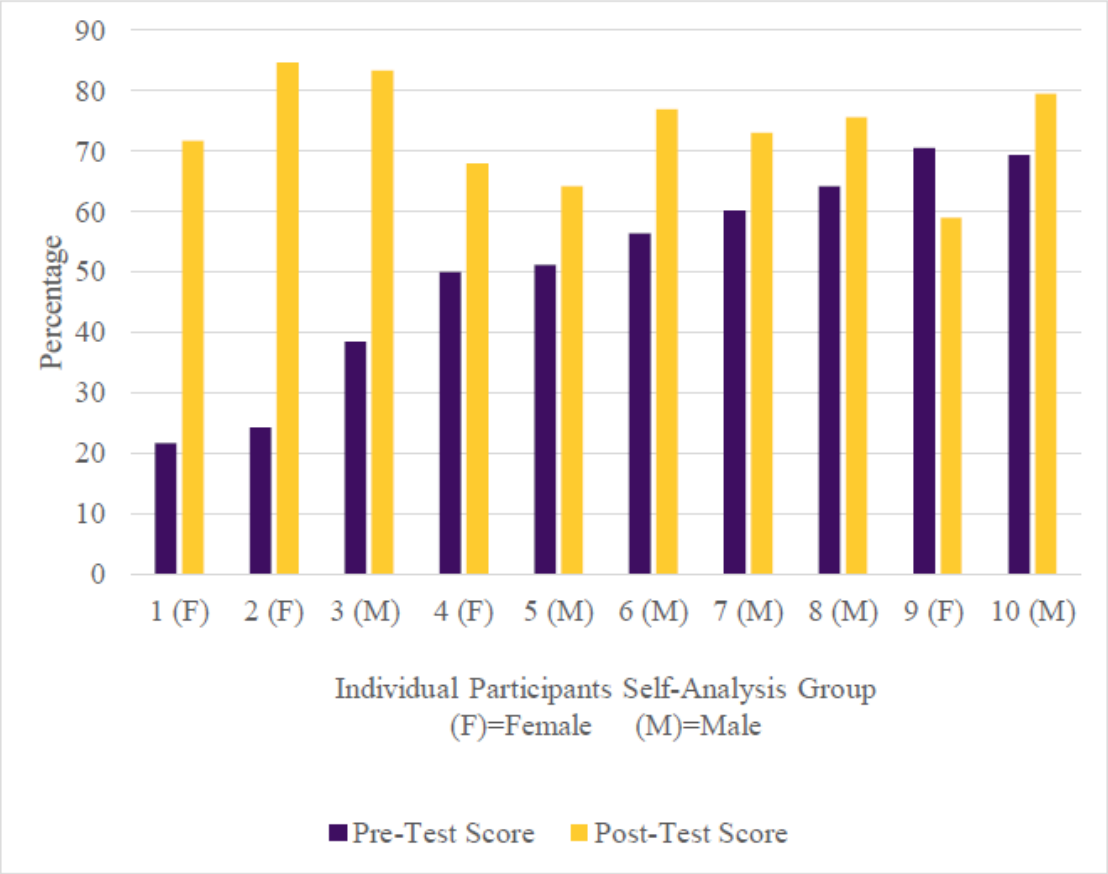

Figure 7. Percent of Critical Elements Identified Correctly by Individuals in the Self-Analysis Group

CHAPTER V

DISCUSSION

For a physical educator, the ability to observe students and identify errors in their movement performance is a skill that is vital to helping children become proficient movers. Neither pre-service nor in-service physical educators are proficient at identifying errors. Consequently, methods for increasing error detection ability need to be explored. This study was designed to investigate whether error detection abilities could be improved in pre-service physical educators. Specifically, this study sought to determine if attending a common content knowledge (CCK) and specialized content knowledge (SCK) workshop and assessing videotaped performances of a volleyball skill (forearm passing) resulted in an increased ability to identify performance errors in that skill and if attending the workshop and then assessing one's own performance impacted later error detection as compared to assessing a performance of a peer.

Ward (2009) suggests that content knowledge in physical education can be identified in two forms, CCK and SCK. The first question of this study sought to determine whether a change would occur in SCK as a result of attending a CCK and SCK workshop and assessing videotaped performances. Results indicated a positive change and significant difference in mean scores from pre-test to post-test for all participants (see Figure 5). The positive change in mean scores indicated that participants were able to detect more errors (SCK) in the volleyball passing performances following the workshop and video evaluation. Significantly improving SCK through attending a workshop supports the work of Sinelnikov et al. (2015) and Ward et al. (2014) who also utilized

workshops to increase SCK. Sinelnikov et al. (2015) and Ward et al. (2014) examined the effect of a workshop on the quality of instruction and student learning. Others (Chang, 2014; Kim, 2011; Lee, 2011) have also utilized short workshops with physical education pre-service teachers but have explored the effects of short workshops on pedagogical content knowledge, while this study investigated error detection abilities. It appears that short content knowledge workshops provide the opportunity for physical education pre-service teachers to significantly increase their SCK and specifically in this study, the knowledge and the skill to detect errors in a beginner performer's volleyball forearm pass.

This study demonstrated that in addition to developing pre-service teachers SCK, the skill of observing and accurately identifying errors in student performance can be increased through instruction. Skill analysis includes observing and analyzing the movement and making a determination if the movement was equivalent to an accepted criteria (Morrison & Reeve, 1989). The results of this study indicate that instruction, via a short CCK and SCK workshop, significantly increased participants ability observe and analyze a volleyball forearm pass and accurately identify errors following instruction during workshop. When reviewing the data, a trend emerged showing that participants with lower pre-test scores exhibited a larger increase in error detection abilities than those with higher pre-test scores. Three participants did not show improvement (1%-2% decrease) from pre-test to post-test which may have been caused by sampling error while two participants showed larger decreases (12% and 9% decrease) from pre- to post-test.

These decreases may have been due to lack of focus or attention during the post-testing phase of the study.

This study lends support to previous research that found that through instruction undergraduates can improve perceptual and diagnostic aspects of skill analysis. The majority of previous research has analyzed fundamental movement skills such as kicking, throwing, jumping, and striking (Beveridge & Gangstead, 1984, 1988; Gangstead, 1984; Gangstead & Beveridge, 1984; Morrison & Reeve, 1986, 1989) and not specialized movement skills such as a forearm pass in volleyball. However, one study (Wilkinson, 1991) was located that investigated the how a visual-discrimination training program effected undergraduate physical education majors ability to accurately diagnose errors in three volleyball skills (forearm pass, overhead pass, overhead serve). Wilkinson (1991) found that with specialized training that participants improved their error detection abilities. The Wilkinson study was conducted over a 10 week period whereas this study provided the instruction in a much shorter time frame and was able to significantly improve error detections skills.

Questions two and three of the study sought to determine whether a change would occur in SCK as a result of attending a workshop and specifically analyzing a peer's passing performance or a self-analysis of passing performance. Results indicated a positive change and a significant difference between pre-test and post-test mean scores for both groups. That is, after attending the workshop and regardless of whom they evaluated passing a volleyball, themselves or a peer, their ability to identify errors increased significantly. The use of video, in particular video modeling and feedback,

have been effective ways to increase skill acquisition (Dowrick, 1991) and typically are used by a coach and athlete reviewing an athlete's performance (Boyer et al., 2009; Guadagnoli et al., 2002; Stokes et al., 2010). This study utilized video analysis differently than previous studies and found it to be an effective way to develop knowledge and observation skills of pre-service teachers and not for the sole purpose of skill development and acquisition.

The last question sought to determine whether analyzing a peer's performance increased error detection ability more than analyzing their own performance. Results indicated that analyzing a peer's performance does not significantly increase error detection ability more than analyzing their own performance.

Implications for Practice

It is important to determine processes that PETE programs can implement to increase pre-service teachers content knowledge and specifically their ability to detect errors in movement performances. The results of this study indicated that the use of short CCK and SCK workshop and video analysis may provide an effective path for increasing error detection skills. Physical education teacher education programs may want consider utilizing this information in the following ways. First, using video analysis could be used to supplement instruction content courses that teach fundamental and specialized movement skills. Following the introduction of a movement skill, pre-service teachers could be videotaped performing the skill and then review the video of themselves or a peer, and analyze the movement using a document with the critical elements listed.

A second way to consider using this information would be in curriculum development or realignment. College preparation courses are typically offered two or three times per week for 50 minutes to 80 minutes in duration for an entire semester. Results indicated that participants with the least amount of knowledge following the pre-test demonstrated the greatest gains. Research (Allison 1987; Barrett et al., 1987; Bell et al., 1985) has indicated that as preservice teachers progress through programs their observational skills continue to develop. Knowing this, PETE programs may want to consider increasing the number of content courses earlier in preparation programs as well as reducing the courses to half semester courses. This would allow for preservice teachers the opportunity to increase preservice teachers' content knowledge, specifically SCK and error detection skills in a wider variety of movement skills. Consequently, as PETE majors progress through the program and their observation skills increase their ability to identify errors may continue to progress.

Lastly, this study revealed that regardless of the video that the participants analyzed they increased their error detection abilities. The use of peer teaching is convenient when used in pre-service teaching programs if K-12 students are not be available. The findings of this study suggest that using self-analysis was just as effective at increasing error detection skills as watching a peer. Physical education teacher education programs may want to consider purchasing devices that allow students to video record their skill performances and then have them analyze their movements for errors. This could be done within a course using iPads and applications such as Hudl Technique or Bust A Move (BaM) video delay.

Implications for Future Research

The results of this study have suggest ways for how PETE programs can increase SCK and specifically increase error detection abilities. Kim et al. (2015) and Ward et al. (2012) reported that the majority of PETE courses focus on CCK and not SCK, which perpetuates the issue of lack of SCK knowledge of pre-service and in-service teachers. It will be important moving forward that research continues to explore how error detection skills can be increased during pre-service teachers training. If replicating this study, researchers would want to control for the possible effects of the seating location of the participants. This is in reference to the location of the participant and the angle that they are viewing the video from. One way to account for this would be to have the participants individually view videos on computer monitors instead of in a classroom on a big screen.

Another factor to control for if replicating this study would be to carefully consider the performers to be evaluated during the peer and self-analysis portion of the study. Researchers would want to ensure that the performers are demonstrating errors that parallel to each other in terms of errors committed in their performance. Another consideration would be to investigate if the number of errors that participants view during the intervention phase would influence error detection abilities.

Future research should expand on the number of participants in this study because results for peer analysis group compared to self-analysis were inconclusive. With increased number of participants results may reveal that one is more effective than the other.

Additional sport skills should be evaluated to see if error detection abilities can be increased, including those skills that are more complex (baseball swing) or less complex (shooting a basketball) in regard to the number of critical elements involved in performing the skill. In this study, the critical elements that were missed were those elements that were multi – joint movements. Movements and sports skills that are slow and sustained such as swimming should be considered.

When establishing the content validity of the evaluation instrument, the volleyball experts were able to view the video as many times as they wanted. During the pre-test, video analysis and post-test portions of the study participants were only able to view the performance one time at normal speed, much like physical educators must do in their gymnasiums. Future research should vary the condition for viewing performances to see whether participant error detection abilities continue to improve when they are provided the opportunity to view a performance multiple times. In this study, those with little knowledge increased their error detection ability significantly but those that scored higher on the pre-test exhibited little gains. Future research should investigate if and how we can move those participants that were able to detect more errors initially to an even higher level of error detection ability.

Lastly, as error detection abilities are increased it will be important to examine the feedback that participants would provide following the error being detected. It is imperative to be able to identify and analyze errors but the next step in creating more proficient movers is to provide feedback that will enable them to correct those errors.

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APPENDIX A

PARTICIPANT RECRUITMENT EMAIL

To: dsazama@uwlax.edu (I am going to use this line for my your own address to BCC potential participants)
From: dsazama@uwlax.edu; sazamad@uni.edu
BCC: This line will include multiple potential participant addresses
Subject: Research Participation Invitation

Hello!

I am asking all students enrolled in physical education major classes this semester if they would like to participate in a research study about increasing pre-service physical educators' ability to identify errors. The purpose of the study is to determine if attending a short workshop and either watching yourself or a peer on video will increase your ability to identify errors. Participation in the study includes being video-taped performing the volleyball forearm pass.

I am seeking participants who are willing to meet with me on three different days in Mitchell Hall on the UW La Crosse campus. Day #1 of the study would require 30-45 minutes (video pre-test and workshop on forearm passing a volleyball), Day #2 (two days later) about 10 minutes (video assessment of a peer or self-analysis, and Day #3 (two days later) about 10 minutes (video post-test).

Your participation in this study is voluntary and you are free to withdraw at any time. Your decision to participate or not participate will not have any affect during course work within the class or PETE program.

Information from this study will be kept confidential and the summarized findings may be published in an academic journal or presented at a conference but will not provide any identifying information.

I have attached the Informed Consent to this email which includes more detailed information. If you are willing to participate please clink on the link below

https://uwlacrosse.qualtrics.com/SE/?SID=SV_9Kpy5s8rWavD2VD

Thank you for your time and consideration!

Deb

This email message is an approved request for participation in research that has been approved by the University of Northern Iowa Institutional Review Board. The telephone number of the person to contact for answers to questions about research participants' rights or in the event of a research related injury is Anita Gordon, UNI IRB Administrator, 319-273-6148, anita.gordon@uni.edu.

Questions about this research should be addressed to Deb Sazama, 563-513-1810 and dsazama@uwlax.edu or sazamad@uni.edu

APPENDIX B

RECRUITMENT FLIER FOR INSTRUCTORS AND

FOLLOW-UP PARTICIPANT EMAIL

Hello!

I wanted to follow up to an email that I sent two days ago asking all students enrolled in physical education major classes this semester if they would like to participate in a research study about increasing pre-service physical educators' ability identify errors. If you didn't receive the email here is a little information about the study!

The purpose of the study is to determine if attending a short workshop and either watching yourself or a peer on video will increase your ability to identify errors.

I am seeking participants that are willing to meet with me on three different days for very short amounts of time in Mitchell Hall. Day #1 of the study would require 30-45 minutes (video pre-test and workshop on forearm passing a volleyball), Day #2 about 10 minutes (video assessment of a peer or self-analysis, and Day #3 about 10 minutes (video post-test).

Your participation in this study is voluntary and you are free to withdraw at any time. Your decision to participate or not participate will not have any effect on your coursework within this course or any PETE program courses.

Information from this study you will be kept confidential and the summarized findings may be published in an academic journal or presented at a conference but will not provide any identifying information.

Thank you for your time and consideration!

Ms. Sazama

If you are willing to participate copy and paste the link or scan the QR code to complete a quick survey about your volleyball and coaching experiences!

https://uwlacrosse.qualtrics.com/SE/?SID=SV_9Kpy5s8rWavD2VD

This email message is an approved request for participation in research that has been approved by the University of Northern Iowa Institutional Review Board. The telephone number of the person to contact for answers to questions about research participants' rights or in the event of a research related injury is Anita Gordon, UNI IRB Administrator, 319-273-6148, anita.gordon@uni.edu.

Questions about this research should be addressed to Deb Sazama, 563-513-1810 and dsazama@uwlax.edu or sazamad@uni.edu

APPENDIX C

QUALTRICS SURVEY

Error Detection Abilities in Undergraduate PETE Students

Welcome to my survey and research project on the impact of content knowledge, specialized content knowledge, peer assessment and self-analysis on pre-service teacher's error detection abilities. I would like to invite you to participate in a research project conducted through the University of Northern Iowa which requires that you agree to participate in this project. This form has important information about the reason for doing this study, what I will ask you to do if you decide to participate in the study, and the way I would like to use information about you if you choose to be in the study.

Nature and Purpose: You are being asked to participate in a research study about increasing undergraduate physical education teacher education (PETE) majors' content knowledge and ability to identify errors in volleyball skills. The purpose of the study is to identify if attending a short workshop, reviewing a peer's performance or self-analysis will increase PETE students' ability to identify errors. At the end of the study, I will explain in greater detail what I hope to learn from this research.

Explanation of Procedures: After receiving your consent to participate in the study you will be randomly assigned to one of two groups, Group A (peer assessment) or Group B (self-assessment). On Day #1 of the study you will be asked to come to Mitchell Hall Room 119 to view a video of two different middle school students performing a volleyball pass and after watching each pass you will have 30 seconds to identify whether the critical elements of the skill are present or absent. Following the video evaluation, we will go into the gym and you will participate in a short workshop to learn the proper techniques of teaching a pass and the common errors that beginners make when learning to pass. While in the workshop you will be videotaped performing 10 passes. Day #1 of the study will take approximately 30-45 minutes. After the workshop you will sign up for a 10 minute time slot to come back in two days to either view and analyze yourself or a peer passing the volleyball 10 times. Two days after that analysis, you will return to

post-test following the same process as when you pretested and these days will take approximately 10 minutes each day.

Discomfort and Risks: Risks to participation are minimal. Participants will be engaging in volleyball skills and drills which pose the risk of injury similar to taking physical activity classes.

Benefits: Benefits from this study may include improved volleyball knowledge and skills and ability to identify errors of particular volleyball skills, specifically passing, setting, and serving.

Confidentiality: Information obtained during this study which could identify you will be kept confidential. The summarized findings with no identifying information may be published in an academic journal or presented at a scholarly conference. Right to Refuse or Withdraw: Your participation is completely voluntary. You are free to withdraw from participation at any time or to choose not to participate at all, and by doing so, you will not be penalized or lose benefits to which you are otherwise entitled.

Video Recording: The primary investigator would like your permission to use the video recordings from the volleyball workshop (volleyball passing) during the peer and self-analysis portion of the study. The primary investigator would also like your permission to use the video recordings for educational purposes, which may include instruction, program improvement, professional development, and future research. Granting permissions is entirely voluntary and there will be no consequences or penalty if you choose not to grant permission to use a video or your data for educational purposes.

Questions: If you have questions regarding your participation in the study, about the study in general, or would like information in the future regarding your participation or the study generally, you can contact Deb Sazama at 563-513-1810 or the project investigator's faculty advisor Dr. Linda Fitzgerald in the College of Education at the University of Northern Iowa 319-273-2873. You can also contact the office of the IRB Administrator, Anita Gordon at the University of Northern Iowa, at 319-273-6148, for answers to questions about rights of research participants, the participant review process, or in the event of research related injury.

Please read the statements and CLICK the "YES" or the "NO" box below.

- ❑ YES, by checking this box I am indicating that I am fully aware of the nature and extent of my participation in this project as stated above and the possible risks arising from it. I hereby agree to participate in this project. I am 18 years of age or older. (1)
- ❑ YES I DO give permission to the primary investigator to use video recordings of me and pre- and posttest evaluation data during the study only. (2)
- ❑ YES I DO give permission to the primary investigator to use video recording of me and pre-and posttest evaluation data during the study AND for educational purposes,

which may include instruction, program improvement, professional development, and future research. (3)

- ❑ I DO NOT give permission to the primary investigator to use video recordings of me and pre- and post- video evaluation data for educational purposes, which may include instruction, program improvement, professional development, and future research. (4)

Please identify the last 5 digits of your University ID number here so that you can be assigned a group and your pre- and posttest data can be compared. *Once all data is collect, this number will be replaced with an letter (A, B, C, etc.) to ensure confidentiality.

Gender

- ❍ Male (1)
- ❍ Female (2)

Year in School

- ❍ 1st Year (1)
- ❍ 2nd Year (2)
- ❍ 3rd Year (3)
- ❍ 4th Year (4)
- ❍ 5+ Year (5)
- ❍ Other (i.e. teacher certification, 2nd degree) (6)

Please indicate which course(s) in the Physical Education Teacher Education program you are currently enrolled in OR have taken.

- ❑ ESS 258 - Teaching Activities I (1)
- ❑ ESS 367 - Teaching Activities II (2)
- ❑ Neither ESS 258 or ESS 367 (3)
- ❑ Both ESS 258 and ESS 367 (4)

The next series of questions pertains to your volleyball PLAYING EXPERIENCE. Did you play collegiate volleyball?

- ❍ Did not play collegiate volleyball (1)
- ❍ Played collegiate volleyball for 1 season (2)
- ❍ Played collegiate volleyball for 2 seasons (3)
- ❍ Played collegiate volleyball for 3 seasons (4)
- ❍ Played collegiate volleyball for 4 seasons (5)

Did you play club volleyball in college?

- ❍ Did not play club volleyball (1)
- ❍ Played club volleyball for 1 season (2)
- ❍ Played club volleyball for 2 seasons (3)
- ❍ Played club volleyball for 3 seasons (4)
- ❍ Played club volleyball for 4 seasons (5)
- ❍ Played club volleyball for 5 or more seasons (6)

Did you play club volleyball during high school?

- ❍ Did not play club volleyball during high school (1)
- ❍ Play club volleyball for 1 season (2)
- ❍ Played club volleyball for 2 seasons (3)
- ❍ Played club volleyball for 3 seasons (4)
- ❍ Played club volleyball for 4 seasons (5)
- ❍ Played club volleyball for 5 or more seasons (6)

If you played club volleyball in high school, which would best describe your team.

- ❍ Did not play club volleyball during high school (1)
- ❍ Local (2)
- ❍ Club (3)
- ❍ Open or Elite (4)

Did you play high school varsity volleyball?

- ❍ Did not play high school varsity volleyball (1)
- ❍ 1 year (2)
- ❍ 2 years (3)
- ❍ 3 years (4)
- ❍ 4 years (5)

Did you play high school junior varsity/reserve volleyball?

- ❍ Did not play high school junior varsity/reserve volleyball (1)
- ❍ 1 year (2)
- ❍ 2 years (3)
- ❍ 3 years (4)
- ❍ 4 years (5)

Did you play high school freshman/9th grade volleyball?

- ❍ Did not play high school freshman/9th grade volleyball (1)
- ❍ 1 year (2)
- ❍ 2 years (3)
- ❍ 3 years (4)
- ❍ 4 years (5)

Which best describes how much your CURRENTLY play volleyball?

- ❍ I rarely, if ever play volleyball (1)
- ❍ Recreational for fun (i.e., parties, gatherings) (2)
- ❍ Weekly Bar League (3)
- ❍ Organized League (i.e., Recreation Department, YMCA) (4)
- ❍ Intramurals (5)

The next two questions pertain to your COACHING EXPERIENCE. Please check all of the following levels that you have coached at. This question pertains to your VOLLEYBALL coaching experience.

- ❑ I have not coached any volleyball teams at any level (1)
- ❑ Collegiate Level (2)
- ❑ Collegiate Club Level (3)
- ❑ High School Level (4)
- ❑ Junior High/Middle School Level (5)
- ❑ Elementary School Level (6)
- ❑ AAU Level (7)
- ❑ Junior Olympics (8)
- ❑ Camps/Clinics (9)

This question pertains to your COACHING EXPERIENCE. Please check all of the following levels that you have coached at. This question pertains coaching experience in ANY sport.

- ❑ I have not coached any sports teams at any level (1)
- ❑ Collegiate Level (2)
- ❑ Collegiate Club Level (3)
- ❑ High School Level (4)
- ❑ Junior High/Middle School Level (5)
- ❑ Elementary School Level (6)
- ❑ AAU Level (7)
- ❑ Junior Olympics (8)
- ❑ Camps/Clinics (9)

Please select all times that you would be available to participate in Day #1 of the study (pre-test and workshop) on Sunday Sept. 25th. An email will be sent on indicating the time we will begin.

- ❑ 9-10 am (1)
- ❑ 10-11 am (2)
- ❑ 11-12 am (3)
- ❑ 12-1 pm (4)
- ❑ 1-2 pm (5)
- ❑ 2-3 pm (6)
- ❑ 3-4 pm (7)
- ❑ 4-5 pm (8)
- ❑ 5-6 pm (9)
- ❑ 6-7 pm (10)
- ❑ 7-8 pm (11)
- ❑ 8-9 pm (12)

Please include the email you check most often so you can be contacted with the time for the pre-test and workshop (Day #1 of the study).

APPENDIX D

EMAIL INDICATING TIME AND LOCATION OF DAY #1 AND DAY #3 OF THE STUDY

Thank you for completing the survey and agreeing to participate in my research.

We will be meeting in Mitchell Hall Room 119 on Sunday September 25th at (time inserted) for the pre-test and workshop which will take approximately 30-45 minutes.

Post-testing will occur on Thursday Sept. 29th at 8 pm in Room 119 Mitchell Hall

APPENDIX E

EVALUATION INSTRUCTIONAL SCRIPT

Hello everyone and welcome! To begin today you are going to be evaluating six volleyball passing performances. On this video there is a middle school male and female who will be performing a volleyball pass. The video is going to be played only one time at regular speed and you will viewing the same performance for the male 3 times and the female 3 times. You will see one trial and then the screen will be blank and you will have 30 seconds to complete the evaluation document that I will be handing out. After watching the trial look at the critical elements listed on the left hand side of the document and determine if you saw it displayed during the performance. If you observed the critical element "check the **yes** box" and if you didn't "check the **no** box". After each trial make sure that each critical element has a box checked. Remember, you will have 30 seconds to do this and I'll give you a "five second warning" before the next trial begins.

Does anyone have questions?

APPENDIX F

EVALUATION INSTRUMENT

		Trial 1		Trial 2		Trial 3		Trial 4		Trial 5		Trial 6	
Illustration	Critical Elements	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Preparatory Phase 	1. Feet shoulder width apart or slightly wider with right foot slightly forward 2. Head is in front of shoulders, shoulders in front of knees and knees flexed 3. Body weight is on the front half of the foot with toes pointing forward 4. Arms are flexed in a relaxed position with elbows bent 5. Chest is up and not bent at waist												
Execution Phase 	1. Hands interlock with thumbs pointed to the floor 2. Arms extended and elbows locked creating a “V” 3. Ball contacts between wrists and elbow 4. Ball rebounds off platform 5. Simultaneously extends legs and arms towards target on contact with ball												
Follow Through 	1. Simultaneously extends legs and arms towards target on contact with ball 2. Knees remained flexed when weight transfers forward 3. Recover to preparatory phase												

APPENDIX G

PEER/SELF-ANALYSIS EVALUATION SCHEDULE

Morning	Name - Phone	Name - Phone	Name - Phone
7:30 AM			
7:45 AM			
8:00 AM			
8:15 AM			
8:30 AM			
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Afternoon	Name - Phone	Name - Phone	Name - Phone
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